CHARACTERIZATION OF MANAGEMENT PRACTICES, PRODUCTIVE AND REPRODUCTIVE PERFORMANCES OF EXOTIC CHICKENS UNDER DIFFERENT AGRO-ECOLOGIES IN EZHA DISTRICT OF GURAGE ZONE, SOUTHERN ETHIOPIA

MSc. THESIS

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JUNE, 2022

WOLKITE, ETHIOPIA

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EXAMINORS' APPROVAL SHEET

As members of the Board of Examiners of the final Master's degree open defense, we certify that we have read and evaluated the thesis prepared by **Gizeyatu Cheru W/Senbet** under the title **"Characterization of Management practices, Productive and Reproductive performances of Exotic chickens under different agro-ecologies in Ezha district of Gurage zone, Southern Ethiopia "** and recommend that it be accepted as fulfilling the thesis requirement for the degree of **Master of Science** in **Animal Production.**

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STATEMENT OF THE AUTHOR

First, I declare and affirm that this thesis is my own work and that all sources of materials used for this thesis have been duly acknowledged. I have followed all ethical and technical principles of scholarship in the preparation, data collection, data analysis and compilation of this thesis.

This thesis is submitted in partial fulfillment of the requirements for Master of Science degree at the Wolkite University. The thesis is deposited in the Wolkite University Library and is made available to borrowers under the rules of the library. I solemnly declare that this thesis is not submitted to any other institution anywhere for the award of any academic degree, diploma, or certificate. In all other instances, however, permission must be obtained from the author of the thesis.

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BIOGRAPHICAL SKETCH

I was born to farmer family on March 21, 1978, in Gurage Zone of SNNPRS. I attended my elementary education at Yekmene Primary School and secondary and high school education at Endibir Secondary and High School. I joined the Wolaita Sodo Agricultural training centre in 2001 and graduated as an Animal health technician. After graduation, I joined Gurage zone, Mihure-Aklil Woreda cluster health center in October 2002 and served for 2 years until October 2004. Then in 2004, I joined Mizan Agricultural Technical Vocational Educational and Training College Diploma study in Animal science and completed in June 2007. Then after my graduation, I joined again Gurage zone, Mihure-Aklil Woreda Kebele development agent in September 2007 and served for nine years as an Animal health technician, development agent, cluster supervisor and PAs agriculture office head. Then, I joined Dilla University, College of Agriculture and Natural resource, Department of Animal and Range Science in 2016 for my BSc degree study completed in Animal and Range Sciences. Since after graduation, I was serving in Gurage zone Ezha woreda Livestock and Fishery resource office as Livestock nutrition and use coordinator for four years. Then, I joined Wolkite University, College of Agriculture and Natural Resource, Department of Animal Production and Technology in 2019 for my MSc study in Animal Production.

LIST OF ACRONYMS

ANOVA	Analysis of Variance
BB	Bovans Brown
BW	Bovans White
CSA	Central Statistics Agency
DZARI	Debre Zeit Agricultural Research Institute
DA	Development Agent
EDANRO	Ezha District Agriculture and Natural Resource Office
EDLFRO	Ezha District Livestock and Fishery Resource Office
FAO	Food and Agricultural Organization
FTC	Farmers Training Center
GDP	Gross Domestic Product
GLM	General Linear Model
IB	Isa Brown
Kg	Kilogram
NCD	Newcastle Disease
NGO	Non-Governmental Organization
PK	Potchefstroom Koekoek
RIR	Rode Island Red
SNNPRS	Southern Nation, Nationality and Peoples' Regional State
SPSS	Statistical Package for Social Sciences
WLH	White Leghorn

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ABSTRACT

This study was conducted to assess the management practices, productive and reproductive performances of exotic chickens under different agro-ecologies, from March 2021 to September 2021 in Ezha district of Gurage zone, Ethiopia. A total of 280 (165 from highland and 115 from midland) households were randomly selected households from six peasant associations (PAs) were used in the study to collect primary data using semi-structured questionnaires. The collected data were analyzed using SPSS version 21and mean differences were compared using Independent-Sample T Test. The result indicated that using extension package exotic chickens keeping as a parameter showed a significant difference (P<0.05) between the two agro-ecologies of the study area. The results obtained showed that the mean flock size of the study area was 10.5 chickens/household and types of exotic chicks to chicken owners showed that the majority of the respondents (80%) used Sasso breed the rest (20%) used Bovans brown. 90.4% of the respondents used separate house for their chicken from both agro-ecologies. However only 133(54.5%) of the respondent kept the chicken in a house at the time of both day and night. Regarding the feeding activities, majority 235(83.9%) was scavenging in addition to supplementary feed. Whereas, (11.1%) were homemade feed and only (4.3%) used formulated balanced diets feed. 279(99.6%) of chicken owners provide supplementary feed for their chickens and also (99.6%) of the respondents provide water to their chicken. About (68.6%) of the respondents vaccinate their chickens and (35.7%) use modern drugs to treat sick chickens. Newcastle (80.8%) vaccine is the most frequently used vaccine in the area. New castle disease (68.9%) and Fowl thiphoid, Gumboro and Foul pox disease (31.1%) were the major poultry diseases with relatively high prevalence. About (41.1%), (21.1%) and (19.3%) of the respondent reported that weasel, eagle and wild cat as major predators, respectively. (97.5%) of the respondent has market access for products. Most respondents (97.1%) get the extension service from the extension agent and (74.3%) of them get the training about chicken production. The mean egg number/ hen /year were calculated to be (224.37 and 223.44) for the highland and midland respectively. The mean age at first egg was reported to be (5.88 and 5.83) months for highland and midland hens respectively. Exotic village chicken productivity estimating parameters like eggs/hen/year, number of clutch/hen/day, market age of cock and hen, sexual maturity of hen and age at 1st egg were showed a significant difference (P<0.05) between agro-ecologies. Market weight of Sasso cock was reported to be (3.27 and 2.99) Kg and hen (3.0 and 2.88) Kg for the highland and midland respectively. There was no variation (P<0.05) between agro-ecologies. Thus, improving the overall management system such as improved feeding, recommended housing and health care extension packages could be a better strategy to increase the egg and meat production potential of exotic chickens under village management condition. The outstanding effort has been made to improve farmers raising a small number of exotic chickens to increase their chicken number under semi-intensive production system to play a role to improving chicken production and productivity.

