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Husbandry Practices of Bovans Brown and Sasso T44 Chicken Breeds Managed Under Smallholder Chicken Management System and Evaluation of Their External and Internal Egg Quality Traits in Sekela District, West Gojjam Zone, Amhara Region, Ethiopia

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BAHIR DAR UNIVERSITY

COLLEGE OF AGRICULTURE AND ENVIRONMENTAL SCIENCES

GRADUATE PROGRAM

HUSBANDRY PRACTICES OF BOVANS BROWN AND SASSO T44 CHICKEN BREEDS MANAGED UNDER SMALLHOLDER CHICKEN MANAGEMENT SYSTEM AND EVALUATION OF THEIR EXTERNAL AND INTERNAL EGG QUALITY TRAITS IN SEKELA DISTRICT, WEST GOJJAM ZONE, AMHARA REGION, ETHIOPIA

M.SC. THESIS

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M.SC. THESIS

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THESIS APPROVAL SHEET

As members of the Examining Board of the final MSc open defense, we certify that we have read and evaluated the thesis prepared by **Kefale Kindie Emrie**, titled "**HUSBANDRY PRACTICES OF BOVANS BROWN AND SASSO T44 CHICKEN BREEDS MANAGED UNDER SMALLHOLDER CHICKEN MANAGEMENT SYSTEM AND EVALUATION OF THEIR EXTERNAL AND INTERNAL EGG QUALITY TRAITS IN SEKELA DISTRICT, WEST GOJJAM ZONE, AMHARA REGION, ETHIOPIA**" and recommend that it be accepted as fulfilling the thesis requirement for the degree of Masters of Science (MSC) in Animal Production.

Board of Examiners

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DECLARATION

This is to certify that this thesis entitled "**HUSBANDRY PRACTICES OF BOVANS BROWN AND SASSO T44 CHICKEN BREEDS MANAGED UNDER SMALLHOLDER CHICKEN MANAGEMENT SYSTEM AND EVALUATION OF THEIR EXTERNAL AND INTERNAL EGG QUALITY TRAITS IN SEKELA DISTRICT, WEST GOJJAM ZONE, AMHARA REGION, ETHIOPIA"** submitted in partial fulfillment of the requirements for the award of the degree of Master of Science in "**Animal Production**" to the Graduate Program of College of Agriculture and Environmental Sciences, Bahir Dar University carried out by Mr. Kefale Kindie Emrie (ID. No. 1501037) was an authentic work carried out by here under our guidance. The matter embodied in this project work has not been submitted earlier for the award of any degree or diploma to the best of our knowledge and belief. Therefore, we recommend that it could be accepted as fulfilling the thesis requirements for the degree of Master of Science in Animal Production.

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LIST OF ABBREVIATIONS AND ACCRONYMS

BB	Bovans Brown
IB	Isa Brown,
RIR	Rhode Island Red
NGO	Non-Governmental Organizations
ML	Midland
HL	Highland
DOC	Day Old Chicken
NCD	New Castle Disease
HU	Haugh Unit
AH	Albumen Height
HH	Household
CSA	Central Statics Agency
DA	Development Agents
EW	Egg Weight
M.A.S.L	Meter Above sea level
PK	Potchefstroom Koekoek
LSD	Least Significant Difference
SPSS	Statistical Package for Social Sciences
SD	Standard Deviation
CI	Confidence Interval

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ABSTRACT

This study was conducted to evaluate the egg quality traits and assessing the husbandry practices of Bovans Brown and SassoT44 chicken breeds managed under smallholder chicken management system in Sekela district, West Gojjam zone, Amhara region, Ethiopia. A total of 210 randomly selected smallholders having Bovans Brown and sassoT44 chickens in back yard production system were considered for the survey study. Total 300 eggs were collected from Bovans Brown and SassoT44 hens at different age groups under small scale production system, i.e.150 eggs from Bovans Brown and 150 eggs from SassoT44 at 22, 33 and 44 weeks of age with an interval of 11 weeks of laying phase for studying the external and internal egg quality parameters. The collected data were analyzed using descriptive statistics, one way ANOVA and two ways ANOVA in statistical Package for Social Sciences (SPPS 22). The results indicated that the number of eggs per hen per year was 165.22 and 167.25 for SassoT44 and Bovines Brown breeds, respectively in back yard management system. The majority 94.8% of distributed Bovans Brown and SassoT44 chickens were being kept under backyard production system. About 90.5% of the chicken owners provided supplementary feed to their chicken, especially during feed scarcity season in the study area. Grain 80.3 % and food leftover 19.7 % were the most common supplementary feeds being utilized. Most respondents repeatedly mentioned diseases prevalence as the first ranked chicken production constraint whereas predators, feed shortage, lack of knowledge about modern chicken management and lack of market were the 2nd, 3rd, 4th and 5th constraints in the study area. The result of the study indicated that the distribution of Bovans Brown and SassoT44 chicken in the district is increasing from time to time but, the survival rate is found to be too low due to poor management system and high prevalence of disease in the study area. A significant difference in mortality was observed between Bovans Brown 33.28% and SassoT44 breed 28.57%, respectively due to poor management system. The result of the egg quality analysis showed that chicken breed and egg laying phase had a significant effect ($P<0.001$) on majority of the egg quality traits except for Haugh unit, egg shape index and yolk color. The results revealed that there are variations between the laying phase and breeds on egg quality traits. It is concluded that Bovans Brown was superior to SassoT44 in mast external and internal qualities. However, SassoT44 chicken eggs are found with better yolk weight.

Keywords: *Breed, Egg Quality, Exotic chicken, Management system, Mortality*

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CHAPTER1. INTRODUCTION

1.1 Back Ground and Justification

Poultry is the largest livestock group in the world and is estimated to be about 23.4 billion consisting of chickens, turkeys, ducks, geese, ostriches, guinea fowls, doves and pigeons (Atsbaha Hailemariam, 2017). The total chicken population in Africa accounts for about 1.5 billion chickens (Amanuel Bekuma and Abdissa Tadesse, 2022). Chicken population in Ethiopia is estimated to be about 56.1 million chickens (CSA, 2021) and 3,436,000 chickens in West Gojam zone (Paulos Desalegn, 2018). The Central Statistics Agency CSA (2021) report revealed that 95.86% of the total chicken population comprises indigenous breeds, while 2.79 crossbreds and 1.35% are exotic breeds. Similarly, the total chicken population of the Amhara Region is estimated to be 17.7 million which accounts for 31.6% of the national chicken population (CSA, 2020). From the total population of chicken in the country , 99% are raised under the backyard system of management, while 1% is under intensive management system (Desalew Tadesse, 2018). The poultry sector in Ethiopia can be characterized into three major production systems based on some selected parameters such as breed, flock size, housing, feed, health, technology, and bio-security. These are large scale commercial, small scale commercial and village or backyard chicken production system Edao Shanku and Eskindir Amanuel,2023). Among those village chicken production system is characterized by low input, low output and periodic destruction of large proportion of the flock due to disease outbreaks (Aman Getiso et al., 2017)

Ethiopia's vast chicken flock is underutilized due to lack of better management practices and poor productivity of local chickens. The productivity of local hens (30-60 eggs per year/hen with average 38g egg weight) is extremely low under backyard management conditions where as a typical exotic layer can produce 250 eggs per year with 60 g of egg weight (Eyerus et al., 2024).With the aim of improving poultry productivity, different breeds of exotic chickens (Rhode Island Red, Australorp, New Hampshire and White Leghorns) were imported to Ethiopia since the 1950‟s (Aderaw Litigebew et al., 2021).According to Melkamu Bezabih (2020), high producing chickens like Isa Brown (IB), Bovans Brown (BB) and dual purpose hybrid Potchefstroom Koekoek (PK)and SassoT44 breeds have been introduced to rural farmers and urban-based small scale chicken producers via higher learning institutions, research organizations, the Ministry of Agriculture, and non-governmental organizations (NGOs).

Bovans Brown and SassoT44 hens are newly introduced into the country. SassoT44 is a dual-purpose (meat and egg production) chicken which produces more than 210.4 eggs under small-scale management

system (Birtukan Matebie et al., 2023)whereas it produces more than 133 eggs per year under back yard production system (Serkalem Assefa et al.,2019). Bovans Brown is a brown feathered chicken, brown egg layer with a white tail feather (FAO, 2019). According to Mengeshaet al.(2022) the annual egg production performance of Bovans Brown chicken was 292 at Mekelle northern Ethiopia under small-scale management system. Whereas producing more than 117 eggs per year under backyard production system (Serkalem Assefa et al., 2019).However, the adoption of these exotic chicken breed in most parts of the country is not promising due to its hindrance by a set of factors including sub-optimal management, lack of supplementary feed, and high mortality rate due to diseases and predator (Desalew Tadesse et al., 2013). Besides, lack of recorded data on the productive performance of chicken makes it difficult to assess the importance and contributions of the past attempts to improve the sector (fisseha moges et al., 2010).

Egg quality has been defined by Eisen et al. (2019) as the characteristics of an egg that affect its acceptability to the consumer's. It is important for consumer and producer, where the economic success for poultry production is measured by the total number of Quality eggs produced (Youssao et al., 2019). Quality of an egg can be explain under two broad categories, namely, external and internal quality (Hagan et al., 2013). External and internal quality of eggs are dependent on genotype and environmental factors, oviposit ion time, age and nutrition, as well as their interactions (Sekeroglu et al.,2014). External factors including cleanliness, freshness, egg weight, egg length (mm), egg width (mm), shell thickness (mm) and shell weight (g)are important in consumer’s acceptability of shell eggs (Hanusová et al., 2015). The internal quality refers to egg white (albumen), relative viscosity of albumen, shape and firmness of yolk, strength of yolk, size of air cell and presence or absence of blood or meat spots (Hussain et al., 2013).

In Sekela district, there is no easily available information with regard to the SassoT44 and Bovans Brown production performance, management system, egg quality and constraints of chicken production. Hence, identifying the BB and SassoT44 breed chickens production performance, husbandry practice and internal and external quality of eggs in the study area was the main aims.

1.2. Statement of the Problem

Amhara region especially in the western areas, chicken has a great role in providing household income, economic return, and job opportunity for society. However, the chicken population in the region are found in traditional scavenging systems. The most frequently mentioned constraint to the regions are, lack of recorded data on husbandry, productivity, egg quality and lack of year-round quality and quantity of feed, low genetic potential and disease prevalence which are lowers the egg production performance.

In Sekela district, a number of Bovans Brown and SassoT44 Chicks have been distributed to farmers for long years. However, there is no easily available information with regard to the SassoT44 and Bovans Brown husbandry practice, egg production performance, constraints of chicken production and egg quality. Hence, identifying the BB and SassoT44 breed chickens husbandry practice, egg production performance, constraints of chicken production and internal and external quality of eggs in the study area was the main aims. Moreover, this information may be important for governmental, NGO, and other development organizations to undertake relevant development interventions, and it also gives a clear understanding to those individuals involved in chicken production.

1.3. Objectives

1.3.1. General objective

- To assess husbandry practices of Bovans Brown and SassoT44 chicken breeds managed under smallholder chicken management system and evaluate the egg quality traits in the district.

1.3.2. Specific objectives

- To assess the husbandry practices and egg production performance of Bovans Brown and SassoT44 chickens under smallholder farmer's management system of the district.
- To identify the major constraints affecting the productivity of BB and SassoT44 chickens managed under smallholder farmers management in the district
- To evaluate external and internal egg quality traits of BB and SassoT44 chickens based on their laying phase managed under small-scale management system in the district.

1.4. Research Questions

- What looks like the husbandry practices and egg production performance of BB and SassoT44 chickens under smallholder farmer's management system of the district?
- What are the major constraints affecting the productivity of BB and SassoT44 chickens managed under smallholder farmers' management in the district?
- Are the external and internal egg quality traits of BB and SassoT44 chicken breeds affected by chickens reared under small-scale management system in the district?

CHAPTER2. LITERATURE REVIEW

2.1. The Poultry Production System in Ethiopia

Based on the objective, breed, flock size, housing, feeding, health, Bio-security level and technology used, the poultry production system in Ethiopia as well as in Amhara Region can be classified into three types of commercial poultry production systems. These are large commercial, small scale commercial and village or backyard poultry production system (FAOSTAT, 2021) as well as the poultry production systems of Ethiopia are classified in to medium and large-scale intensive systems (>1000 broilers and 500 layers), Small-scale intensive system (200–1,000 broilers, 100–500 layers), Semi-intensive system (50 to 200 birds), Extensive scavenging system (ranging from 5 to 50 birds) and Small-extensive scavenging systems (1–5 indigenous chickens) (FAO, 2019B) .

2.1.1. Backyard chicken production system

Backyard chicken production in Ethiopia is generally characterized by little or no inputs for housing, feeding (scavenging is the only source of diet) and health care with minimal level of bio-security, high off take rates and high level of mortality(often >70%) due to lack of proper health care and veterinary services (Murray et al., 2017). This system flock size (ranging from 5 to 50 birds) comprised of indigenous and/or crossbred chickens, and it is practiced by households with access to rural markets(Soresa Shuma et al., 2021).Producers in this system do not have regular access to exotic chickens and usually raise their own replacement stock (Ahmed Mohammed, 2018). Food security and income generation are the primary reasons for keeping chickens. Chicks are produced through natural incubation by using broody hens (Murray et al., 2017). The extensive/ scavenging system is practiced by households located in remote villages with little or no access to markets, with the main purpose of chicken rearing being for household consumption.

2.1.2. Small-scale Commercial chicken Production System

This type of chicken production system is better than free ranging production system since it uses inputs like medium level of feed, water, recommended housing/shelter, and veterinary service inputs and minimal to low bio- security (Paolo Pagani and Abebe Wossene, 2008). The small-scale intensive system involves use of specialized, commercial DOCs or pullets 200–1,000 broilers, 100–500 layers (Mearg Fitsum, 2014). Producers in this system have full access to veterinary services and the mortality rates are low to medium (<20%).

Currently, several small-scale chicken farms have emerged and they are contributing to improvement of livelihoods, food security and poverty reduction (Aderaw Litigebew et al., 2021). Small-scale intensive poultry production currently plays a significant role in the employment of youth.

2.1.3. Large scale commercial chicken Production System

These production systems are highly intensive and use more inputs (feeds and feeding, breed, health, housing and other inputs) than the above two chicken production systems (Bayesa Tolasa, 2021). This type of chicken production system is market oriented and the main objective of production is to get better profit. The integrated large-scale commercial production system contains an average of greater than or equal to 10,000 birds with a high level of Bio-security Practices has reduced chick mortality rates to merely 5% (Fikadu Wodajo,2021). In addition, these systems are heavily dependent on imported exotic breeds that require intensive inputs such as feed, housing, health, and modern management systems(Bayesa Tolasa, 2021).