Key words: *Agro-ecology, Exotic chicken, Extension package, Ezha, Management practices, Production and Reproduction performances.*

1. INTRODUCTION

In Ethiopia, the agricultural sector is a corner stone of the economic and social life of the people. Livestock is an integral part of the agriculture and the contribution of live animals and their products to the agricultural economy accounts for 40% of the national Gross Domestic Product (GDP) and provides more than 68% of employment, excluding the values of draught power, manure and transport of people and products (FAO, 2019). Animal production in general and chickens in particular play important socioeconomic roles in developing countries (Alders, 2004; Salam, 2005).

Poultry occupies pivotal roles in alleviating protein deficiency by providing eggs and meat which are important sources of edible animal protein (FAO, 2010). The CSA (2021) report revealed that the total chicken population is estimated at 57 million, from which 78.85% indigenous, 12.02% hybrid and 9.11% exotic breeds. However, the economic contribution of the sector is not proportional to the huge chicken numbers, attributed to the presence of many productions, reproduction and infrastructural constraints (Aberra, 2000). Haftu (2016) reported that exotic breed and cross breed chicken can produce an adequate number of eggs in the presence of an adequate amount of feed.

The poultry sector in Ethiopia can be characterized into three major production systems based on breed, flock size, housing, feed, health, technology and bio-security; these are large-scale, small-scale, and scavenging or backyard poultry production systems. The classification is based on some selected parameters such as breed, flock size, housing, feeding, health, technology, and bio-security (Nebiyu, 2016). Each can sustainably coexist and contribute to solve the socio-economic problems of different target societies (Tadelle *et al*., 2003). The traditional backyard systems are characterized by mainly low-input and small-scale with 4-10 mature birds per household, reared in the backyards with inadequate housing, feeding and health care. Scavenging is the most important component of the poultry diet in village production system (Fisseha *et al*., 2010; Meseret, 2010).

The poultry sector is characterized by its industrialization, faster growth in consumption and trade than any other major agricultural sectors in the world. Worldwide, industrial systems now account for approximately two-thirds of egg and poultry meat production (Dolberg, 2007).

Improved exotic chickens produce a higher number of eggs and more meat than the indigenous chicken breeds, but the tropical climate is a great challenge in many environmental factors like feeding shortage, poor management practice, predator attack, and high disease prevalence (Tarekegn, 2015). In Ethiopia chickens are the most widespread and almost every rural family owns chickens, which provide a valuable source of family protein and income (Tadelle *et al.*, 2003). Reproduction is one of the most important aspects of poultry breeding (Abou-Elewa and Abdou, 2017) and it is characterized by parameters, such as, age at sexual maturity, fertility, hatchability, clutch size and clutch length (Addisu, 2013). Among reproduction traits, sexual maturity is paramount in terms of progress in poultry breeding (Chiemela *et al*., 2018). In addition, poultry breeders must consider total egg production rate as key traits in egg stocks (Schmidt and Figueiredo, 2005).

According to Ministry of Agriculture (MoA, 1997), in Ethiopia, like many African countries, attempts have been made at various times to improve local chicken production through introduction of exotic chicken breeds. Distribution of pullets, cockerels, day old chicks and fertile eggs, layers and duals breeds, has been one of the poultry extension packages accomplished by the Regional Office of Agriculture, since the last 20 years, aiming at improving chicken production and productivity. The productivity of the Ethiopian indigenous chickens is very low. With the aim of improving poultry productivity, different breeds of exotic chickens *i.e*., Rhode Island Red, Australoup, New Hampshire and White Leghorns is imported to Ethiopia since the 1950's. Since then higher learning institutions, research organizations, the Ministry of Agriculture and Non-Governmental Organizations (NGO"s) have disseminated many exotic breeds of chicken to rural farmers and urban-based small-scale poultry producers (Solomon, 2008).

Similar to other parts of the country, recently, layer and dual-purpose hybrid chicken are being distributed to the farmers of Gurage zone in SNNPRS sourced from Ethio Chicken, other government and non-governmental organizations. Despite this huge distribution of exotic chicken breeds, the contribution of improved chicken breeds in the current production system of the region is very low. A study by Tekelewold *et al*., (2006), on the adoption of poultry technology in the highlands of Ethiopia (East shewa and Welayta) indicated that adoption has been limited by a set of factors such as lack of knowledge on chicken husbandry (feeding, housing, health care, etc), lack of complimentary inputs (feed, alternative breeds, etc), lack of

strong extension follow up, high disease prevalence and predation, unavailability of credit services and market problems.

The Livestock and Fishery Resources office has also been distributing many exotic chickens, mainly Sasso and Bovans brown. Ezha district of Gurage zone is one of the districts of the zone where these exotic chicken breeds is distributed and located. The study district is favorable climate for chicken production that makes the country to have a substantial potential for chicken production development by increasing the income of chicken producers and creating employment and transforming the existing extensive chicken production system to semi-intensive production system. However, the problems associated in exotic chicken production undertaken especially in the management practices, and their gaps does not studies the impact of productive and reproductive performances of exotic chickens under different agro-ecologies of the district have not been systematically assessed and documented. Therefore, this study has designed to contribute to filling the gap and set the following general and specific objectives.

1.1. Objectives

1.1.1. General objective

To characterize the management practices, productive and reproductive performances of exotic chickens under different agro-ecologies of Ezha district, Gurage zone, Southern Ethiopia.

1.1.2. Specific objectives

- To characterize management practices of exotic chickens under different agro-ecologies in Ezha district
- Monitoring evaluation of production performances of exotic chickens under different agro-ecologies in Ezha district
- Monitoring evaluation of reproduction performances of exotic chickens under different agro-ecologies in the study district

1.2. Research Questions

The study tries to answer the following major guiding questions:

- What are the management practices of exotic chickens in Ezha district?
- What are the production performances of exotic chickens in different agro-ecologies in Ezha district?
- What are the reproduction performances of exotic chickens in different agro-ecologies in Ezha district?

2. LITERATURE REVIEW

2.1. Poultry Production

Poultry are kept in most areas of the world and provide an acceptable form of animal protein (meat and egg) to most people throughout the world. They provide a source of high-quality protein and a source of income. The poultry sector supports the livelihoods and food security of millions of people. Currently the demand for poultry meat and eggs has increased, due to population growth, increased income and urbanization, (FAO, 2011). Poultry production is an important economic activity in Ethiopia. It plays a significant role in family nutrition beside its social and cultural benefits. According to Fisseha *et al.* (2010) also reported that provision of animal protein, generation of extra cash incomes and religious/cultural considerations are amongst the major reasons for keeping village chickens by rural communities. According to the CSA (2021), the total poultry population in Ethiopia was estimated to be about 57 million.

The word poultry include all domestic birds kept for the purpose of human food production such as chickens, turkeys, ducks, geese, ostriches, guinea fowls, doves and pigeons. However, in Ethiopia, except chickens, all the others are found in their natural habitat. Thus, the word poultry is synonymous with chickens under the present Ethiopian condition (Matawork, 2016). In Ethiopia, Poultry (chicken) production plays a significant role in the supply of human food (eggs and meat) in rural and urban area and as a source of income, especially to small holder farmers. The role of poultry in Ethiopia became very important over time (Alemu *et al.*, 2006).

2.2. Chicken Production Systems in Ethiopia

Chicken production systems in Ethiopia show a clear distinction between traditional, low input systems and modern production systems using relatively advanced technology. There is also a third upcoming "small scale" intensive system with small number of birds (from 50 to 500) as an urban and peri-urban household income source using exotic birds and relatively improved feeding, housing and health care (Alemu and Tadella, 1997).

Scavenging chicken is the predominant system in Ethiopia and accounts for nearly 98% of the chicken population (CSA, 2013). The breeds are mostly indigenous chickens and although some hybrids and exotic breeds (< 50 birds) may be kept under this system and managed by individual farm household management with minimum labor inputs (Dawit *et al.*, 2008). When birds are kept under a scavenging system; little or no inputs for housing, feeding or health care

are provided. The system is not business oriented and is rather intended to satisfy the various needs of farm households (Tadelle *et al.,* 2000).

The country has diverse agro-climatic conditions favoring production of many different kinds of crops, providing a wide range of ingredients and alternative feedstuffs suitable for poultry feeding. Making use of these resources to complement the scavenging resource base promises a considerable potential for success (Dessie and Ogle, 2001).

Chicken can be reared in different management and production systems. In Ethiopia there are three types of chicken production systems. These are the traditional/scavenging chicken production system; small-scale market-oriented chicken production system and large-scale chicken production system. The classification is based on some selected parameters such as breed, flock size, housing, feeding, health, technology, and bio-security (Yenesew *et al.,* 2015; Emebet and Kidane, 2016; Nebiyu, 2016).

Table 1. Characteristics of Ethiopian chicken production systems

Characteristic	**Intensive commercial**	**Small scale market oriented**	**Traditional**
Breed and flock Size	Specialized breeds: 2,500–50,000 (18 farms)	Specialized and dual-purpose breeds: 50–1,000	Local indigenous type: <50
Housing	Modern housing, generally with concrete walls and regulated internal environment	Varies from modern houses to simple housing made from locally available materials	Specific poultry houses are rare
Feed resource	Commercially compounded feeds	Commercially compounded, homemade mixtures and scavenging	Scavenging and occasional feeding with home grains and refuse
Health Programmer	Standard and regular animal health program	Disease control and health program at varying levels	No regular health program of disease control measures

Markets	Cold chain system for input-output distribution	Input and output distribution is based on existing trading centers	No formal marketing channels

Source: FAO, 2007

2.2.1. Scavenging or traditional chicken production system

The village chicken production systems in the country are characterized by their smaller flock size, nil or minimal inputs, low outputs and periodic devastation of the flocks by disease outbreaks. Birds are owned by individual households and are maintained under a scavenging system, with little or no inputs for housing, feeding or health care (Tadelle and Ogle, 2001). The husbandry of this system is often poor and is characterized by flocks of multi-age groups kept together with other chicken breeds (exotic hybrids) and animal types. Research suggests that the application of improved husbandry practices and improved basic resources such as better chicken selection, improved housing, availability of feeds and feeding, improved health management and predator control could improve production and productivity (Habte *et al.,* 2017).

Scavenging chicken (backyard or village-level poultry) in Ethiopia is characterized by having low feed input (primarily scavenging), low veterinary services and no investment in housing and hence minimal level of biosecurity (Dawit *et al.,* 2008). Village chickens are kept under free ranging systems, where the main source of their feed is obtained through scavenging: such as insects, worms, seeds and plant materials, with very small amounts of grain crop and table leftover supplements from the household (Gueye, 2003). The amount given is small and do not fulfill their nutrient requirement. Because of this, their productivity is low. Indigenous poultry breed in this system of production does not produce more than 60 eggs per hen per year (Addisu *et al.,* 2013).

2.2.2. Small-scale poultry production system

The small-scale intensive poultry is newly emerging system in urban and peri-urban areas, where either broilers or egg type exotic breeds of chickens are produced along commercial lines using relatively modern management methods (Solomon, 2008). Most of these farms obtain their feeds and foundation stocks from the large-scale commercial poultry farms and involved in the supply of table eggs and broilers to various supermarkets, kiosks and hotels through middlemen (Nzietchueng, 2008). The small-scale intensive production system is

characterized by medium level of feed, water and veterinary service inputs and minimal to low bio-security Small scale flock sizes usually ranging from 50 to 500 exotic breeds kept for operating on a more commercial basis are common in the urban and per-urban areas of Addis Ababa (Adugna, 2020).

2.2.3. Large-scale poultry production system

The large-scale commercial production system is highly intensive production system involves an average of greater or equal to 10, 000 birds kept under indoor conditions with a medium to high bio-security level. This system heavily depends on imported exotic breeds that require intensive inputs such as feed, housing, health and modern management systems (Bush, 2006). Large scale poultry producers mostly make their own feed (Lawrence *et al.,* 2015). The large-scale commercial poultry provide fertile eggs, table eggs, day old chicks, broiler meat and adult breeding stocks to the small-scale modern poultry farms They are kept as full-time business and highly dependent on market for inputs. The general indications are that the intensive poultry industry plays a key role in supplying poultry meat and eggs to urban markets at a competitive price (Getinet, 2007).