2.2. Husbandry practice of village chicken production in Ethiopia

2.2.1. Housing

Housing systems in village chicken production system is rudimentary and mostly built with locally available materials (Ahmed Mohammed, 2018). In traditional free range, the majority smallholders did not have a separate chicken house there is no separate poultry house and the chickens live in family dwelling together with humans (Desalew Tadesse, 2018). According to Saba Haile and Kasa Biratu (2016) in South Western Ethiopia about 74 % of the respondents did not have separate house for their chicken but provide overnight shelter in different places like in the living house 24.6%, kitchen 29.1%, veranda 15.4 and animal barn 5%.On the other hand fissha moges et al. (2010) who reported 92.55%, and Mosa Mitiku (2021) who reported 97.6% of respondents not separate chicken shelter. In their study, they mentioned lack of attention for chickens 34.6%, lack of construction materials 25%, Poor extension service/lack of knowledge and awareness 19.6%, risk of predators 12.1%, and shortage of labor and time 5.4% as major reasons for not preparing a separate shelter. Majority 77.9% of village chicken owners kept birds on various night sheltering places including; perches inside the house 45.7% on the floor covered by bamboo made materials 27.1%, on ceilings of the house 3.6% and under locally constructed sitting place 1.4%.

2.2.2. Feeding

Family poultry production in Africa survives by scavenging and generally, no supplements provided except that sometimes, household waste fed to the birds and other circumstances the diet supplemented

with grain (Ahmed Mohammed, 2018). Similarly, in Ethiopia the overall standard of husbandry is mainly scavenging type and usually poor because of the low level of inputs and in addition, there are a considerable number of constraints to village poultry production (Merhun Lamaro, 2018). The feeding practices and feed sources for chickens depend on scavenging with little supplementation (Aman Getiso et al., 2017). According to Tilahun Sisay et al. (2017) from 180 respondents about 72.77% of the respondents managed their exotic chickens under a free scavenging system with no additional feed supplements; the remaining 27.22% of the exotic chickens are managed under free scavenging with supplementary feed. However Hailu Assefa et al. (2019) reported about 79.6% of the chicken owners reared their chickens in an open scavenging with seasonal and regular supplementations in Sheka zone, south western Ethiopia. The major supplementary feed sources of chicken were obtained from their house 94.7%, and are mainly cereal grains (wheat and Barley) which were the major crops grown in the study areas. According to Demissu Hundie et al. (2019)reported households provided supplementary feeds, which has a hand full amount of grain and household refusals such as bread, injera, covering of tomatoes, carrot, potatoes, vegetables and cooked foods. On the other hand Saba Haile and Kasa Biratu (2016) who reported supplement cereal grains such as wheat 15.4%, maize 26.7%, barley 9.6%, sorghum 22%, household scraps 25% and rice 1.3%.

2.2.3. Watering practices

Water plays an important role in the digestion and metabolism of the fowl (Alebachew Getachew et al., 2022). Therefore fresh and clean water should be made available always for the chickens (Wondmeneh Esatu et al., 2022). According to Saba Haile and Kasa Biratu (2016)who reported smallholder farmers in Jimma and Ilu Aba Bora zones, South Western Ethiopia used different water sources for chickens i.e. tap water 17%, river 56%,Spring14% and Hand dug well 13%. Teshome Gemechu and Tesfaye Amene (2015) also reported that the major sources of water for chicken in the area were river 30.4%, spring 28.5%, locally made underground water 21.4% and pipe water 19.7%.

According to Mosa Mitku (2021)finding the frequency of watering revealed that the majority 76.9% of the households provided water once a day at noontime all year round with particular emphasis during the dry season (or when the chickens show sign of thirst) while only a few 10.1% of the households provided water twice at noon and evening. In rift valley Oromia village chicken producers provided water for village chickens at different times of the day; adlibitum 47%, once a day 14%, twice a day 18%, three

times 16% and four times a day 5% from tap water 66%, river water 15%, borehole 6% and other sources 13%(Alebachew Getachew et al.,2022).

2.2.4. Chicken Health Management

Health care is one management activity of village poultry production to improve chicken productivity. But the chicken owners experienced the highest chicken death rate during the rainy season (Alebachew Getachew et al., 2022). About 89.5% of the farmers reported high incidence of diseases in wet season(Saba Haile and Kasa Biratu, 2016). Hunduma Dinka et al. (2010) also reported the occurrence of diseases is seasonal where the highest chicken death rate was observed during the rainy season (June to August) 80% in Rift Valley of Oromia, Ethiopia. Besides Teshome Gemechu and Tesfaye Amene (2015) reported the prevalence of the NCD and mortality of chicken were higher at the start of rainy season, mainly on April 66.8% and May 31.4%. However, according to study reported by Ahmed Mohammed (2018) from northwest Ethiopia that most 72.43 % farmers do not properly examine their chicken and provide no health management services. The major causes of death were seasonal outbreaks of chicken diseases, (particularly Newcastle disease (locally known as 'fengele'), followed by predation (Alebachew Getachew et al., 2022). In Ethiopia, the majority of the owners did not vaccinate their chicken properly (Bayesa Tolasa, 2021). According to Aman Getiso et al. (2017) finding high cause of mortality is due to disease 20.2% for SassoT44 and 31% for Bovans brown followed by predators 11.9 and 13.8% for SassoT44 and Bovans Brown respectively though .The majority of farmers 78.3% use traditional medicine by local herbs such as garlic, lemon and ginger with feeds to cure chickens when they are infected (Feleke Assefa et al.,2015). Instead bio-security measures, vaccination and medication are very important activities in chicken production (Ahmed Mohammed, 2018).

2.3. Growth and egg productivity of BB and SassoT44 chicken breeds in the tropics

2.3.1. Bovans Brown

The growth performance of the chicken was affected by the genetic potential of the breeds and management differences of chicken producers (Teshome Gemechu and Tesfaye Amene ,2015) . According to Aderaw Litigebew et al. (2021) Bovans Brown chicken breed reached 1.58 kg at the age of 5.5 months .The same finding by Brhane Gebremaria (2021) average body weight at sexual maturity of Bovans Brown is 1.55 kg at age of 5.58 months. Similar lines of reports finding by Legesse Tunsisa and Kefyalew Berihun et al. (2024) the mean ages at first laying of Bovans Brown was 23.31±3.55weeks in Sidama Zone and Halaba Special Woreda, SNNPR, Ethiopia. According to Aman Getiso et al. (2017) Bovans

Brown chicken breeds reach an age of egg production earlier than SassoT44 breeds which is attributed to breed type difference. The total number of eggs laid per hen per year was 239.63 ± 4.32 under small scale production system in Bahir Dar City (Aderaw Litigebew et al., 2021) and according to Birtukan Matebie et al. (2023) the total number of eggs laid was 238.6 per hen per year under small-scale chicken production system in South Gondar Zone, Ethiopia .However, according to Nega Mekonnen and Betelihem Adamu (2022) the total number of eggs laid per hen per year was 178.70 ± 0.11 under traditional management system. This indicates that better improvement on the husbandry practices of chicken producers could improve the performance of the chicken breeds in different parts of the country.

2.3.2. SassoT44

Several exotic chicken breeds have been disseminated for Ethiopian farmers to improve the egg and meat production in the country. Mostly dual purpose and layer chicken breeds were distributed in the last two decades. Among the dual purpose breeds of chicken, SassoT44 is one of the chicken breeds found in Ethiopia. The average age at first lay for the SassoT44 chicken in SNNPRs Region, Ethiopia was 5.95 months (Aman Getiso et al., 2017) and according to Legesse Tunsisa et al. (2024) the average ages at first egg of SassoT44 chickens were 24.93±3.78 weeks in Sidama Zone and Halaba Special Woreda, SNNPR, Ethiopia. The mean annual egg production was 135.20 ± 0.11 eggs/hen/year under backyard production system (Nega Mekonnen and Betelihem Adamu, 2022). However, according to Birtukan Matebie et al. (2023) the total number of eggs laid per hen was 210.4 per Year under small-scale chicken production system in South Gondar Zone, Ethiopia

2.4. Constraints of Chicken Production in Ethiopia

In Ethiopia, however, lack of knowledge about poultry production, limitation of feed resources, prevalence of diseases (Newcastle, Coccidiosis, etc.), predators attack, lack of modern technologies, and uncontrolled breeding as well as institutional and socio-economic constraints remains to be the major challenges in village based chicken productions (Ahmed Mohammed, 2018). According to Aman Getiso et al.(2017) research finding feed shortage as the first ranked chicken production constraint in Southern Nations, Nationalities, and Peoples' Regional State (SNNPR) 25.4% whereas predators 20.1% were the second and disease was the third constraints in overall agro ecologies of the study area. Ahmed Mohammed (2018) also reported that diseases 57.8%, predator 21.1%, feed shortage 16.7%, and lack of improved breeds 4.4% were major constraints of chicken production in Hadiya zone, Southern Ethiopia. Similar constraints have been found elsewhere in Jimma and Ilu Aba Bora zones, South Western Ethiopia

were disease 35.8%, lack of veterinary services 17.9%, predators 18.8%, feed shortage 11.7%, lack of proper house 8.8% and unstable prices 7% (Saba Haile and Kasa Biratu, 2016). The other village chicken production and reproduction constraints observed by Mekete Manjura, et al., (2023) in the study districts of Gamo zone were lack of knowledge on the husbandry of chickens and lack of well-organized veterinary service. So up to date information on the type of the production constraints and their degree of importance is helpful to make necessary innervations at farm level(FAOSTAT, 2021).

2.5. Egg Qualities

Egg quality is the characteristics of an Egg that affect its acceptability to the consumer (Sumashree et al., 2019) . Egg quality is affected significantly by feeding , genetic and agro-ecologies (Duman, 2014) .The breed age also significantly affected on the egg qualities (Zehara Bozkrut and Mustafa Tekerli, 2019). The overall quality of an egg can be discussed under two broad categories, namely, external and internal quality (Legesse Tunsisa ,2022).

2.5.1. External Egg quality

Egg weight (g), egg length and width (mm), shell weight (g) and thickness (mm) are the external characteristics of egg(Hanan Khalifa and Gehan Ragheb, 2013). Egg weight is among the most important parameters not only for consumers, however for egg producers as well (Jeke et al., 2018) .The difference in egg weight could be attributed to either age of the birds and/or genetic makeup of the chickens (Sumashree et al., 2019). In Africa, the egg weight may range from 35 to 65 grams (g), while in Europe it may range from 45 to 70 grams (g). However, Egg weight is largely affected by environment factors; feed and feeding system, breed type and breed age(Navneet et al., 2018).As a layer gets older the weight of the eggs increase (Olatunji et al., 2012). The average values of weight of egg are found to be 55.82±2.01 g for exotic breed (Sumashree et al.,2019). Leke et al. (2019)reported that egg weight increased as layer's age advanced. According to Sumashree et al. (2019) the egg length was found to be 5.52±0.24 cm for exotic breed eggs and Monira et al. (2018)also reported length of exotic breed eggs were 5.91 cm .Egg length increases steadily with increasing hen's age which implies that as the age of hen increases, the length of egg laid also increases(Olatunji et al.,2012).

The most important quality traits of the egg shell are its strength and thickness (Sumashree et al., 2019).The average weight of eggshell and thickness of shell are 5.06 -5.09 g and 0.35 mm /egg respectively (Leke et al., 2019).According to Leke et al. (2019) shell thickness is positively correlated with weight. The thicker the shell, the heavier is shell and weight produced. Shell thickness is influenced

by calcium availability in layer nutrition and the ability of the hen to absorb calcium by the shell gland.

2.5.2. Internal quality

The internal egg quality traits are influenced by the quality and quantity of the feed supplied to the chickens apart from the genotypes of the birds as reported by Serkalem Asefaet et al.(2019)**.** The internal quality of eggs including yolk weight, albumin weight, yolk color, albumin height, yolk height and Hugh unit and it decline as soon as they are laid by hens(Shegaw Ambel,2022). Albumen quality has a major influence on overall interior egg quality and it provides more protein than the yolk(Walkite Furgasa , 2019). Thinning of the albumen is a sign of quality loss (Navneet et at., 2018). Navneet et at. (2018)reported the hen ages, albumen quality decreases due to physical Changes (produce eggs with thinner albumen), reproductive health (older hens may have more reproductive health issues), hormonal changes (as hens age, hormonal changes can affect egg production) and decline of Shell quality (as hens age, the quality of the eggshells may also decline. Thinner shells can allow for more moisture loss, affecting the albumen's thickness).

Yolk quality is determined by the color, texture, firmness and smell of the yolk. Yolk color is a key factor in any consumer survey relating to egg quality. The primary determinant of yolk color is the xanthophyll (plant pigment) content of the diet consumed(Shegaw Ambel, 2022) Birds reared under backyard system get sufficient amount of plant pigments, which will be deposited in the yolk(Navneet et at., 2018).Yolk height is measured the center part of yolk. The yolk is carefully separated from the albumen. Albumen and yolk weight are determined by weighing with electronic sensitive balance separately(Melkamu Bezabih, 2020). According to Melkamu Bezabih (2020) Yolk heights in the current study were18.83±1.24mm for SassoT44 and Desalew Tadesse et al. (2013) also reported that the mean yolk heights were 17.84 mm for Bovans Brown and 17.41 mm for Isa brown small-scale production system.

According to Desalew Tadesse (2018) the mean albumin weight of commercial breed are 33.32 - 35.13 g/egg under small-scale production systems. The albumen height and Haugh unit (key egg quality characteristics) decreased their measurements, indicators of a poor albumen quality(Martinez et al., 2020).The albumen height is important criteria for analysis of internal quality of egg(Shegaw Ambel , 2022). The egg albumen height is greatly influenced by genetic factors with minor effects of nutrition (Lado et al., 2015). However, Extended storage time and higher storage temperature decrease the albumen height, and thus degrade the internal quality of the egg(Shegaw Ambel , 2022). According to Shegaw Ambel et al. (2022) research result the mean of albumen height is 9.51, 6.92 mm for BB under intensive

and village production systems, respectively. The HU is calculated from the height of the inner thick albumen and the weight of an egg and it is considered to be a typical measure of albumen quality(Haugh,1937). The HU scores indicate varied albumen quality in different chicken varieties(Desalew Tadesse, 2018). According to Martinez et al. (2020)the higher the HU value, the better the quality of the eggs.

CHAPTER3. MATERIALS AND METHODS

3.1. Description of the study Area/Sekela district

The study was conducted at Sekela District in West Gojam Zone, Amhara Regional State, Ethiopia. West Gojam zone comprising seven districts named Degadamot, Quarit, Denbecha, Jabitehinan, Bure, Wonberma, and Sekela. Finote-selam town is the capital of the zone. Hence from those districts, Sekela was selected for the study purpose based on Bovans Brown and SassoT44 chicken potential. It's located about 174 km South East of Bahir Dar, the capital city of Amhara region. The district area of land is 768.83 km^2 with a total population of 153056 ;(Male =76172: Female 76884) and the area population density781/ km^2 (CSA, 2021).

The area is located at 10° 39' 59.99" N latitude and 37° 19' 60.00" E longitudes at an altitude of 1500 to 3535 meter above sea level (M.A.S.L) with two different agro-ecologies. I.e. highland (>2500 M.A.S.L) and midland (1500-2500 M.A.S.L).The annual temperature is ranged from 10°C -18 °C and an average annual rainfall of 1700mm. The total livestock population of Sekela district is 98217 cattle, 17142 small ruminants, 62650 poultry and 18401equines. In the district, there is a huge potential for chicken production, which is an integral part of animal husbandry. It is a common culture and farming practice. Most of the chickens are virtually kept in backyards or under traditional production system with most local chickens are common. However, nowadays farmers' have familiarized with exotic chicken like Bovans Brown and SassoT44 breeds.

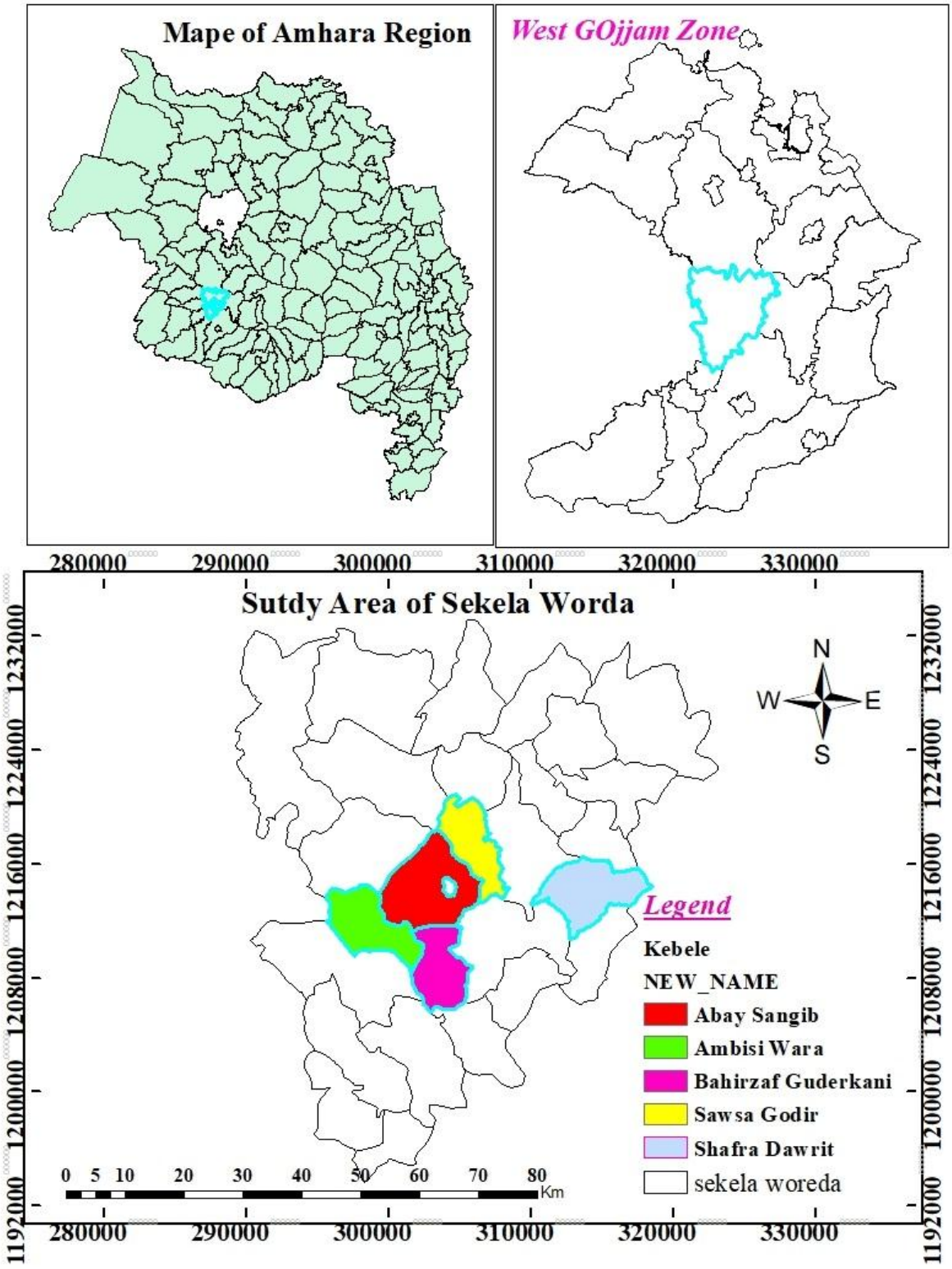

Figure 1 Map of the Study Area

3.2. Sampling Methods and Techniques

From the total of 27 kebeles in the district, five kebeles were selected purposively based on Bovans Brown and SassoT44 chicken production potential of the study Kebeles. After selecting the kebeles, households having a minimum of eight Bovans Brown and SassoT44 chickens were properly registered in each study kebele as a sampling frame and respondents were randomly selected to study the husbandry practices, egg production performance, major constraints affecting the productivity and egg quality traits of Bovans Brown and SassoT44 chickens in the study area. The selected Keble households having Bovans Brown and SassoT44 chickens listed below in table 1

Table 1 Study Kebeles and households having BB and sassoT44 chickens

Name districts	Sample kebeles	HHs having BB&SassoT44 chickens/kebele	**Average BB& SassoT44 chickens/ HHS**	Total BB&SassoT44 chickens/ kebele
Sekela	Ambessi	86	9.2	791
Sekela	Abay	88	8	704
Sekela	Sawussa	84	9	756
Sekela	Shafera	90	8.5	765
Sekela	Bahirzafa	92	8.9	823
	Total	**440**	**9**	**3839**

BB=Bovans Brown, HHs=households

3.3. Sample Size Determination

A single household respondent was used as a sampling unit and the total households included in this study were determined according to the formula given by Yamane (1967),with a 95% confidence level of the households from the total Exotic chicken owners in the five kebeles were selected as follow as:

$$n = \frac{N}{1+N(e2)} \quad \text{Equation 1}$$

Were n=Sample size; N=population size; e=the desired level of /precision (e=0.05)

Based on equation 2 $n = \frac{N}{1+N(e2)}$, $n = \frac{440}{1+440(0.05)2}$ =210

A total of 210 Households (HHs) who have Bovans Brown and SassoT44 chickens were selected randomly from 5 selected kebeles and those households were allocated for each kebele proportionally. Thus, 5 kebeles HHs were allocated (table 2) by using the formula derived by PaulLavrakas (2008). Then selected respondents in each Keble were interviewed by using semi-structured questionnaires.

W= [A/B] x No ..... Equation **2**

Where: W= number of households to be calculated from a single selected kebele

A=total no of households per single selected kebele

B= total number of households in the five kebeles

No =the total required calculated sample size

Table 2 Sample size determination for each kebeles

No	Name districts	Sample kebeles	Population size	Sampling size
1	Sekela	Ambessi	86	[86/440]*210=41
2	„	Abay	88	[88/440]*210=42
3	„	Sawussa	84	[84/440]*210=40
4	„	Shafira	90	[90/440]*210=43
5	„	Bahirzafa	92	[92/440]*210=44
		Total	440	210

3.4. Data Collection methods

Both primary and secondary data were used to achieve the objectives of the study. Therefore husbandry practice, egg quality traits and other household survey data were collected by using primary data sources included semi-structured questionnaire (i.e. a questionnaire that includes both fixed questions and open-ended questions, allowing for more in-depth responses) interviews with key informants, focus group discussions (FGD), household survey and field observations.

Secondary data were collected from different published and unpublished sources such as regional, zonal and districts Fishery and livestock resource office, NGOs, internet, and other published and unpublished

materials. Data related to livestock population, demographic structure, altitude, rainfall, topography, temperature, etc., were obtained from the above sources.

3.4.1. Primary data collection methods for survey part

Household interview: Semi-structured questionnaire were used to document household characteristics (sex, age, family size, and educational level), the total numbers of livestock species owned by the households, chicken management practice, disease control, flock size, survival rats, production systems (feeding, housing), current status of laying chickens and production constraints. In this way, the household characteristics like sex, age, education level and marital status of respondents were documented.

Key informant interview: Key informant interviews were made with district poultry experts, development agents (DAs), and some individual influential farmers. The qualitative information collected in key informant interview was used to supplement and crosscheck the data obtained through the household survey. A total of five key informant interviewer were held contained 6-8 members (one key informant interviewer/kebele).

Focus group discussions (FGDs): FGD was held to triangulate and support the household survey data and cross-check the individual informants. A total of 5 group discussions were held contained 8-12 members having BB and SassoT44 based on their village in the study kebeles.

3.4.2. Study design for survey

Across sectional study design was employed for each household to collect information focusing on household characteristics of the respondents, livestock holding per household, Bovans Brown and SassoT-44 chicken flock size and structure, status of keeping BB and SassoT44 chickens, SassoT44 and Bovans Brown Survival, egg production performance of BB and SassoT44 and its constraints from member(s) of the households directly responsible for management and care of chickens.

Mortality and $Survivability$ rates of Bovans Brown and SassoT44 were calculated as follows

$$Mortality\ rate\ (\%) = \frac{\text{Total number of deaths of chicken in the study area}}{\text{Total number chicken present in the study area}} * 100$$----------Equation **3**

3.5. Egg Quality Analysis

3.5.1. Egg sample collection and sampling techniques

For the determination of egg quality parameters, 150 eggs from Bovans Brown (50 eggs from each 22, 33 and 44 weeks of age group) and 150 eggs from SassoT44 (50 eggs from each 22, 33 and 44 weeks of age group) total 300 eggs were collected from 6 small scale producers under small scale production system (i.e. Producers having similar management, feeding, housing and health care in the study area). Then after the collected, eggs were transported to Andasa poultry farm for Laboratory examination.

3.5.2. Evaluation of external egg quality

External quality was evaluated in terms of egg weight, egg length, egg width, shell thickness, shell weight, and shape index. External egg quality traits such as egg weight and shell weight were measured by using digital weighing balance (g). Other external egg quality trait likes egg length, egg width and shell thickness were measured by using stainless hardened Digital Caliper (mm). The shell thickens was measured after the internal membrane is removed and it was measured at three different parts of the shell at the middle part, at the broad end, and at the sharp end of the shell. Then the average of the eggshell thickness was taken. In addition, Albumen index was calculated using the formula described by Duman (2014)

$$Shape\ index\ (\%) = \frac{\text{width of Egg}}{\text{Length of Egg}} * 100 \quad \text{Equation 4}$$

3.5.3. Evaluation of internal egg quality

Internal Egg qualities were evaluated in terms of yolk color, albumen height, Albumen weight, yolk height, yolk weight and Haugh Unit (HU). To determine the internal egg quality traits, the eggs were broken onto a flat surface. The thick albumen height (AH) was measured at its widest part at a position half way between the yolk and the outer margin. The yolk was carefully separated from the albumen and Yolk height was measured at the central part of the yolk. Yolk weight was determined by weighing with electronic sensitive balance separately. The albumen weight was calculated from the difference between the egg weight, and the yolk and shell weight {Albumen weight=. [Egg weight- (yolk weight+ shell weight)]}. The yolk color was determined using the Roche Color Fan with a standard colorimetric system ranged from 1to15.

The Haugh unit (HU score) is one of the important criteria for determining the internal quality of eggs. It is one of the widely used measures to evaluate the albumen quality. The better the albumen quality the

better the HU score and the better the internal egg quality. It was calculated as follows:- Individual Haugh Units (HU) was calculated from the two parameters; height of Albumen (AH) and egg weight (EW) using the formula(Haugh, 1937)

$HU=100\log (AH–1.7\ EW^{0.37} + 7.6)$ ----------Equation **5**

Where, HU = Haugh Unit, AH= Albumen height in millimeters, EW= Egg weight in grams

3.6. Data Analysis

The collected data were entered and stored into Microsoft Excel spreadsheet. All the qualitative and quantitative data were subjected to one-way and two-way ANOVA using SPSS version 22 package and descriptive statistics were employed. The effect of laying phase (22-27, 33-38 and 41-46 wks.), breeds (BB and SassoT44) and their interactions on external and internal egg quality traits were determined using two-way analysis of variance in SPSS version 22. The mean differences were separated using Least Significant Difference (LSD) and Statistical significance was considered at $p<0.05$. Moreover, the categorical data were analyzed with crosstabs $\chi 2$ square procedures to determine variation in study kebeles. Normal distribution was tested by Levene's test of equality. The following statistical models were used for the analysis of the data:

$Y\ ijk = \mu + Bi + A\ j + (BA)\ ij + e\ ijk$

Where Y ijk= Egg quality traits as affected by laying phase, breed and their interaction

μ=Overall mean of the respective variables

A j= is the effect of the jth laying phase

Bi = is the effect of the ith breed, (BB and SassoT44)

(BA) ij= is the interaction of the ith breed with the jth laying phase

Eijk = the random residual error.

3.7. Ranking analysis

The Constraints of chicken production in the study areas were ranked using the ranking index method(Kosgey, 2004) . Rank index = sum of (n∗ number of house hold ranked first) + (n∗ number of house hold ranked second) + (n∗ number of household ranked third) + (n∗ number of households ranked fourth) + (n∗ number of + household + ...+1 ranked last) given for each factor divided by the total sum of (n∗ number of household ranked first) + (n∗ number of household ranked second) + (n∗ number of households ranked third) + (n∗ number percent of households ranked fourth+. . .+ 1(n∗ number of household ranked last) for overall reasons.

CHAPTER4. RESULTS AND DISCUSSION

4.1. Household Characteristics of Respondents

Household characteristics of the respondents in the study area is presented in Table 3. There was not significant ($P \geq 0.05$) difference on sex of respondents. However, the numbers of female respondents were higher than male in Ambessi 53.7%, Abay 52.4% and Sawussa 60% Kebeles. Because chicken production mainly managed by women households. This result agrees with Saba Haile and Kasa Biratu (2016) and Aman Getiso et al. (2017) reported 56.2% and 58.9% interviewed farmers were female, respectively.

The analysis for educational status disclosed that 48.1% of the respondents were illiterates. Others 36.2% can write and read and involved in formal education such as elementary school 14.3% and 1.4% were high school in the study areas. From interviewed respondents, 87.6% were married while 8.6%, 3.3% and 0.5% of the respondent were single, divorced and widow respectively. The number of farm producers involved in poultry production in the current study was greater than that reported by Mosa Mitiku (2022), who reported 79.4% married poultry producers. However, the number of farm producers involved in poultry production in the current study was lower than that reported by Saba Haile and Kasa Biratu (2016) and Mebratun Yigzaw et al. (2020) who reported 95 % and 93.3% of the smallholder farmers were married, respectively.