2.3. Distribution of Exotic Breeds in Ethiopia and Study area

The word poultry is synonymous with chicken's production under the current Ethiopian condition. It is widely believed that the importation of the first batch of exotic poultry was probably done by missionaries. Four breeds of exotic chicken (Rhode Island Red, Australia, New Hampshire and White Leghorns) were imported to Jimma and Alemaya in 1953 and 1956, respectively under USAID project (Solomon, 2007).The activities of those institutions focused on the introduction of exotic breeds of chickens into the country for distribution to the farming population along with management i.e. feeding, housing and health care practices (Tadelle, 2001). And yet, the traditional practices continue to dominate the Ethiopian poultry production with minor shift to industrial type modern poultry production (FAO, 2008). Further breeds of chicken introduced include, Rhode Island Red (American dual-purpose breed), New Hampshire (American breed), Australoup (English breed), White Leghorn (Italian egg type breed), Brown Leghorn (Italian egg type breed), Sussex (English), Egyptian breed (Fayoumi), Commercial breeds (Isa Brown), Bovan Brown and SassoT44 (Ararsa and Chala, 2020).

The current extension package in Ezha districts was based on the distribution of exotic dual-purpose chicken Sasso and Bovans Brown (BB) layer chicken from large scale private farms (mainly Ethio-Chicken) and other commercial poultry farms located primarily on Bishoftu

town. The purpose of supplying these exotic chickens was mainly to increase egg production under improved village management systems (EDLFRO, 2020).

In the Ezha district of Garage Zone, development agents (DAs) are adopting a different approach to a contract growing of chicken from day old to forty-five days of age. Development agents collect money from interested youth and farmers to cover the expenses for the purchase of day-old chicks, feed, and vaccination until they reach pullet age for forty-five days at the main district town, Agena and PAs. The purpose of this approach is to provide vaccination for major diseases, decrease chick mortality, and provide an adaptation period before distribution to households. During the forty-five days, birds are vaccinated for Newcastle, Gumboro, Marks disease and fowl pox. The supply of day-old chicks/pullet chain continues based on the interest of farmers every year to replace aged layers (EDLFRO, 2020).

2.4. Management Practices of Village Chicken Production in Ethiopia

Most of the caretaking practices of both chicken husbandry practices are similar, including off-take decisions were being undertaken by women, followed by children of the households in Ethiopia. Poultry keeping practiced by rural households using family labor is referred to as village poultry keeping (Moges and Dessie, 2010). Village chickens are generally hardy, adaptive to rural environments survive on little inputs and adjust to fluctuations in feed availability (Moreda, 2015).

Traditional production practices are well adapted to the tropics, resistant to poor management, feed shortages, tolerate to diseases and provide better test of meat and eggs than exotic chickens (Halima, 2007). There is no well-developed breeding practice in chicken production in Ethiopia (Negussie, 1999). The other practice was the use of improved exotic breeds were usually planned without participation of farmers, with no parallel improvement of feeding, housing and health care and typically lasts for short time (Bogale, 2008).

2.4.1. Feeds and feeding system

Poultry production in Africa mainly depends on scavenging and generally, no supplements deliver except that sometimes. Similarly, in Ethiopia chicken production is characterized by keeping under the free-range system with some amount of supplementary feeds like frushika, maize, sorghum, food leftover and the major feed sources are believed to be insect worms, seed and plant materials (Kebede *et al.*, 2012) the availability of the supplementary feeds was reported during the dry season (November to March) following the grain harvest while the

grains/grain by-products were in short supply leading to feeding scarcity during the rainy reason (Habte *et al.,* 2017). Poultry diets are formulated from a mixture of ingredients, including cereal grains, cereal by-products, fats, plant protein sources, animal byproducts, vitamin and mineral supplements, crystalline amino acids and feed additives. These are assembled on a least-cost basis, taking into consideration their nutrient contents as well as their unit prices (Ravindran, 2012).

Ethiopia produces a wide range of ingredients suitable for poultry feeding. It is a country where practically all crop types can be grown somewhere, providing the opportunity for a wide variety of alternative feedstuffs. Varieties of grain and protein sources are available. But this does not mean that poultry feeds are available everywhere in sufficient quality and quantity; rather Ethiopia faces substantial problems in terms of feed shortages for poultry production (Habte *et al.,* 2017).

In the village production system, chickens almost entirely depend on the scavenging for feed, making it difficult to estimate the amount of consumption and utilization. However, chicken crop content analysis indicates that the feed is often deficient in protein, energy and calcium (for shell production in layer birds) (Tadelle and Ogle, 2000). Sekeroglu *et al.* (2008) has also indicated that feed from warmer climates (lowlands) usually have low protein with higher crude fiber contents when compared to the feed obtained from the midlands. Chickens are not able to utilize feed with high crude fiber, which in turn can influence their growth and egg production potentials.

According to Wondu *et al. (*2013) in Northern Gondar indicated that, chickens obtained their major feed resources through scavenging with little supplementary feed provision. Tadesse *et al.* (2013) reported that the dominant system of poultry feeding practiced was free scavenging with supplementary feeding and (94%) of respondents provided maize and wheat as additional supplements three times a day in both Ada'a and Lume districts of East Shewa. Additional feed supplementation to chicken was practiced by (97.5%) of respondents in Bure district of North West Ethiopia (Moges and Dessie, 2010) and (98%) of respondents in Jamma district of South Wollo (Mengesha and Tsega, 2011). Meseret (2010) reported that 50%, 25% and 25% of respondents offered supplementary green materials, homemade and scavenging on top of purchased commercial poultry ration to their chickens, respectively, in Jimma zone.

Water plays an important role for feed digestion and metabolic activity of chickens. According

to Derbie and Mebratu (2020) in Amaro woreda SNNPRS, and Mekonnen *et al.* (2017) in Assosa Town, Beneshangul Gumuze Region, all respondents provided water *adilbitum*. According to Zekarias and Abera (2017) in Boloso Sore Woreda, Wolaita Zone, Southern Ethiopia, majority (79.5%) of the respondents do not provide water to their chicken on free of access. Therefore, chickens are forced to search water by themselves from the available source while only (7.75%) and (12.75%) of the respondents supply water to their chicken twice and once a day respectively.