Age classification was done according to Mosa Mitiku (2021) . Most of the respondents 52.4% were categorized under the age group between 20-40 years, 31.9% of respondents were categorized under the age group between 41-60 years, 8.1% were below 20 years and only 7.6% were above 60 years of aged. This result is in line with the report of Aman Getiso et al. (2017) where most of respondents were categorized under the age group between 20-40 years(or 36.53 average years of age) in the study area of Sodo zuria and Boloso sore from Wolayita zone.

Average family size of Ambessi, Abay , Sawussa, Shafra and Bahirzafa kebeles were 4.76±1.841, 5.6±2.379, 5.83±2.319, 4.72±2.374 and 4.98±2.293 persons, respectively with overall mean family size of 5.20±2.328. These results were smaller than north Gondar zone (6.2 persons) reported by Addisu Hailu et al.(2014) and result agrees with CSA (2018) reported the national average of 5.5 persons.

Table 3. Household characteristics in the study area

Parameters	Study Kebeles					
	Ambessi N=41	Abay N=42	Sawussa N=40	Shafera N=43	Bahirzafa N=44	Overall N=210
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Sex of Respondents (%)						
Male	22(53.7)	22(52.4)	24(60.0)	19(44.2)	16(36.4)	103(49.0)
Female	19(46.3)	20(47.6)	16(40.0)	24(55.8)	28(63.8)	107(51.0)
X^2–value						5.695^{NS}
Age of Respondent (%)						
Below 20 years	2(4.9)	3(7.1)	4(10.0)	10(23.3)	1(2.3)	17(8.1)
20-40 years	29(70.7)	12(28.6)	31(77.5)	9(20.9)	26(59.1)	110(52.4)
41-60 Years	6(14.6)	25(59.5)	4(10.0)	20(46.5)	12(27.3)	67(31.9)
Above 60 years	4(9.8)	2(4.8)	1(2.5)	4(9.3)	5(11.3)	16(7.6)
X^2–value						59.223^{**}
Educational Level (%)						
Illiterate	6(14.6)	19(45.2)	11(27.5)	35(81.4)	30(68.2)	101(48.1)
Read & write	25(61.0)	18(42.9)	23(57.5)	6(13.9)	4(9.1)	76(36.2)
Elementary	10(24.4)	4(9.5)	6(15.0)	2(4.7)	8(18.2)	30(14.3)
High School	0	1(2.4)	0	0	2(4.5)	3(1.4)
College and above	0	0	0	0	0	0
X^2–value						40.248**
Marital status (%)						
Single	0	5(11.9)	2(5.0)	7(16.3)	4(9.1)	18(8.6)
Married	39(95.1)	34(80.9)	38(95)	35(81.4)	38(86.4)	184(87.6)
Divorced	2(4.9)	3(7.2)	0	0	2(4.5)	7(3.3)
Widow/er	0	0	0	1(2.3)	0	1(0.5)
X^2–value						4.915^{Ns}
Average family size/HH (Mean± SD)	4.76±1.841	5.6±2.379	5.83±2.319	4.72±2.374	4.98±2.293	5.20±2.328
p-value						0.135^{Ns}

N = Number of households; SD=Standard deviation. ; HH = interviewed households; x^2 = Chi square; *=significant (P<0.05), ** = highly significant (P<0.01), Ns= Non significant (P>0.05).

4.2. Livestock holding per household

As an integral part of the mixed farming system, livestock production in the study area plays a substantial role in the household food security. The major livestock reared in the study area were cattle,

sheep, goat, donkey, mule, horse, beehive and exotic (BB&SassoT44) chickens. The average livestock holding per households were 6.50± 1.335, 4.88±1.748, 4.64±1.734, 0.54±0.706, 0.49±1.381, 0.21±0.872, 0.09±0.288 and 0.07±0.258 for chicken, sheep, cattle, horse, beehives, goat, mule and donkey, respectively (Table 4). The result showed that among the livestock species, exotic (BB&SassoT44) chickens were dominant in the study area and it was the gateways of animals for raising larger livestock while sheep and cattle were next to them. This indicated that chicken production appears to be an important activity in the study area. There was a significant (P<0.01) difference of livestock holding patterns among the household in study area, however; there was no significant difference (P>0.05) in the proportion of honey beehives.

Table 4. Livestock Holding per Household in the study area

Categories	Kebeles					Overall N=210	P-Value
	Ambessi N=41	Abay N=42	Sawussa N=40	Shafera N=43	Bahirzafa N=44		
	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	
Cattle	3.49±1.6^{c}	4.71±1.77^{b}	5.43±1.27^{a}	4.95±1.66^{ab}	4.61±1.6^{b}	4.64±1.73	**
Sheep	5.66±1.3^{b}	6.21±1.31^{a}	4.88±1.58^{c}	3.65±1.73^{d}	4.07±1.3^{c}	4.88±1.74	**
Goat	0	0	0	0.63±1.54^{a}	0.39±1.0^{b}	0.21±0.87	**
Donkey	0	0	0	0.14±0.35^{b}	0.20±0.4^{a}	0.07±0.25	**
BB&SassT44chickens	6.37±1.1^{c}	7.02±2.0^{a}	6.05±0.8^{d}	6.51±1.14^{b}	6.55±0.9^{b}	6.50±1.33	*
Mule	0.15±0.35^{b}	0.26±0.44^{a}	0.05±0.22^{c}	0	0	0.09±0.28	**
Horse	1.05±0.66^{b}	1.21±0.64^{a}	0.38±0.58^{c}	0	0.11±0.3^{d}	0.54±0.70	**
Beehive	0.88±2.32	0.40±1.28	0.60±0.95	0.28±0.90	0.30±0.87	0.49±1.38	.238^{Ns}

^{abcd} Means in the same row with different superscripts are statistically different (P<0.05), N = Number of respondents, SD = Standard deviation, *=significant (P<0.05), ** = highly significant (P<0.01, Ns= Non significant (P>0.05), BB=Bovans Brown

4.3. Bovans Brown and SassoT44 chicken flock size and structure

The overall average BB and SassoT44 flock size and structure of chickens kept per household in the study area was 4.25±1.110, 1.90±0.941, 0.20±0.500, 0.08±0.266 and 0.08±0.543 for hens, pullets, cockerels, cocks and growers, respectively with a total flock size of 6.50±1.335. The dominant BB and SassoT44 flock structures of chicken in the study area were hens 4.25±1.110 followed by pullets

1.90±0.941 (Table 5). The higher proportion of hens in the chicken flocks is an indication of strong desire for egg production. The average BB and SassoT44 flock size (6.5 BB &SassoT44 chickens) of the study areas was higher than the average flock size 2.94±0.2 per household reported by Edao Shanku and Eskindir Amanuel (2023) in Angacha and Damboya districts of Kembata Tambaro zone southern Ethiopia. However, it was lower than 16.43±0.92 exotic chickens per household reported by Malede et al.(2014) in northern Gondar (Quara district) and 13 ± 10 chickens per household reported by Fisseha et al.(2010) in Bure district, Amhara National Regional State, located in the North Western part of Ethiopia.

Table 5. SassoT44 and BB flock size and structure in the study area

Categories	Kebeles					Overall N=210	P-Value
	Ambessi N=41	Abay N=42	Sawussa N=40	Shafera N=43	Bahirzafa N=44		
	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	
Grower (9–16 weeks)	0	0.4±1.17	0	0	0	0.08±0.543	Ns
Pullet(8-24 weeks)	1.90±0.76^{c}	0.90±0.93^{d}	2.23±0.57^{b}	2.07±0.79^{b}	2.39±0.81^{a}	1.90±0.941	**
Cockerel(<1 year)	0.27±0.50^{b}	0.19±.50^{d}	0	0.30±0.59^{a}	0.25±0.57^{c}	0.20±0.50	*
Hen(>25 weeks)	4.17±0.80^{b}	5.19±1.34^{a}	3.83±0.78^{c}	4.16±1.09^{b}	3.91±0.88^{c}	4.25±1.11	**
Cock (>1 year)	0.10±0.30^{b}	0.29±0.45^{a}	0	0	0	0.08±0.26	**
Total flock size BB &Sasso-t44	6.37±1.11^{c}	7.02±2.08^{a}	6.05±0.81^{d}	6.51±1.142^{b}	6.55±0.99^{b}	6.50±1.33	*

^{abcd} Means in the same row with different superscripts are statistically different (P<0.05), N = Number of respondents, SD = Standard deviation, *=significant (P<0.05), ** = highly significant (P<0.01, Ns= Non significant (P>0.05), BB=Bovans Brown

4.4. Source of BB and SassoT44 Chickens in the study area

The Source of BB and SassoT44 chickens rearing by respondents is presented in Table 6. This study does not conclude all types of breeds available in the study area, rather it touches only Bovans Brown and SassoT44 chicken breeds. The result of the present survey shows that SassoT44 breed holds higher than Bovans Brown in Ambessi 46.3%, Sawussa 47.5%, and Shafera 44.2%, and Bahirzafa 43.2% study kebeles. However, among study areas Abay kebele respondents used higher Bovans Brown chickens 40.5% than SassoT44 35.7% chickens. The overall type of chickens kept by respondents in study area were SassoT44.8%, Bovans Brown 34.8%, and both SassoT44 and BB 20.5%. This indicates that SassoT44

chicken production is higher than BB chicken in the study area. This might be due to scavenging ability, low mortality and high survivability SassoT44 as compare with Bovans Brown chicken in the study area.

Government Extension agents, NGOs, purchasing from market and private farms were the major sources of improved chicken in the studied areas. The result of this study revealed that most of the respondents 44.8% chicken sources were purchased from private poultry farm (Table 6). Similarly, Mosa Mitiku (2022) reported that the main sources of foundation stock were purchased from private farms 46.7%. Other farmers obtained as purchased from market 40%, purchased from government farms through livestock development extension system 6.6% and provided from different NGOs 8.6 % in the form of cockerels and pullets (45 days age). There was significant ($P<0.05$) difference between the study areas of respondents in the source of Bovans Brown and SassoT44 chickens.

The result clearly indicates that they can obtain this breeds easily by purchasing from market (40%) and private farms (Ethio-chicken poultry farm) 44.8% in the study area. The implication of the current result is that in the absence of government source, there is no lack of the supply of SassoT44 and Bovans Brown breeds since the private farm (Ethio-chicken poultry farm) gave to them with the help of Ethio-chicken representatives in the study area.

Table 6. Source of BB and SassoT44 chickens rearing in the study area

Variables	Study Kebeles					
	Ambessi N=41	Abay N=42	Sawussa N=40	Shafera N=43	Bahirzafa N=44	Overall N=210
	N %	N %	N %	N %	N %	N %
Type of breeds rearing						
BB	16(39.0)	17(40.5)	12(30)	13(302)	15(34.1)	73(34.8)
SassoT44	19(46.3)	15(35.7)	19(47.5)	22(51.2)	19(43.2)	94(44.8)
Both BB & SassoT44	6(14.6)	10(23.8)	9(22.5)	8(18.6)	10(22.7)	43(20.5)
X^2–value						3.579 ^{Ns}
Source of BB & SassoT44						
Purchased from Gov't farm(i.e. Andasa poultry farm)	3(7.3)	0	4(10)	0	7(16.6)	14(6.6)
Purchased from cooperatives	0	0	0	0	0	0
Provided from NGOs	5(12.2)	0	6(15)	7(16.3)	0)	18(8.6)
Purchased from market	18(43.9)	20(47.6)	13(32.5)	13(30.2)	20(47.6)	84(40)

Hatching of eggs naturally	0	0	0	0	0	0
Purchased from private poultry farm	15(36.6)	22(52.4)	17(42.5)	23(53.5)	17(38.6)	94(44.8)
X^2–value						29.890**

- N = Number of respondents, X^2 = Chi-square; ** = highly significant (P<0.01), Ns= Non significant (P>0.05)**,**BB=Bovans Brown

4.5. SassoT44 and Bovans Brown Survival

There was a substantially significant difference (p<0.05) in mortality rates among SassoT44 28.57% and BB 33.28% breeds in the study kebeles (Table 7). There was high mortality rate in the study area due to poor management system in both breeds. The total mortality rate of Bovans Brown and SassoT44 breeds in this study were 33.28% and 28.57% respectively in the study area. There was significant variation (P<0.05) in survival mean between SassoT44 2.96±3.158 and Bovans Brown 2.48±2.839 from 45 days age till production. This indicates that Bovans Brown breed had higher mortality rate (lower survivability) than SassoT44 breeds in study areas due to differences in genetic trait and environment adaptability.

The high mortality 33.28% and 28.57%, of BB and SassoT44 chicks, respectively under back yard chicken production in the study area of the district is due to diseases, parasites, predation, feed shortage and poor housing. Under backyard chicken production, prevailing diseases, predators, lack of proper health care, poor feeding were reported as constraint by Fisseha Moges et al.(2010)and Aman Getiso et al. (2017). This result is lower than that reported by Tilahun Sisay et al.(2017) in north western Amhara in mean mortality rate of Bovans Brown 89% and higher than that reported by Aman Getiso et al. (2017) the mortality recorded in SassoT44 breed at farmers level condition after 45 day old till the age of production was 16.3% in Gamo gofa zones in the SNNPR ,Ethiopia.

Table 7.Survival of SassoT44 and BB chicken (Mean ±SD) in study area

Breeds	Study Kebeles					
	Ambessi N=41	Abay N=42	Sawussa N=40	Shafera N=43	Bahirzafa N=44	Overall N=210
SassoT44 chicken						
SassoT44 received	4.93±4.51	6.02±4.18	1.98±3.69	5.09±3.17	2.43±3.53	4.1±4.12
P-value						**
SassoT44 survived till production (%)	78.72	70.51	68.36	71.24	62.39	71.43
X^2–value						46.33**

Mortality rate of SassoT44 (%)	21.28	29.49	31.64	28.76	37.61	28.57
X^2–value						42.96**
BB chicken						
BB received	2.95±3.47	3.05±4.66	5.75±3.71	2.02±3.75	4.77±3.86	3.70±4.10
P-value						**
BB survived till production (%)	64.47	62.39	68.70	64.37	70.0	66.72
X^2–value						47.32**
Mortality rate of BB (%)	35.53	37.61	31.30	35.63	30.0	33.28
X^2–value						53.37**

- X^2 = Chi-square;*=significant (P<0.05), ** = highly significant (P<0.01), BB=Bovans Brown

4.6. SassoT44 and BB Chicken management system, housing and facilities used in the study area

The results of the study Table 8 showed that the dominant 94.8% chicken production system in the study areas is a free range (backyard) or extensive type. SassoT44 and BB Chickens were managed mainly on free ranging, utilizing various feed sources searching by their own in the field, with conditional feed supplementation. However, some 5.2% of the respondent farmers practice semi-intensive type of chicken management system. According to the result obtained from group discussion, the majority of the farmers managed SassoT44 and BB chickens extensively under traditional production systems. The reason might be created by poor knowledge of farmers due to lack of strong extension service. This result agrees with Tilahun Sisay et al.(2017) report 91.12% of respondents used backyard chicken management systems, whereas 8.89% of farmers kept their chicken by the semi-intensive management system in Burie and Banja District in the northern part of Ethiopia. Similarly, Worku Azanaw (2017) reported that the most dominant 83% chicken production system in North Gondar administrative zone of Amhara region was free range with seasonal supplementation. However, this result is disagreed from Aman Getiso et al.(2017) reported that 63.9% and 36.1% keep chicken in backyard and semi-intensive production system respectively in Sodo zuria and Boloso sore from Wolayita zone and Angecha and Hadaro tunto from Kambata tambaro zone, SNNPR, Ethiopia. As the response of respondent farmers and group discussion with key informants, farmers in the study area are going to change and improve chicken management practice for future by critical following up of kebele DAs recommendation and improving the management activity.