2.4.2. Housing system

Housing is essential to chickens as it protects them against predators, theft, inclement weather (rain, sun, cold wind, dropping night temperatures) and shelter for egg laying (Salo *et al.,* 2016). However, accommodating too many chickens in a small area negatively affects health and growth and exacerbates the development of parasites, such as red mites, worms, lice and fleas. Hence, it is essential to accommodate the appropriate number and type of chicken in a house (Habte *et al.,* 2017). According to Lemlem and Tesfaye (2010) indicated that small flock size per household, lack of construction materials, lack of knowledge and shortage of labor and time are some of the reasons for not constructing a separate house for their chicken.
According to Derbie and Mebrate (2020) majority of the household used separate house for exotic chicken production, the houses were not constructed considering the space requirement per a chicken and not hygienic. Moreover, it was observed that the houses lack some internal facilities like egg laying nests and feeders. This indicates a huge knowledge gap among the producers about the modern chicken production and it needs a due attention by concerned bodies to create awareness (Mekonnen *et al.,* 2017).

In survey conducted in Ada'a and Lume districts of East Shewa by Tadesse et al. (2013) revealed that (91.11%) in Ada'a and (95.6%) of respondents in Lume districts, constructed a separate house entirely for poultry, whereas (4.44%) of respondents constructed Separate house with other animals in Ada'a, (4.44%) in Ada'a and (4%) of respondents in Lume districts share the same house with people. Similarly, Fisseha et al. (2010) reported that (22.1%, 59.7% and 97.6%) of village chicken owners construct separate overnight shelter for chickens in Bure, Fogera and Dale districts of Ethiopia, respectively while the rest chicken owners keep chicken in various night sheltering places.

2.4.3. Major chicken diseases

A disease can be spread in various ways: infection from animal to animal, infection from the environment, people can spread disease by clothes or air, all sorts of materials can spread disease and others (Nigist and Haben, 2020). The innumerable diseases that can affect a chicken can be divided into three categories: Those prevented by locally recommended vaccines (such as Newcastle), those prevented by or treated automatically in a good management schedule (such as coccidiosis), and those for which good sanitation and nutrition are the best means of prevention (such as cholera or coryza) (Dessie *et al.*, 2013).

According to Hunduma *et al.* (2010) reported that, diseases, lack of proper health care, poor feeding and poor marketing information were the critical constraints of village poultry production in Oromia Rift Valley of Ethiopia. Replacement of indigenous chickens by exotic chicken breeds is also found to be a major threat in eroding and dilution of the indigenous genetic resources and New castle disease is the major economically important health constraint that hinders the expansion of village chicken production in the study area. Infectious diseases, such as Newcastle disease, salmonellosis, fowl cholera, coccidiosis and fowl pox, are the major causes of morbidity and mortality in village poultry. Vaccine packaging in large (up to 1,000) multi-dose vials that are not cost-effective for small producers, and a lack of veterinary service or an organized village level delivery system are major barriers to implementing vaccination for economically important poultry diseases in village chickens (Habte *et al.*, 2017).

Scavenging chicken production system is characterized by high chick mortality in the first two weeks of life, caused by predators and Newcastle disease (Aberra and Tegene, 2011). Addisu *et al.* (2013) reported that NCD locally called fengile were the most prevalent and economically important disease affecting village chicken production in north Wollo.

The survey result by Mekonnen (2017) reported that, (47.1%) of the respondents treated only when chicken get sick. (35.5%) of all respondents treated both sick and healthy chicken and the remaining (17.6%) didn't face and treat disease. For (64.7%) of the respondent's treatment of exotic chicken was done by animal health professionals, (23.5%) of the respondents treat their exotic chicken by themselves. and (11.8%) no disease.

2.4.4. Major Chicken Predators

According to Habte *et al.* (2017), in guide to chicken management in Ethiopia, Predators are among the major constraints that cause chicken deaths, especially in the village production system. Snakes, rats, dogs, cats and foxes are the main predators that cause losses of younger

birds. Wild birds (eagles, hawks, etc.) during the dry season and wild cats (locally known as shelemetmat) during the rainy season are the most dangerous predators that attack older chickens.

According to (Mekonnen (2017) report, cat for (41.2%) of the respondents as well as dog and snack for (2.9%) of the respondents were predators that most commonly occur and attack chicken in the study area. According to Aberra (2007), about (46%) of the respondents in Southern Ethiopia reported, that wild birds (eagle, hawk, etc.) are the most common predators during the dry season, while wild cat (locally known as "Shelemetmat") is the most dangerous predator during the rainy season.

2.5. Training and extension services

A good extension approach and tailor-based training are the two most valuable inputs to improving Ethiopia's poultry production and productivity. To bring improvements to the system, these activities must be given by professionals and continuous assessment and improvement has to be in place. The extension approach should include a demonstration of good experiences/practices performed by farmers. In order to disseminate such good technologies to a given community, development agents (DAs) should carry out continuous follow-up and technical backup (Habte *et al.*, 2017).

Most of the interviewed chicken owner farmers (82.5%) responded that their major source of information for improved chicken production are DA's or livestock experts at Farmers Training Centers (FTC's) and at the meetings are reported by Eyob (2019) in Silte, Dalocha and Wulbareg Woreda, Silt'e Zone. According to Mekonnen (2017) reported that (61.8%) the respondents were accessible to extension service, and around (38.2%) the respondent didn't get any service. So, due to lack of extension service the production performance of exotic chicken was low and it became difficult to improve the performance of exotic chicken breeds in the Assosa town, Ethiopia.

According to the resent study, most of the chicken owners had access to extension services; but some are no access to extension services. Institutional supports like training, extension, and veterinary services were provided by the Sub-city urban agricultural offices, and credit services were also provided by the microfinance of the Sub-city. Most of the households received the training at the time of starting the poultry farming. All of the poultry farmers got commercial poultry rearing training before starting the business (Nebiyu *et al.*, 2013).