Good housing is a precondition for any sustainable poultry production. In rural areas, housing occupies a low priority in managing poultry including chickens under free-range Mekete Manjura and Ayano Abera

(2023) and also housing is necessary to chickens as it protects them against predators, theft, extreme weather (rain, sun heat, cold wind, cold temperatures) and to provide shelter for egg laying and broody hen. However, the majority of the surveyed respondents did not have a separate chicken house and they shared their house with chickens during the night time. This implies chickens spent most of their day time scavenging around the family house. As presented in Table 7, only 10% of BB and SassoT44 chicken producers in the study area constructed separate house for their chicken. However, 10% the household used separate poultry house for BB and SassoT44 chicken production, the houses were not constructed based on recommended package (Table 8). Moreover, the respondents reported that the houses lack some internal facilities like egg laying nests and feeders. The rest 51%, 23.8% and 15.2% of the respondents reported that they shared family house, perch and kitchen, respectively. This result is disagreed from Andualem Yihun(2021) reported that 86.7% of chicken producers in Fagita district, Awi Zone, constructed separate chicken house. Likewise Saba Haile and Kasa Biratu (2016) reported that about 92.56 % of the chicken owners in south western Ethiopia, have no separate poultry house. In a group discussion made with key informants and selected farmers the problem of predators, fear of theft, lack of experience and lack of awareness (poor extension service by DAs) were the main reasons for not constructing poultry houses in the study area. There is a significant difference ($p<0.05$) between the study kebeles in availability of housing condition for chickens; accordingly purposively constructing of sheds for chicken was high in Abay 26.2% followed by Bahirzafa 9.1%,Sawussa 7.5% and Ambessi 7.3%.However, none of respondents constructed separate house for poultry in Shafera kebele.

About 55.2% of the respondents were cleaning once a week, while 30.5% of the respondents were reported cleaning two times a week as well as 11.9% of the respondents was clean daily and 2.4 % of respondents that clean once a month in the study area. This result slightly agrees with Mosa Mitiku (2022) who reported that about 40%, 12.2% and 5.55% of all the respondents reported cleaning their poultry houses weekly, twice a week and daily, respectively in the Gurage zone; Southern Nations, Nationalities and Peoples' Regional State (SNNPRS), of Ethiopia. There was a highly significant ($P>0.05$) difference in the frequency of cleaning the chicken's houses among the studied kebeles. The proportion results in Abay kebele the farmers that clean their chickens' houses daily more than Ambessi, Sawussa, Shafera, and Bahirzafa kebeles. And Sawussa kebele farmers clean the chicken house two times a week more than others. This result indicated that lack of frequent cleaning of chicken shelter might cause disease and increase morbidity and mortality rates of chicken. Thus, raising awareness of farmers on the

need for cleaning shelters is important. So strong extension for farmers by kebele livestock DAs need about bio-security.

Table 8. SassoT44 and BB Chicken management system, housing and facilities used in the study area

Parameters	Study Kebeles					
	Ambessi N=41	Abay N=42	Sawussa N=40	Shafera N=43	Bahirzafa N=44	Overall N=210
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Management practices						
Backyard	40(97.6)	39(92.9)	37(92.7)	43(92.7)	40(90.9)	199(94.8)
Semi-intensive	1(2.4)	3(7.1)	3(7.5)	0	4(9.1)	11(5.2)
X^2-value						5.059 ^{Ns}
Available housing condition						
Share the same house with people	24(58.5)	15(35.7)	25(62.5)	24(55.8)	19(43.2)	107(51)
Perch	11(26.8)	9(21.4)	8(20)	13(30.2)	9(20.5)	50(23.8)
Separate house for chicken	3(7.3)	11(26.2)	3(7.5)	0	4(9.1)	21(10)
Kitchen	3(7.3)	7(16.7)	4(10)	6(13.9)	12(27.3)	32(15.2)
X2-value						28.183**
Frequency of Cleaning						
Daily	3(7.3)	10(23.8)	5(12.5)	4(9.3)	3(6.8)	25(11.9)
Once a week	30(63.4)	17(73.2)	11(27.5)	24(25.5)	30(68.5)	116(55.2)
Two times a week	8(19.5)	13(30.9)	24(60)	8(18.6)	11(25)	64(30.5)
Once a month	0	2(4.8)	0	7(16.3)	0	5(2.4)
X2-value						41.920**
CBRP						

Yes	0	0	0	0	0	0
No	41(100)	42(100)	40(100)	43(100)	44(100)	210(100)

N = Number of respondents, X^2 = Chi-square; ** = highly significant (P<0.01), Ns= Non significant (P>0.05), CBRP= Constructed based on recommended package

4.7. Feeds and feeding practices

The major feed resources, feeding system, season of feed shortage, additional feed type and frequency of giving to consume in the study area indicated by the respondents showed in Table 9. Although scavenging was the major feeding system encountered in all study areas, about 72.4% of the BB and SassoT44 chickens are managed under free scavenging with supplementary feed. The remaining 27.6% of the BB and SassoT44 chickens are managed under free scavenging with no supplementary feed. Similarly, Saba Haile and Kasa Biratu (2016) in Ilu Aba Bora zones, south western Ethiopia reported that 72.5% of BB and SassoT44 chicken owners were offered supplementary feeds. However, the result of this study was lower than study of Fisseha Moges et al.(2010) and Ahmedin Abdurehaman (2020) 97.5% and 95.6% of the chicken owners provided supplementary feed to the village chicken, especially during feed shortage season in Bure district, West Gojam zone and East Hararghea administrative zone, respectively. This result also is not in line with reports by Tilahun Sisay et al.(2017) at Awi zone in Banja district in which 72.77% and 27.22% the managed exotic chickens were scavenging with no additional feed supplements and scavenging with additional supplements for exotic chicken, respectively.

About 90.1% of the respondents stated that the season of serious feed shortage was in rainy season (June-September) in all study areas (Table 9). Therefore the respondents elicited that season of extra feed were from June to September (long-rainy) in all study areas, as well as supplementation was mainly in long wet seasons. This report is in line with Dereje Bekele and Bodena (2018) who reported that majority of the respondents 92.9% supplement their chicken during rainy season. Based on the information obtained from the respondents, the major additional feed type (supplementation) in the study area was grain 80.3% like wheat 36.15%, maize 27.9% and barley (26%. Beside the grains, chickens were also provided with food leftover or/and kitchen wastes (19.7%) as supplementary feeds. In the study area, the major sources of supplementary feed were from their house 94.7% and purchased from market 5.3%. The majority of respondents simply feeding on the floor 96.7%, whereas few of them use feeding trough 3.3% when they provided supplementary feed (grain) in the study areas. These poor feeding practices cause disease outbreaks through soil contamination. This result corresponds to Worku Azanaw (2017) who 91.7% of

respondents were fed chicken on the ground and 8.3% used local containers like plastic or metallic made. The majority 66.5% of respondents supplement their chickens only once a day. The rest 30.9% and 2.6% supplement their chickens two times per day and three times per day respectively. This result is in line with Bangu Bekele (2016) who reported 72.7 % and 14.3% of respondents offer once and twice a day respectively in *Sidama Zone and Halaba Special Woreda*. However, the current results disagree with the report of Birtukan Matebie et al. (2023), who reported 57.1% of the producers provide feed to their chicken three times a day and other 28.6% of the producers provide feed four times per day in three selected districts (Ebinat, Addis Zemen and Debre Tabor) of South Gondar Zone, Amhara Region, Ethiopia and Aman Getiso et al. (2017), who reported 61.4% of the respondents in the study districts, feed their chicken three times per, while 10.1% and 28.5% provide two times per day in the morning and evening; morning and afternoon respectively in three agro-ecologies of Southern Nations , Nationalities , and Peoples ' Regional State (SNNPR).

Table 9. Feeds and feeding practices for BB and SassoT44 chickens in the study area

	Study Kebeles					
Feed & Feeding practices for BB and SassoT44 chickens	Ambessi N=41	Abay N=42	Sawussa N=40	Shafra N=43	Bahirzafa N=44	Overall N=210
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Feeding system						
Only scavenging	9(22.0)	13(31)	7(17.5)	14(32.6)	15(34.1)	58(27.6)
Scavenging with additional supplement(Grain)	32(78)	29(69)	33(82.5)	29(67.4)	29(65.9)	152(72.4)
Season of feed scarcity & Needs Additional feed						
Wet season (June-Sep)	23(62.5)	28(96.6)	31(93.9)	28(96.6)	27(93.1)	137(90.1)
Dray season	9(37.5)	1(3.4)	2(6.1)	1(3.4)	2(6.9)	15(9.9)
Supplement feed type						
Grain	26(81.25)	27(93.1)	23(69.7)	21(72.4)	25(86.2)	122(80.3)
Others(Food leftover or/and kitchen wastes)	6(24.4)	2(6.9)	10(30.3)	8(27.6)	4(13.8)	30(19.7)
Type of grain feed (%)						
Wheat	12(46.2)	15(55.6)	10(43.5)	8(38.1)	12(48)	44(36.1)
Maize	5(19.2)	4(14.8)	4(17.4)	10(47.6)	11(44)	34(27.9)

Barley	9(34.6)	8(29.6)	9(39.1)	3(14.3)	2(8)	32(26)
X2-value						8.13^{NS}
Source of feed addition						
From the house	29(90.6)	27(93.1)	33(100)	26(89.7)	29(100)	144(94.7)
Purchased from market	3(9.4)	2(6.9)	0	3(10.3)	0	8(5.3)
How do you provide the supplementary feed(Grain)						
By feeder	3(9.4)	2(6.9)	0	0	0	5(3.3)
Throw on the ground	29(90.6)	27(93.1)	33(100)	29(100)	29(100)	147(96.7)
Frequency feeding						
Two times per day	5(15.6)	16(55.2)	9(27.3)	7(24.1)	10(34.5)	47(30.9)
Once per day	25(78.1)	13(44.8)	22(66.7)	22(75.9)	19(65.5)	101(66.5)
three time per day	2(6.3)	0	2(6.0)	0	0	4(2.6)
X^2-value						18.477*

- N = Number of respondents, X^2 = Chi-square;*=significant (P<0.05), ** = highly significant (P<0.01), Ns= Non significant (P>0.05)

4.8. Water sources and watering practice

Water plays an important role for feed digestion and metabolic activity of chickens. All respondents 100% of the study area provided water for their chickens Table 10. The current finding is similar to Mosa Mitiku(2021), Amanuel Bekuma (2018),Mebratu Yigzaw et al.(2020) and Tilahun Sisay et al.(2017) who reported that most of the respondents provided water for their chicken. The major sources of provided water in study area are obtained from whole water 87.6%, spring 7.1%, and river 4.3% and tap water 1.0%.Almost all farmers provide water for their chickens; however the frequency of provision per day varies mainly based on the availability of labor, water and their understanding label about the use of water. Information recorded for frequency of watering revealed that about 56.2% of respondents provide water once a day at noontime (or when the chickens show sign of thirst). Only 22.9% provides ad-libitum (Free access) and 20.9% of them provides twice at noon and evening in the study area. This result disagrees with Legesse Tunsisa1 and Kefyalew Berihun (2024) who reported about half 50% of respondents provide free access water to chicken whereas some of them 25% provide once a day and the remaining 25% provide twice a day for their chickens. As it was noticed during the chicken drinking material visit, almost all materials used by the sample respondents for providing water for chickens were not cleaned and were dirty. Therefore the farmers must take care of the quality of the water and drinking materials. Concerned bodies (poultry experts, DAs) should provide intensive training for producers on the concerns of chicken bio-security.

Table 10. Watering practice for BB and SassoT44 chickens in the study area

Watering practice	Study Kebeles					
	Ambessi N=41 N (%)	Abay N=42 N (%)	Sawussa N=40 N (%)	Shafra N=43 N (%)	Bahirzafa N=44 N (%)	Overall N=210 N (%)
Provision of water						
Yes	41(100)	42(100)	40(100)	43(100)	44(100)	210(100)
source of water						
whole water	33(80.5)	32(76.2)	37(92.5)	43(100)	39(88.6)	184(87.6)
River	3(7.3)	4(9.5)	0	0	2(4.5)	9(4.3)
Tap water	0	2(4.8)	0	0	0	2(1.0)
Spring	5(12.2)	4(9.5)	3(7.5)	0	3(6.9)	15(7.1)
X^2-value						21.746*
How frequent you provide water						
ad-libitum (Free access)	17(41.5)	13(31.0)	5(12.5)	1(2.3)	12(27.3)	48(22.9)
Once a day	20(48.9)	22(52.4)	24(60.0)	30(69.8)	22(50.0)	118(56.2)
Twice a day	4(9.6)	7(16.6)	11(27.5)	12(27.9)	10(22.7)	44(20.9)
Does not provide water	0	0	0	0	0	0
X^2-value						23.027*

- N = Number of respondents, X^2 = Chi-square;*=significant (P<0.05)

4.9. Chicken health and disease control measures

Diseases were one of the major bottlenecks for village chicken productions in the studied areas. The results of this study tend to indicate those poultry disease were widely spread in the study area. About 100% of the respondents confirmed that occasional and serious disease outbreak results in complete devastation of the flock when accrued Table 11. Respondents were identified disease by its symptom when birds get sick. Based on the information obtained from veterinarians and disease symptoms revealed by respondents, New castle 84.3%, Gumboro 8.1% and Marek's 7.6% were reported as most important poultry diseases in the study area.

Newcastle disease (NCD) was the most prevalent and economically important 84.3% disease problem affecting village chickens and it is reported to be the first major causes of chicken death/loss in the area.

Fisseha Moges et al., (2010) also reported that the major cause of death in chickens in Bure district, West Gojam zone is seasonal outbreak of diseases, specifically Newcastle Disease. About 90.5% of the respondents reported that ground serious disease outbreak mainly prevalent during the start of the main rainy season mainly from April to June. However, there were also respondents who experienced high rate of disease occurrence any time in a year 9.5%. This might be due to the critical time for virus outbreak or reproduction at the time of the early rainy season. This result agree with Saba Haile and Kasa Biratu (2016) the occurrence of diseases is seasonal where the highest chicken death rate was observed during the wet season 88.7% in Jimma and Ilu Aba Bora zones Oromia regional state, south western Ethiopia.

In the study areas about 51.4% of respondents do not give any kind of vaccination to chicken, whereas about 48.6% of respondents vaccinate chicken for the disease. There was significant ($P<0.05$) difference in getting vaccines for their chicken in the study kebeles. The average mean of 41.3%, 40.5%, 45.0%, 69.8% and 40.9% that get vaccination services for Ambessi, Abay, Sawussa,Shafra and Bahirzafa kebele in the study area Table 11, respectively. Prevention measures taken by households (respondents) minimize losses due to disease. Around 29.4% and 69.6% of respondent were treated the diseases outbreak by veterinarian and treated the diseases outbreak by using traditional methods, respectively in the study area. Traditional home made medicines were mainly the combinations two or more of the locally available materials such as garlic, oil, ginger, grawa (vernonea omygdalan) and also were usually administered through cutting of black side part of wings and then the blood removes to treat sick chickens. Only 1.4% of the respondent households were slaughtering of chickens immediately after sickness to minimize chicken losses due to diseases.

Table 11. Chicken health management in the study area

Health management practice	Study Kebeles					
	Ambessi N=41	Abay N=42	Sawussa N=40	Shafra N=43	Bahirza N=44	Overall N=210
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Disease occurrence						
Yes	41(100)	42(100)	40(100)	43(100)	44(100)	210(100)
Most prevalent diseases						
Newcastle	30(73.2)	37(88.1)	36(90.0)	33(76.7)	41(93.2)	177(84.3)

Gumboro	4(9.8)	3(7.1)	0	7(16.3)	3(21.5)	17 (8.1)
Marek's diseases	7(17.0)	2(4.8)	4(10.0)	3(7.0)	0	16(7.6)
X^2-value						17.950*
Time of disease occurrence						
Start of rainy season (April to June)	35(85.4)	34(80.9)	40(100)	38(88.4)	44(100)	198(90.5)
Always	6(14.6)	8(19.1)	0	5(11.6)	0	12(9.5)
Dry season	0	0	0	0	0	0
X^2-value						15.363**
Annual vaccination for chicken						
Yes	19(41.3)	17(40.5)	18(45.0)	30(69.8)	18(40.9)	102(48.6)
No	22(53.7)	25(59.5)	22(55.0)	13(30.2)	26(59.1)	108(51.4)
X^2-value						10.156*
Measurements taken when chicken become sick						
Treat them using traditional methods	23(56.1)	27(64.3)	28(70.0)	31(72.1)	37(84.1)	146(69.6)
Slaughter immediately after sickness	0	0	3(7.5)	0	0	3(1.4)
Treat by veterinarian	18(43.9)	15(35.7)	9(22.5)	12(27.9)	7(15.9)	61(29.0)
X^2-value						22.346**

- N = Number of respondents, X^2 = Chi-square;*=significant (P<0.05)

4.10. Culling practice and reasons for culling chickens

The information recorded for culling of chicken are presented in Table 12. In study areas, farmers have experienced the culling of chicken for different reasons. The study result showed that culling was practiced by most of the respondents 99% in the study area. A similar result was reported by Hailu Assefa et al. (2019) who indicated that that 100% of the respondents practiced culling in the Southwestern part of Ethiopia in the South Nations, Nationalities and Peoples Region. However, this result disagrees with Mosa Mitiku(2021) who reported the majority of the respondents74.40% did not practice chicken culling in the Gurage zone; Southern Nations, Nationalities and Peoples' Regional State (SNNPRS), of Ethiopia. Based on the study result the main reasons for culling were low egg production 44.3%, old age 29%, feed shortage 20 %, space problem 3.8% and sickness 1.9%. From the total 1% of the respondents were not culling their chickens by any means (Table 12).This result is in line with Saba Haile and Kasa Biratu (2016) who reported that the majority of village chicken households practiced culling chickens based on

poor productivity 53 %, old age 29.6% %, and 10% disease outbreak. There is significant difference (P<0.05) on culling of chicken based on different reasons. Legesse Tunsisa et al., (2022) reported that chicken producers cull chicken for old age, low egg production, disease problem and feed shortage. This result disagrees with the finding of Addisu Hailu et al. (2013)who reported that the reason of culling chicken from their flock is Slaughtering 53.3%, sell 41.2% and devour or sell eggs of unwanted hens5.6%. Reasons may vary from time to time and from area to area depending on the problem encountered in the production.

When culling is necessary, farmers cull their chicken in different ways. In this study, selling and home consumption were the dominant methods of culling in all study kebeles. About 78.1% and 21.9% of the respondents soled culled chickens for income sources and home consumption respectively.

Table 12. Culling practices and reasons for culling chickens in the study area

Culling practices	Study Kebeles					
	Ambessi N=41	Abay N=42	Sawussa N=40	Shafra N=43	Bahirzafa N=44	Overall N=210
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Culling practice						
Yes	40(97.6)	42(100)	40(100)	43(100)	43(97.7)	208(99.0)
No	1(2.4)	0	0	0	1(2.3)	2(1.0)
X^2-value						8.234 ^{Ns}
Reason of culling						
Low egg production	20(48.8)	15(35.7)	17(42.5)	18(41.9)	23(52.3)	93(44.3)
Old age	12(29.3)	18(42.9)	9(22.5)	10(23.3)	12(27.0)	61(29.0)
Sickness	0	0	3(7.5)	1(2.3)	0	4(1.9)
Feed shortage	8(19.5)	6(14.3)	9(22.5)	11(25.6)	8(18.2)	42(20.0)
Space problem	0	3(7.1)	2(5.0)	3(6.9)	0	8(3.8)
X^2-value						34.512*
Way of culling						
Sell	37(90.0)	31(73.8)	35(87.5)	29(67.4)	32(72.1)	164(78.1)
Home consumption	4(10.0)	11(26.2)	5(12.5)	14(32.6)	12(27.9)	46(21.9)

X^2-value	9.651*

- N = Number of respondents, X^2 = Chi-square;*=significant (P<0.05), Ns= Non significant (P>0.05)

4.11. Production Performance of Bovans Brown and SassoT44 chicken breeds

The average egg production and growth performance of BB and SassoT44 chicken in village production system is shown in Table 13. There is no significant difference (P>0.05) in age at the chickens first egg-lying and the number eggs produced per hen per year in the study area Table 13.The information collected on age at first laying disclosed that the mean ages at first laying were 5.43±0.21 and 5.42±0.22 months for SassoT44 and Bovans Brown chicken breeds, respectively. The current finding was in line with the average age at the first egg laying of exotic chicken 5.4 ± 24 reported by Serkalem Assefa et al. (2018) under Village Production System in Sidama Zone, southern Ethiopia. However, the results of the current study disagreed with the mean age at the 1st lay of improved chicken 6.076 ± 1. 61 and 6.05 ± 1.5 months reported by Amanuel Bekuma and Abdissa Tadesse (2022) and Mekete Manjura and Ayano Abera(2023), respectively.

The average egg production per/year/hen for Bovans Brown and SassoT44 chicken breeds in the study area were 167.25±35.961and 165.22±37.91, respectively. The result of the current study is in line with Mosa Mitiku (2021) and Nega Mekonnen and Betelihem Adamu (2022) who reported the average egg production per/year/hen for exotic chicken breeds was 174.27±1.12 and 178.70 ± 0.11 in South and West Ethiopia.

Table 13. Production Performance of BB and SassoT44 chicken breeds in the study area

Parameters	Study Kebeles						
	Ambessi N=41	Abay N=42	Sawussa N=40	Shafera N=43	Bahirzafa N=44	Overall N=210	P-Value
Age at 1st egg laying (months							
SassoT-44	5.47±0.22	5.38±0.21	5.38±0.16	5.42±0.21	5.50±0.23	5.43±0.21	0.786Ns
BB	5.48±0.22	5.38±0.27	5.39±0.18	5.41±0.21	5.46±0.20	5.42±0.22	
Number of eggs/hen/yr.							
SassoT44	165.80±37.74	165.42±42.17	162.20±39.62	163.38±38.47	169.00±34.78	165.22±37.91	0.686Ns

BB	176.80±35.58	162.90±40.16	166.00±35.05	168.40±34.37	162.72±36.07	167.25±35.96

- BB=Bovans Brown, N = Number of respondents, Ns= Non significant (P>0.05)

4.12. Constraints of improved chicken production in study area

The constraints of chicken production prioritized by the respondents in the study area is described on Table 14. Poultry production in the study area was hindered with different factors. Farmers in the study areas reported different constraints that affect the village chicken production. The most important constraints impairing the existing chicken production system under farmer's management condition in the study area were disease, shortage of feed, predators, lack of knowledge about poultry management (poor extension service) and lack of market have been ranked as 1st, 2nd, 3rd, 4th, and 5th, respectively, in all the study kebeles; although, the index values for each production constraints among the study kebeles were different. Similar findings were reported by Aman Getiso et al.(2017) and Bangu Bekele (2016) in which under village poultry production, prevailing diseases, predators, poor feeding and poor marketing information as the major constraints in Kambata Tambaro zone and Hadiya zone respectively. Diseases problem was found to be the primary constraint of chicken production in all the study kebeles with an index value of 0.29, 0.3, 0.28, 0.29, and 0.28 for Ambessi, Abay, Sawussa, Shafera and Bahirzafa kebeles, respectively. According to the animal health experts (veterinarians) in livestock office of Sekela district, NCD was the most devastating disease and considered to be a major constraint to the development of poultry production in the study area .Similarly, Fisseha Moges et al.(2010) described that disease is major challenging and most economically important factor for village chicken production system.

Predators are the second major constraint next to disease. The most common predators mentioned by the farmers were wild cat, Hawk, monkey, ape and fox in their order of importance. Similar results have been reported in North Gondar administrative zone of Amhara region Worku Azanaw (2017) stated that predators 23.3% were the 2nd constraint next to disease that devastate chicken productivity. Shortage of supplementary feed was the third constraint next to predators which hinders chicken productivity in Sekela district. Lack of knowledge about poultry management (poor extension service) was the fourth constraint. There was low extension support from responsible bodies to improve chicken production in study areas. The extension linkage between the respondents and the livestock office and the DAs are found to be extremely weak, thus in general there is lack of knowledge about poultry management in farmers. Other constraints identified in the study areas during the interview are shortage of feed and lack of market.

Table 14. Major Constraints of Village Chicken Production in the Study Area

Kebeles	Rank	Presence of disease	Attacks of predators	Shortage of feed	Lack of market	Poor extension service/Lack of knowledge about chicken management
		N	N	N	N	N
Ambessi	R1	15	5	4	2	5
	R2	8	15	10	3	5
	R3	5	11	9	7	9
	R4	3	4	9	12	13
	R5	0	6	9	17	9
	Index	0.29	0.21	0.19	0.14	0.17
	Rank	1st	2nd	3rd	5th	4th
Abay	R1	28	3	8	1	2
	R2	9	11	13	4	5
	R3	3	15	14	5	5
	R4	1	7	4	16	14
	R5	1	6	3	16	16
	Index	0.30	0.20	0.23	0.13	0.14
	Rank	1st	3rd	2nd	5th	4th
Sawussa	R1	19	11	6	4	0
	R2	9	13	10	4	4
	R3	10	12	1	3	4
	R4	1	2	12	12	13
	R5	1	2	11	17	19
	Index	0.28	0.23	0.19	0.14	0.17
	Rank	1st	2nd	3rd	5th	4th
Shafra	R1	24	9	6	0	4
	R2	12	13	13	3	2
	R3	5	12	12	9	5
	R4	1	5	6	14	17
	R5	1	4	7	16	15
	Index	0.29	0.23	0.21	0.13	0.14
	Rank	1st	2nd	3rd	5th	4th
Bahirzafa	R1	21	13	3	1	6
	R2	13	16	9	2	4
	R3	8	11	10	8	7
	R4	1	3	10	17	13
	R5	1	1	12	16	14
	Index	0.28	0.26	0.17	0.13	0.16
	Rank	1st	2nd	3rd	5th	4th
Overall	Index	0.29	0.23	0.2	0.13	0.16
	Rank	1st	2nd	3rd	5th	4th

R_1, R_2, R_3, R4, R_5= $Rank_1$, $Rank_2$, $Rank_3$, $Rank_4$ and $Rank_5$, respectively

4.13. Effects of Breeds and Egg laying phase on Egg Quality Parameters

The mean values for the effect of the egg laying phase and breed of on external and internal egg quality traits of chickens in the study areas are show in (Table 15, Table 16. Table 17 and Table 18).

4.13.1. Egg weight

The results of the study (Table 16) showed that the Eggs from Bovans Brown breeds were significantly heavier than those from SassoT44 breeds ($P \leq 0.05$). The reason why Bovans Brown egg weight greater than SassoT44 due to body weight difference. That means Bovans Brown: Average weight: 1.5-2.0 kg (3.3-4.4 lbs.) SassoT44: Average weight: 2.0-2.5 kg (4.4-5.5 lbs). The average mean egg weight of SassoT-44 and Bovans raised in the study area were reported to be 58. 10±4.93 g and 59.73±2.83 g, respectively(Table 16), which was in agreement with the finding of Navneet et al. (2018)who reported the egg weight may range from 35 to 65gm in Africa, while in Europe it may range from 45 to 70 grams (g)for exotic chickens. However, the mean egg weight of the present study is lower than the report of Desalew Tadesse et al.(2015) and Fanu Woldemichael et al.(2015) for Bovans Brown 60.27 ± 6.03gm and SassoT-44 65.57±5.26 gm, respectively in east Shewa and north shewa Tarmaber district , Ethiopia. In general, heavier hens tend to lay larger eggs, while lighter hens may produce smaller eggs. Several studies have shown heavier eggs in brown hens than in white one Lukas Zita et al. (2013), Olatunji et al.(2012) and kraus et al.(2020). The weight increased significantly with laying phase ($P \leq 0.001$) and there have been significant interactions of laying phase and breed ($P \leq 0.001$) on egg weight (Table 15). The weight of the egg is highly correlated with the genetic makeup, weight, and age of the chickens. It is one of the important phenotypic traits that influence egg quality (kraus et al., 2020).

The analysis for average egg weight were 56.05±4.93, 59.08.±5.02 and 59.15±4.44 gm for SassoT44 and 56.51±3.30, 59.60±2.71and 60.35±1.39gm for Bovans Brown in 1st phase, 2nd phase and3rd phase of laying, respectively (Table 15). The results of this study tend to indicate those egg weight increases as the laying phase of measurement increases in both breeds. This observation corroborates with the report of Leke et al. (2019)and Olatunji et al.(2012) who reported that egg weight increases with the age of hens. The present findings for egg weights were higher than those reported by Rajkumar et al. (2014) which are 37.08, 38.83 and 47.52 g with in1st phase, 2nd phase and3rd phase of laying, respectively.