2.6. Marketing practices of poultry products

Poultry is kept mainly to produce eggs and meat for home consumption, to provide a surplus for sale and for use in ceremonies and to provide feasts for guests (Wilson, 2015). The current poultry and poultry product market is characterized by lack of information which favors relatively high profit for the intermidiataries. The share of the intermidiataries could be reduced through improving access to information. Better infrastructure and organization of the poultry producers. However, cost of transportation, credit and market risk should be carefully assessed (Akililu et al., 2007). In most parts of the country, prices fall to their lowest annual level until the end of August. Prices rise for the Ethiopian New Year and for the epiphany Festival (Solomon, 2007; Alemayehu, 2017).

Poultry products in most developing countries, especially in Africa, are still expensive. The marketing system is generally informal and poorly developed. Unlike eggs and meat from commercial hybrid birds (derived from imported stock), local consumers generally prefer those from indigenous stocks. As most consumers with greater purchasing power live in and around cities, intensification of poultry production should be initiated in peri-urban areas or, at least, in areas having a good road network (Branckaert *et al.,* 2000).

The birds usually sold from the village flock are surplus males (cockerels and cocks); pullets and non-productive hens; large sized birds; old hens and sick birds. Growing chicken are sold just before the onset of the high-risk Newcastle Disease. The main actors in egg marketing are producers, collectors, traders or (wholesalers), local kiosk, shops and supermarkets (Byarugaba, 2007). Higher product price was recorded in secondary market both in chicken and egg. The prices of products were almost double when compared between farm gate and secondary market. Even if the price of chicken is higher at all festive periods, the price of chicken became double at Ethiopian New year compared to any another festive periods of the year (Tilahun and Mitiku, 2019).

2.7. Production Performances of Exotic Chickens

Dual-purpose chicken breeds aim at uniting both, eggs and meat i.e., the hens lay eggs and the cockerels produce meat, but it may require a compromise from both sides because laying more eggs is negatively correlated with gaining more meat (Lohmann, 2016). These efforts aim also to address the current intensive ethical discussion of the practice of culling the day-old male brothers of the egg-type females. One solution to avoid this practice could be using dual-

purpose production, where males are reared for meat and females used for egg production (Kreuzer *et al.,* 2018). According to Matawork (2016) revealed that, traditional practices continue to dominate domestic poultry production in Ethiopia.

2.7.1. Egg production performance

Egg production is characterized by the number of eggs in a clutch and the period between clutches, where oviposition fails to occur because of pause, resulting in missing eggs between clutches (Sakunthaladevi *et al.,* 2011). Chicken breeders must consider total egg production rate as key trait in egg stocks (Schmidt and Figueiredo, 2005). Conversely, the total egg production of a flock of hens is determined by the individual patterns of sequential laying, a number of clutches and size (Johnston and Gous, 2003).

Egg production performance of three chicken breeds which is local, crossbreed and exotic chickens in Ethiopia were different (CSA, 2017). The egg production performance of Sasso chickens is superior to the egg production performance of indigenous chicken under improved management system Aman et al. (2017) results in the three agro-ecologies of SNNP.

2.7.2. Market/Slaughter age and weight of exotic chickens

Lower age at slaughter has its own economic importance as such birds are expected to consume less feed and the business turnover is faster thereby lowering the overall risk (Wright *et al.,* 2012). The differences in slaughter age might be described to the genetic makeup of the chickens. While the native chickens have been selected for their adaptive traits compromising the productive parameters, the reverse was true for the exotic chickens (Aman *et al.,* 2017).

The average slaughter age of the chickens varied across the genotypes with the slaughter age of the native chickens being higher when compared to the exotic ecotypes. The findings also indicated that the Sasso chickens had a higher growth rate and the slaughter age was the lowest when compared to the other ecotypes (Kejela, 2020).

2.7.3. Clutch size and length

Laying sequence or clutch is defined as the number of eggs laid on consecutive days and separated from another by one or more pause days (Tumova *et al.,* 2017). Despite their breed, the overall number of clutch sizes observed in different parts of the country under Smallholders' is various and it ranges between (2.7 and 4.3) per year. The observed differences among countries with respect to number of clutches per year might be related to the practices

taken by the farmers to break broodiness (Mersha and Senbeta, 2020). The number of eggs laid per clutch in Ethiopia is ranged from (10.10 to 21.0) (Nebiyu *et al*., 2013).

2.8. Reproduction Performances of Exotic Chickens

Reproduction is one of the most important aspects of poultry breeding (Abou-Elewa and Abdou, 2017) and it is characterized by parameters, such as, age at sexual maturity, fertility, hatchability, clutch size and clutch length (Addisu, 2013). Among reproduction traits, sexual maturity is paramount in terms of progress in poultry breeding (Chiemela *et al.,* 2018). According to Ararsa and Chala (2020), exotic chicken breeds have better reproductive and productive performance than the local indigenous chicken breed.

2.8.1. Age at sexual maturity

Age at sexual maturity refers to age at which the reproductive system achieves its complete development and it has long been considered as an important factor that determines fecundity trait and affects subsequent performance (Forment *et al.,* 2009) In spite of genetic variation, the average age at sexual maturity reported in different parts of the country was different and it ranges from (19.6 to 26.8) weeks for male chickens and (19.7 to 34.05) weeks for female chickens. This variation in age at sexual maturity may be due to the variation in environmental factors (temperature and nutrition) in different parts of the country (Sisay and Ewonetu, 2020). This is supported by Guni *et al.* (2013), who observed variation both between and within districts regarding age at first egg, which is attributable to the genetic ecotype and non-genetic factors.

Body weight at maturity is an important trait which is indicative of the genotype environmental interaction as chickens with optimal mature weight are those which have adapted to the specific environment (Mube *et al.,* 2014). Optimal weight at maturity if reached at an early age ensures that the managerial costs are low and hence adds on to the profit of the venture (Wright *et al.,* 2012). According to Padhi (2016) reported the slaughtering age is correlated with growth which in turn is influenced by the feed availability besides other environmental factors. Hence holistic improvement of the non-genetic factors can help lower the age at slaughter of both the native and exotic genotypes.