4.13.2. Egg length

The results of the study showed that there was variation observed in egg length among laying phase ($P<0.05$) in both breeds (Table 15). The mean egg length were 52.35±7.37, 54.91±3.88and 56.80±5.10mm for SassoT-44 and 53.53±4.78, 56.50±3.16and 57.44±5.10mm for Bovans Brown in 1st phase, 2nd phase

and3rd phase of laying, respectively. Egg length increases steadily with increasing hen's laying phase which implies that as the age of hen increases, the length of egg laid also increases. This result supports the findings of Olatunji et al.(2012) . No interactions was revealed for egg length in breed by laying phase. However, there have been significant effects of laying phase ($P \leq 0.001$) on egg length. The average mean egg length of SassoT-44 and Bovans raised in the study area were reported to be 54.89±5.82mm and 55.83±4.65mm, respectively(Table 16), which was in line with the finding of Sumashree et al.(2019)who reported the egg length for exotic chicken to be 55.02 ±0.24mm.

4.13.3. Egg width

The results of the study (Table 15) showed that, there was significant ($P \leq 0.0001$) effect of laying phase and breed on egg width. However, the interaction of laying phase by breed was not significant. The analysis for egg width revealed that 40.17±2.99, 41.50±0.63, 42.67±2.99and 41.53±2.60, 43.89±3.50, 43.78±2.54mm for SassoT44 and Bovans brown under 1st phase, 2nd phase and 3rd phase of laying, respectively. The variations in the egg width can be associated with the genetics and age of the chicken. The average mean egg width of SassoT44 and BB raised in the study area were reported to be 41.45±2.63and 43.07±2.06mm, respectively(Table 16), which was in agreement with the finding of Olatunji et al.(2012) who reported that the egg width of exotic chickens to be 42.45cm in Nigeria

4.13.4. Shell weight

The results of the study (Table 15) showed that, there was significant ($P \leq 0.0001$) effect of laying phase and breeds on shell weight. The interaction of laying phase by breed was also significant ($P \leq 0.001$). The results of this study tend to indicate the Bovans Brown breed egg shells were significantly heavier than SassoT44 breed egg shells (Table 16). These differences might be due to age of production stage, calcium intake in diet and genetic differences in breeds studied. Similarly, Serkalem Assefa et al.(2019) discovered significant effect of the breed on eggshell weight. Park (2013) similarly confirm that age significantly influences eggshell weight and that eggshell weight fluctuates with the age Zehara Bozkrut and Mustafa Tekerli (2013) agrees that the interaction between age and genotype in eggshell weight is significant.

The analysis for egg shell weight revealed that 6.42±0.43,5.71±0.53, 5.55±0.91 and 8.01±0.69, 7.22±0.57, 6.41±0.52 gm for SassoT44 and Bovans Brown under 1st phase, 2nd phase and 3rd phase of laying, respectively. The average mean shell weight of SassoT44 and BB raised in the study area were reported to be 5.89±0.75 and 7.21±0.88 g, respectively (Table 16). The present result is higher than the report of

Yonas Kejela et al. (2019) Bovans Brown 6.21±1.01 gm and SassoT44 4.24±0.34 gm under small scale management systems in Yirgalem and Hawassa towns, Ethiopia.

4.13.5. Shell thickness

The results of the study (Table 15) showed that, the shell thickness was not affected ($P > 0.05$) by laying phase and interaction of breed and laying phase. However, there was significant ($P \leq 0.0001$) effect of breed on egg shell thickness (Table 16). The shell thickness of egg produced by BB was significantly ($P \leq 0.0001$) higher than that of SassoT44. The difference egg shell thickness among BB and SassoT-44 breeds might be due to genetic peculiarities of these birds, because the ability to produce eggs with shell thickness is an inherited character.

The analysis for egg shell thickness revealed that 0.28±0.02, 0.27±0.01, 0.26±0.04 and 0.33±0.03, 0.32±0.03,0.32±0.02mm for SassoT-44 and Bovans brown under 1st phase, 2nd phase and 3rd phase of laying, respectively. The average mean shell thickness of SassoT-44 and BB raised in the study area were reported to be 0.27±0.03 and 0.33±0.03 mm, respectively (Table 16). These results was in line with the report of Desalew Tadesse et al.(2015) who reported that the average mean of egg shell thickness was 0.33±0.04mm for BB and Serkalem Assefa et al.(2019) who reported that the average mean of egg shell thickness of 0.27±0.02 mm for SassoT-44 chicken in North Shewa and Sidama Zone, Ethiopia respectively. However, this result was not agreement with the report of Fanu Woldemichael et al.(2019) who reported average egg shell thickness was 0.32 ±0.03 mm for SassoT44 and Serkalem Assefa et al.(2019) who reported that the average mean of egg shell thickness of 0.28±0.02 mm for BB chicken in North Shewa and Sidama Zone Ethiopia, respectively.

4.13.6. Egg shape index

The shape index was 78.08±9.18, 75.92±5.26, 75.68±8.55and 78.20±8.92, 77.98±8.36, 76.80±8.32 in 1st phase, 2nd phase and 3rd phase of laying for SassoT44 and BB, respectively (Table 15). The average mean shape index of SassoT44 and BB raised in the study area were reported to be 76.56±7.73 and 77.66±8.39, respectively(Table 16) .The results was in agreement with the findings of Fanu Woldemichael et al.(2019) and Kraus et al.(2020)who reported that the average mean of egg shape index was 76.08±3.88 and77.98 ± 0.27 for SassoT44 and BB chicken, respectively. Though ESI shows a fluctuating trend there was no any significant difference ($p>0.05$) observed among breeds, laying phase and interaction between laying phase by breed. These results were in line with Padhi and Haunshi(2014) who reported no significant effect of age and breed on shape index in commercial laying hen. The average mean shape

index of SassoT44 and BB raised in the study area were reported to be 76.56±7.73 and 77.66±8.39 which is round shape. According to Fanu Woldemichael et al.(2019) , Rajkuma et al. (2014) and Lado et al. (2015)the shapes of egg most often encountered are sharp, normal and round eggs, and their shape indices were reported to be <72, 72-76 and >76, respectively.

Table 15.Effect of laying phase and interactions of LP by breed on external quality of eggs (Mean±SD)

Variables	Breed	laying phase in Weeks			Significance	
		1st phase 22weeks N=100	2nd phase 33weeks N=100	3rd phase 44weeks N=100	LP	LP*Breed
Egg weight (g)	SassoT44	56.05±4.93[b]	59.08.±5.02[a]	59.15 ±4.44[a]	***	***
	BB	56.51 ±3.30[c]	59.60 ±2.71[b]	60.35 ±1.39[a]		
Egg length (mm)	SassoT44	52.35±7.37[c]	54.91±3.88[b]	56.80±5.10[a]	*	0.92[Ns]
	BB	53.53±4.78[c]	56.50±3.16[b]	57.44±5.10[a]		
Egg width (mm)	SassoT44	40.17[c]±2.99	41.50[b]±0.63	42.67[a]±2.99	**	0.589[Ns]
	BB	41.53±2.6 [b]	43.89±3.5 [a]	43.78±2.54[a]		
Shell weight (g)	SassoT44	6.42±0.43[a]	5.71±0.53[b]	5.55[c]±0.91	***	**
	BB	8.01±0.69[a]	7.22±0.57[b]	6.41±0.52[c]		
Shell thickness (mm)	SassoT44	0.28±0.02	0.27±0.01	0.26±0.04	0.195 [Ns]	0.344 [Ns]
	BB	0.33±0.03	0.32±0.03	0.32±0.02		
ESI	SassoT44	78.08±9.18	75.92±5.26	75.68±8.55	0.66 [Ns]	0.90[NS]
	BB	78.20±8.92	77.98±8.36	76.80±8.32		

- [abc] Means with different letter superscript on the same row are significantly different ($p<0.05$) , BB= Bovans Brown, ESI= Egg shape index, LP=Laying Phase, Ns= Non significant ($P>0.05$), ***$P \leq 0.0001$; **$P \leq 0.001$; *$P \leq 0.05$

Table 16.Effect of breed on external quality of eggs (Mean±SD)

Variables	Egg weight (g)	Egg length (mm)	Egg width (mm)	Shell weight (g)	Shell thickness (mm)	ESI
SassoT44 N=150	58.10±4.93[b]	54.89±5.82	41.45±2.63[b]	5.89±0.75[b]	0.27±0.03[b]	76.56±7.73

Breed	BB N=150	59.73±2.83[a]	55.83±4.65	43.07±2.06[a]	7.21±0.88[a]	0.33±0.03[a]	77.66±8.39
	Overall mean N=300	58.91±4.08	55.37±4.60	42.59±3.07	6.56±1.05	0.30±0.04	77.11±8.59
	P-value	*	0.301[ns]	***	***	***	0.520[ns]

- [ab] Means with different letter superscript on the same column are significantly different ($p<0.05$) , BB= Bovans Brown, ESI= Egg shape index, Ns= Non significant ($P>0.05$), ***$P \leq 0.000$, *$P \leq 0.05$

4.13.7. Albumen weight

Albumen weight shows significantly different values between breeds and all laying phases as well as interaction of laying phase by breed was also significant (Table 17 and 18). The highest albumen weight was measured 3rd laying phase 35.80±1.28 and 38.33±2.67 and the lowest albumen weight was recorded in 1st laying phase 29.39±2.04 and 31.29±1.47 for SassoT-44 and BB breed, respectively. These values were significantly influenced ($p<0.05$) by age. The weight of albumen increased as the age increases; i.e. as the age of the chicken advanced, albumen weight showed an increase. This observation was in line with the result obtained by Sam et al.(2023). They pointed out that albumen weight was directly proportional to egg weight. The average mean albumen weight was significantly ($P \leq 0.0001$) higher in BB breed 35.73±4.37g as compared to SassoT-44 breed 32.12±3.24 (Table 18). The present finding on albumen weight was higher than the observation of Desalew Tadesse et al.(2015) who reported albumen weight of 34.54 ± 5.67g for BB and Sanka et al.(2021) who reported albumen weight of 29.85g for SassoT44 breed chickens in semi–intensive system. However, Fanu Woldemichael et al.(2019) , found higher albumen weight 40.56±4.41 for SassoT-44 breed in North Showa Zone, Ethiopia and kraus et al.(2020) found higher albumen weight of 41.47 ± 0.32 brown egg laying chicken breed in Prague Czech Republic.

4.13.8. Albumen height

The analysis for egg albumen height revealed that 6.42±1.10, 6.29±1.53, 4.67±0.75 and 6.91±1.27, 6.62±1.27, 5.70±1.33 mm for SassoT44 and BB under 1st phase, 2nd phase and 3rd phase of laying, respectively (Table 17). There was significant ($P \leq 0.05$) effect of laying phase and breeds on albumen height. The highest value of albumin height were recorded 6.42±1.10and 6.91±1.27 mm for SassoT44 and BB under 1st phase of age, respectively due to the decreasing of yolk. The lowest value were recorded 4.67±0.75 and 5.70±1.33 mm for SassoT44 and BB under 3rd phase of age, respectively. Albumen height decreased consistently with increasing chickens age which is the best indicator of egg quality parameters. As the hen become older, albumen quality decrease (Habtamu Tamiru et al., 2019) .

The average mean Albumen height of SassoT44 and BB raised in the study area were reported to be 5.80±1.40 and 6.41±1.36, respectively (Table 18). BB was significantly higher than SassoT44 breed under all laying phase ($P \leq 0.05$). The interaction of laying phase by breed was also highly significant ($P \leq 0.0001$). Under semi-intensive production system, comparable average albumen height was reported by Tadesse et al.(2013) for SassoT44 and BB breeds in East Shewa, Ethiopia. But, this finding is lower than Desalew Tadesse et al.(2015)and Fanu Woldemichael et al.(2019) who reported albumen height of 9.51 and 7.46 mm for BB and SassoT44 breed chickens in North and East Shewa Zone, respectively.

4.13.9. Yolk height

Yolk heights in the current study were 14.92±1.33, 15.26±1.13, 16.07±0.83 and 15.62±1.03, 15.12±1.22, 17.07±1.33 mm for SassoT44 and BB under 1st phase, 2nd phase and 3rd phase of laying, respectively (Table 17). The highest value of yolk height were recorded 16.07±0.83and 17.07±1.33 mm for SassoT44 and BB under 3st phase of laying, respectively. Besides, the lowest value were recorded 14.92±1.33and 15.12±1.22 mm for SassoT44 and BB under 1st and 2nd phase of laying, respectively. The average mean yolk height of SassoT44 and BB raised in the study area were reported to be (15.42±1.20) and (15.94±1.44) respectively (Table 18). The present result is in line with the result of Berhanu Bekele (2024) and Inca et al. (2020) who reported that the mean yolk height of laying hens and SassoT44 15.5 and 15.46 mm in Hawassa University, Ethiopia and Peru, respectively in intensive management system. However, significantly lower than the report of Sumashree et al. (2024) who reported that the mean yolk weight 16.55 mm for commercial breed in India and significantly higher than the report of Mohamed Thariq et al.(2022)who reported that the mean yolk weight 13.88 ±0.41 mm for commercial breed in Ampara district, Sri Lanka

The yolk height was affected ($P \leq 0.05$) by laying phase and breed. It was significantly ($P \leq 0.05$) higher in BB breed as compared to SassoT44 breed (Table 16). However, the yolk height was not affected ($P > 0.05$) by interaction of breed and laying phase.

4.13.10. Yolk weight

Yolk weights in the current study were 13.54±0.83, 16.62±2.53, 17.10±1.45 and 11.97±0.79, 16.53±1.06, 16.18±1.12 for SassoT44 and BB under 1st phase, 2nd phase and 3rd phase of laying, respectively (Table 17). The highest value of yolk weight were recorded 17.10±1.45 and 16.53±1.06 mm for SassoT44 and BB under 3rd and 2nd phase of laying, respectively. However, the lowest value were recorded 13.54±0.83 and 11.97±0.79 mm for SassoT44 and BB under 1st phase of laying, respectively. According to the current

study yolk weight increases steadily with increasing hens age. The average mean yolk weight of SassoT44 and BB raised in the study area were reported to be 15.75±2.34 and 14.90±2.31, respectively (Table 18). The present result is in line with the result of Fanu Woldemichael et al.(2019) who reported that the mean yolk weight of SassoT44 15.99±2.0 mm in Ankober North Shewa Zone, Ethiopia. However, significantly lower than the report of Desalew Tadesse et al.(2015) and Tariku Beyene et al.(2022) who reported that the mean yolk weight 15.39±1.28 and17.32±0.38 under intensive management for BB and SassoT44 breed, respectively.

The yolk weight was affected ($P \leq 0.001$) by laying phase and breed. However, the yolk weight was not affected ($P > 0.05$) by interaction of breed by laying phase. It was significantly ($P \leq 0.05$) higher in SassoT44 breed as compared to BB breed. Similarly Hanan Khalifa and Gehan Ragheb (2023) reported that brown eggs had less yolk than white eggs. These results indicated that brown eggs might have less total lipids than white eggs which give brown eggs more advantages over white eggs. In addition, the results of this study also indicated that brown eggs might have more protein than white eggs, which is an important part of the egg and that which gives more advantage to the brown eggs

4.13.11. Yolk color

Yolk color in the current study was 8.41±0.61, 8.47±0.79, 8.35±0.60 and 8.11±0.99, 8.35±0.70, 8.41±0.61 for SassoT44 and BB under 1st phase, 2nd phase and 3rd phase of laying, respectively (Table 17). The average mean yolk color of SassoT44 and BB raised in the study area were reported to be 8.41±0.66 and 8.29±0.78 respectively (Table 18). In agreement with the present finding, Shewangizaw Wolde(2021) reported that yolk color analysis was 8.34 in SassoT44 breed. However, the result in this study was higher than the report of Desalew Tadesse et al.(2015), Yonas Kejela et al. (2019), Alem Tadesse and Teweldemedhn Gebretinsae (2021) and Hanan Khalifa and Gehan Ragheb (2013) in different breeds and in different areas.

The yolk color during laboratory analysis was ranged from (6-9) color. The lower and higher (deep in yellowish color) yolk color might be due to the difference in presence of xanthophyll (plant pigment) content of the diet consumed or not get enough , which determines the yolk color. The yolk color was not affected ($P > 0.05$) by breed, laying phase and interaction of breed by laying phase (Table 17 and 18).

4.13.12. Haugh Unit

Haugh Unit in the current study was 80.28±11.47, 79.84±7.79, 71.24±5.21 and 85.51±7.62, 79.57±9.66, 72.18±11.68 for SassoT44 and BB under 1st phase, 2nd phase and 3rd phase of laying, respectively (Table

17). The results indicate that the Haugh unit decreases towards later part of the laying phase which is in agreement with Roberts et al. (2013) the values of Haugh Units decreased with the age of hens. Haugh unit is the measure of albumin quality which determines the quality of the egg. According to Jayasen et al. (2012) high quality eggs generally have a Haugh unit of 70 or above.

The average Haugh unit values were 77.12±9.38 and79.09±11.07 for SassoT44 and BB, respectively (Table 18). The present result is in line with the result of Desalew Tadesse et al.(2015) and Serkalem Assefa et al.(2019) who reported that the mean Haugh unit of SassoT44 and BB 77.56±12.96, 78.5±8.0 and 79.26±9.90,78.6±7.4 in East Shewa and Sidama Zone, Ethiopia, respectively. However, significantly lower than the report of Yonas Kejela et al. (2019) who reported that the mean Haugh unit values of 86.50±11.07 and 94.60±7.74 for SassoT44 and BB breed, respectively in Hawassa towns of Southern Ethiopia. .

The Haugh Unit was not affected ($P > 0.05$) by laying phase and breed. However, interactions between breed and laying phase had a significant ($p \leq 0.0001$) effect.

Table 17.Effect of laying phase and interactions of laying phase by breed on internal quality of eggs (Mean±SD)

Variables	Breed	laying phase in Weeks			Significance	
		1st phase 22weeks N=100	2ndphase 33weeks N=100	3rd phase 44weeks N=100	LP	LP*Breed
Albumen weight (g)	SassoT44	29.39±2.04^{c}	31.18±1.9^{b}	35.80±1.28^{a}	***	***
	BB	31.29±1.47^{c}	37.58±4.32^{b}	38.33±2.67^{a}		
Albumen height (mm)	SassoT44	6.42±1.10^{a}	6.29±1.53^{a}	4.67±0.75^{b}	*	***
	BB	6.91±1.27^{a}	6.62±1.27^{b}	5.70±1.33^{c}		
Yolk height (mm)	SassoT44	14.92±1.33^{c}	15.26±1.13^{b}	16.07±0.83^{a}	***	0.120^{Ns}
	BB	15.12±1.22^{b}	15.62±1.03^{b}	17.07±1.33^{a}		
yolk weight (g)	SassoT44	13.54±0.83^{c}	16.62±2.5^{b}	17.10±1.45^{a}	***	0.107^{Ns}
	BB	11.97±0.79^{c}	16.18±1.1^{b}	16.53±1.06^{a}		
Haugh Unit	SassoT44	80.28±11.4	79.84±7.7	71.24±5.21		

	BB	85.51±7.62	79.57±9.6	72.18±11.68		0.295 Ns	***
Yolk color	SassoT44	8.41±0.61	8.47±0.79	8.35±0.60	.	0.685 Ns	0.615 Ns
	BB	8.11±0.99	8.35±0.70	8.41±0.61			

- [abc] Means with different letter superscript on the same row are significantly different ($p<0.05$), BB= Bovans Brown, LP=Laying Phase, Ns= Non significant ($P>0.05$), ***$P \leq 0.0001$; *$P \leq 0.05$

Table 18.Effect of breed on internal quality of eggs (Mean±SD)

Variables		Albumen weight (g)	Albumen height (mm)	Yolk height (mm)	yolk weight (g)	Haugh Unit	Yolk color
Breed	SassoT44 N=150	32.12±3.24[b]	5.80±1.40[b]	15.42±1.20[b]	15.75±2.34[a]	77.12±9.38	8.41±0.66
	BB N=150	35.73±4.37[a]	6.41±1.36[a]	15.94±1.44[a]	14.90±2.31[b]	79.09±11.07	8.29±0.78
	Overall mean N=300	33.00±4.71	6.10±1.40	15.68±1.34	15.32±2.35	78.11±10.25	8.35±0.72
	P-value	**	*	*	*	0.283[ns]	0.422[ns]

- [ab] Means with different letter superscript on the same column are significantly different ($p<0.05$) , BB= Bovans Brown, Ns= Non significant ($P>0.05$), **$P \leq 0.000$, *$P \leq 0.05$

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This study was conducted to assess the husbandry practices, productive performance and survivability of BB and SassoT44 chickens under smallholder farmers' management and evaluate their egg quality traits based on their laying phase under small-scale management**.** The result of this study revealed that the dominant chicken production systems 94.8% in the study area were the back yard extensive systems.

It was found that large numbers of Bovans Brown and SassoT44 chickens were kept by respondents in the study area. Feeding practices in the study area were mainly scavenging with occasional and seasonal supplementary feeding of homegrown grains and household food refusals with no specific poultry houses. Most of the respondents have not access to proper vaccination program and proper prevention mechanism to their chickens and there were high mortality recorded in the study area. It was also indicated that most of the respondents use traditional medicine to treat chicken. Most of the respondents cull their chickens due to low egg production, old age and feed shortage by the way of home consumption and selling in the study area. The result of the present study showed that SassoT44 chicken are well adapted to smallholder farmers conditions interims of disease resistibility, scavenging ability and was better than the BB chicken.

The most important constraints impairing the existing chicken production system under farmer's management condition in the study area were disease, shortage of feed, predators and lack of knowledge about poultry management (poor extension practice) and lack of market. Diseases problem was found to be the primary constraint of chicken production in all the study area. The most commonly happening and economically important disease in the study area was Newcastle and predators are the second major constraint next to disease. Generally in the study district poor attention was given for poultry production and management system.

The result of the present study showed that breed, laying phase and their interactions affected the egg quality traits. The internal and external quality of eggs significantly increases towards the end of the laying phase. However, the decreases in shell thickness, shell weight, albumen height and Haugh Unit towards later part of the laying phase. BB was superior to SassoT44 in most external and internal qualities except yolk weight. However, SassoT44 chicken eggs are found with better yolk weight.

5.2. Recommendations

Based on the results of the current study the following enhancement alternatives are recommended in any attempt to move away from traditional scavenging family chicken management practices.

- Poultry keepers in the study area needs appropriate intervention in disease control activities so as to reduce chicken mortality. Control of diseases, mainly Newcastle disease, could be achieved through improvement in veterinary and extension services.
- Training for farmers focusing on disease control, improved housing, feeding, and marketing systems could help to improve productivity of chicken.
- Generally effective and efficient management should be given for both SassoT44 and BB chicken to get high quality product. This study was conducted in five rural Kebeles, therefore; further research should focus on similar study by increasing the study sites in the district

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CHAPTER 7: APPENDICES

7.1 Questionnaires

Enumerator's Name_____ _____ Date _____signature_____

1. Demographic Characteristics of the Households in the Study Area

1.1. Name of Village/Peasant Association _____

1.2 Name of household head: _____

1.3 Sex of respondents: 1.Male 2.Female

1.4 Age of respondents '1. Below 20 years 2. 20-40 years 3. 41-60 Years 4. Above 60 years

1.5 Family size? 1. 1-5 people 2. 6-10 people 3. 11 and above

1.6 Level of education of the household head? 1. Illiterate 2. Read and write 3.Elementary School 4. High school 5. College and above

1.7Marital status of respondents A. Single B. Married C. Divorced D. Widowed

2. Total numbers of livestock species owned by the household and chicken flock size

2.1. Total numbers of livestock species owned by the household

No.	Types of live stock	Total Number	Number in breed type			
			Exotic		Local	Cross
1	Cattle					
2	Sheep					
3	Goat					
4	Donkey					
5	Chicken Bovans Brown and SassoT44		SassoT44	Bovans Brown	X	X
					X	X
6	Mule					
7	Horse					
8	Mo/Beehive					
9	Tran/Bee hive					
10	Trad/Bee hive					

2.2 .Bovans Brown and SassoT44 chicken flock structure/size

No	Exotic chicken	Total No
1	Chick	
2	Pullet(17-24weeks)	
3	Cockerel (<1years)	
4	Hen(>24weeks)	
5	Cock(>1years)	

3. Source and type of Bovans Brown and Sasso chickens rearing in the study areas

3.1 .Where did you get the exotic breed? 1. Purchased from Gov,t
2. Provided from agriculture research center
3. Provided from NGO's
4. Hatching of eggs naturally at home
5. Purchased from private poultry farm

3.2. Type of breeds rearing by respondents

1. Bovans Brown only
2. Sasso only
3. Both BB & Sasso
4. Other……..

4. Breeds survival

4.1. No of SassoT44 chicken received ----------No of SassoT44 survived till production----------

No of chicken dead ---------- Age when the chicken died?

4.2. No of BB chicken received--------- . No.BB survived till production----------

No of chicken dead ---------- Age when the chicken died?

5. Husbandry system

5.1. Chicken management system, housing and facilities used in the study areas

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

5.1.2 Available housing condition? 1. Share the same house with people 2.Perch 3. Separate house for chicken 4. Kitchen

5.1.3 Frequency of cleaning chicken house? 1. Daily 2.Two times a week 3.Once a week 4. Once a month

- ✓ 5.1.4 Constructed based on recommended package? 1. Yes 2.No If no in Q.3, specify the reasons_____, _____, _____

5.2. Feed and feeding

5.2.2 What are the types of feeding system? 1. Only scavenging 2.Scavenging with additional feed. If the answer is B what type(s) of additional feed do you provide? 1. Grain 2. Grain plus supplement 3. Others

5.2.2. What are the feed resources for chickens? 1. from the house 2. From purchased

5.2.3 At which season the feed shortage severe and needs extra feed? 1. Rainy season 2. Dry season .If the answer of severity is rainy season? 1. Long-rainy (Jun-Sep) 2. All season

5.2.3 How do you provide the feed? 1. by feeder 2. Throw on the ground 3. other

5.2.3 What is the frequency of providing additional feed? 1. Two times per day 2.Once per day 3. Any time

5.3. Watering Practice

5.3.1 Do you provide water for your bird? 1. Yes 2. No. If yes what is the source of water? 1. Whole water 2.River 3.Tap water 4.Pond water 4. If others (specify) _____

5.3.2 How frequent do you provide water? 1. Free access 2.Once a day 3.Twice a day4. Does not provide water

5.4. Culling practice

5.4.1 Do you practice culling of birds? 1. Yes 2. No. If yes, reasons for culling? 1. Low egg production 2. Old age 3. Sickness4. Feed shortage 5.Space problem 6. Specify (if others) _____, rank _____,

5.4.2 What is the way of culling? 1. Sell 2. Consumption

5.5. Chicken Health

5.5.1 Is there any poultry disease in your area? 1. Yes 2. No. If yes, which types of disease occur? 1. Newcastle diseases 2. Marek's Disease 3. Gumboro (infectious bursa disease) 4. Specify (if others)----------

5.5.2 Is their access to veterinary services? Yes NO,

5.5.3 If yes 1. Government veterinarian 2. Private Veterinarian 3. Shop or market 4. None 5. Others (specify)……

5.5.4 Time of disease occurrence? 1. Start of rainy season (April to June) 2. Any season 3. Dry season

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

5.5.6 Measurements taken when chickens sick? 1. Treat those using traditional methods 2. Slaughtering as soon as they are sick 3. Treat by veterinarian

5.6 What is the productive performance of Bovans Brown and Sasso chicken breed in the study area?

1. Number of eggs/hen/yr for Bovans Brown---------

2. Number of eggs/hen/yr for Sasso----

3. Age at 1st egg laying (months) for Bovans Brown----------

4. Age at 1st egg laying (months) for Sasso----

5.7. What are constraints in adoption of improved breeds? (Rank 1-5)

A. Presence of disease
B. Shortage of feed from surrounding
C. Attacks of predators (which age group is affected) _____
E. Lack of market
G. Lack of knowledge about scientific poultry management practices
H. Any other, if any_____

7.2 Appendix Figure

Figure 2. External egg quality measurement

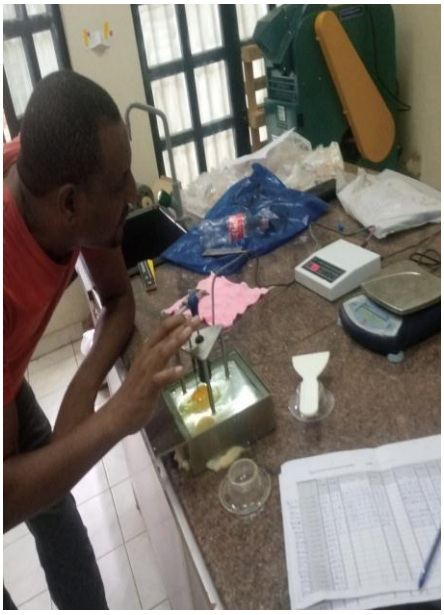

Figure 3.Internal egg quality measurement

Figure 4. Production system in the study area

Figure 5. Egg sample collection from small-scale producer