Sexual maturity of male chicken implies the age of start of service. Sexual maturity and body weight determine the acceptance of service for the first time. The body weight of male Sasso chicken at sexual maturity was (2.98 ± 0.70 kg) and the weight of female chicken of the same

breed at the age of greater than 20 weeks was (2.73±0.53 kg) in the four woredas (Sodozuria and Boloso sore from Wolayita zone; Angecha and Hadarotunto from Kambatatambaro zone) (Aman *et al.,* 2017). Desalew (2012) reported the adult female body weights of (1.54 kg, 1.55 kg and 1.64 kg) for Isa Brown, Bovans Brown and Potchefstroom Koekoek chicken groups, respectively which were lower than the adult female body weights of Sasso. Moreover Dirsha (2009) reported the body weight of male RIR chicken at sexual maturity was (2.3 ± 0.18 kg) and the weight of female chicken of the same breed at the age of 20 weeks was (1.78 ± 0.21 kg) which was lower than (2.73±0.53 kg) Production System in SNNPR, Ethiopia (Aman *et al.,* 2017).

2.8.2. Age at first egg laying

Age at first egg is the time between the date of hatch and the first egg laid. The average age at first lay for the Sasso chickens in the four woredas (Sodo zuria and Boloso sore from Wolayita zone; Angecha and Hadarotunto from Kambatatambaro zone) was 4.76±0.85 months where as that of local chickens were (6.22±1.26) months. The result indicated that Sasso chicken breeds reach an age of egg production earlier than local breeds which is attributed to breed type differences (Aman *et al.,* 2017). Who revealed that the average egg production per month of Bovans Brown (22.2) is higher than that of Sasso (16.2) and local chickens (12.6). Desalew (2012) reported (5.35 ± 0.45, 5.52 ± 0.44 and 5.11± 0.2) months for Isa Brown, Bovans Brown and Potchefstroom Koekoek respectively under village production system in East Shoa and Dirsha (2009) reported (6.34 ± 0.46) months for RIR in cheha woreda, Ethiopia.

The average age at first egg of all exotic chickens was significantly lower than local chickens under both agro-ecologies. Sasso and Koekoek chicken breeds reared in lowland produced significantly higher number of egg per hen per year as compared with other chicken breeds (Serkalem *et al.,* 2019). On-farm studies conducted at Horro and Ada districts showed that Bovan Brown commercial chicken produced (202.5) and (183.6) eggs per year per hen, respectively (Wondmeneh, 2015).

2.8.3. Hatchability percentage

Many scientific scholars reported different hatchability performance for different chickens breeds in different parts of the country and it ranges between (59.6 and 93.2%) for indigenous chickens whereas for the crossbreed it varies from (54.7 to 78.7%). However, the hatchability percentages of eggs for exotic breeds are far lower than the indigenous and crossbreed chickens

(Mersha and Senbeta, 2020). Hatchability is said to be environmentally influenced. Hatchability is major parameters of reproductive performance which are most sensitive to environmental and genetic influences (Ajayi and Agaviezor, 2016).

The hatchability of exotic and their crosses was relatively lower than the indigenous chickens' pure line. Moreover, several factors have been examined to affect hatchability and, among others, they include season of lay, disease, nutrition, age, egg quality, genetic factors, and hygiene and incubation conditions (Nebiyu *et al.*, 2013).

2.8.4. Mortality and survival rate

Indigenous chickens are known by their desirable characteristics such as resistance to diseases and adaptation to their environment. The crossbreed (9-40%) chickens are relatively better in survival rate than indigenous (25.3-61.15) and exotic breed (18.83-53%). This might be due to resistance development in crossbreed chickens than the pure breed (Nebiyu *et al.*, 2013). The major causes of chicken losses in village chicken production were mortality due to disease, predator and nutritional stress (Ararsa and Chala, 2020).

3. MATERIALS ANDMETHODS

3.1. Description of the Study Area

Gurage Zone is found in Ethiopia's Southern Nations, Nationalities and Peoples Regional State (SNNPRS). It is located between 370 28' and 380 38' longitude east and 70 28' and 8027' latitude, covering an area of about 5,932 square kilometers or 593,200ha. The zone is one of the most densely populated areas in the country, with an average of 273.5 people/km^2 mainly concentrated in '*Dega'* (high land) and '*Weyna-Dega*' (midland) areas. Four agro-ecological zones of *Wirch* (4.1%), *Dega* (27.5%), *Weina-Dega* (65.3%) and *Kola* (3.1%) are the characteristics of the zone. Annual rainfall of the zone ranges between 801mm and 1400mm document from the Department of Finance and Economy Development of Gurage Zone (DFEDGZ, 2015). According to CSA (2021) report a total livestock population of 3,611,159 is found in the zone, of which 1,058,674 cattle, 360,291 sheep, 139,061 goats, 542,195 chickens, 46,891 horse, 3,942 mule and 12,421 donkeys.

The study was conducted in Gurage zone, Ezha district where mixed crop-livestock production system is found to be the feature of farming system. The district is bordered with Cheha district to the South, on the West by Abeshge district, on the North by Mihure-Aklil district and on the East by Gumer district and Silte zone. The district constitutes 31 PAs (the lowest administrative unit) of which 28 are rural and 3 rural town PAs. The capital of Ezha named Agena is located at 42 km to the East of capital of Gurage Zone, Wolkite. Agena is also located at a distance of 197 km from the capital of Ethiopia, Addis Ababa to the southwest; and 475 kilometers from the capital of SNNPRS, Hawassa in the northwest direction. Ezha district is almost equally crossed by asphalt road which extends from Wolkite to Butajira according to document of Ezha district Administrative office (EDAO, 2020).

According to document of Ezha district Agriculture and Natural Resource Office (EDANRO, 2019), the district covers 59,091 ha of land and out of which the crop production of the district is 31,517 ha (9,554 ha annual and 21,963 ha perennial crop land), for livestock grazing 6,726 ha, for forest 7,903 ha, and degraded land was 2,200 ha and the remaining 3,061 ha of land is occupied by church, mosques and other social services giving institutions. The district consists of two agro-ecological zones (midland and high land). The midland (Weynadega) accounts

46.4% whereas the highland (Dega) accounts 53.6% of land coverage of the study district. The geographical location of the district ranges from 1950 to 3100 masl and the annual rainfall ranges from 900mm-1200mm. The mean annual temperature is 20.5 ^{0}C and it ranges from 16.5 ^{0}C to 25 ^{0}C. The district's total human populations were 127,374 of whom 66,883 are males and 60,491 are females. From the total population 4.99% are urban and 95.01% are rural dwellers. The total numbers of households found in the district are estimated to be about 20,997, of which 17,630 are males and 3,367 females' households Ezha District Finance and Economic Development Office (EDFEDO, 2019).

According to the data obtained from Ezha district Livestock and Fishery Resource Office (EDLFRO), livestock are considered as an important component of the prevailing crop-livestock mixed farming systems of the study district. Smallholder farmers of the study area owned various livestock species such as; cattle, sheep, goat, chicken and equines. According to Finance and Economy Development Office of Gurage zone, the study district is reported to have a total population of 97,338 cattle, 56,670 sheep, 14,267 goats, 11,426 horses, 850 mules, 5,900 donkey and 71,165 chickens (DOFEDGZ, 2015). According to the data obtained from Ezha District Livestock and Fishery Resource Office (EDLFRO, 2020) about 74,896 chickens are found, of which 45.5% are indigenous and 54.5% exotic breeds. Crop production is highly related to village chicken production of the study district, with high seasonal fluctuation of feeds availability, high prevalence of disease and other production and marketing constraints according to document of Livestock and Fishery resource Development of Ezha district. The major crops cultivated in the district are Enset, chat, coffee, fruits, potato, teff, wheat, barley, maize, pea, bean, vegetables and timber according to Ezha District Finance and Economic Development Office (EDFEDO, 2019).

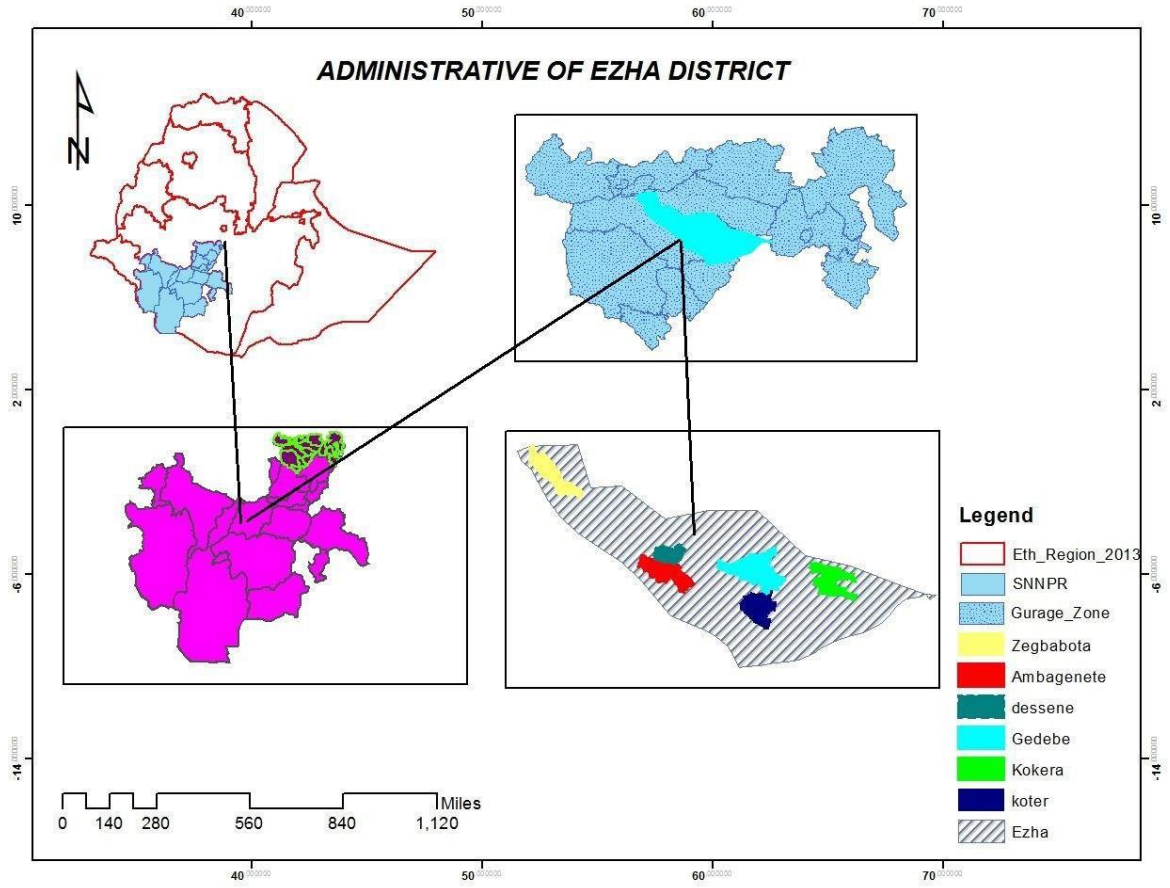

Figure 1. Map of the study areas

3.2. Research Design

A cross-sectional study was carried out to assess the management practices, productive and reproductive performances of exotic chicken under different production systems in Ezha district of Gurage Zone. Accordingly, data on management practices (feeding, housing, health care, *etc*), productive and reproductive performances of exotic chicken production at Ezha district in the Gurage were collected using a structured questionnaire.

3.3. Sources of Data and Method of Data Collection

3.3.1. Sources of data

Both primary and secondary sources of data were used for this study. The primary data were collected from sampled respondents through semi-structured questionnaires and weight measurement to get comprehensive and reliable information. Secondary data were obtained from various sources such as reports from Ezha District Agriculture and Natural Resources Office, Livestock and Fishery Resources Office, Administration Office Gurage Zone Finance and Economic Development Office, previous research finding, internet and others published

and unpublished materials. In addition to questionnaire data collection, general observation in relation to the different exotic chicken management practices was also carried out.

3.3.2. Methods of data collection

Interviewing the concerned stakeholders using a semi-structured questionnaire was the main method of data collection. Therefore, a cross sectional survey was carried out for each selected household to collect information focusing on the management practices, the productive and reproductive performance of exotic chickens under different agro-ecologies of Ezha district.

3.4. Sampling Methods and Sample Size Determination

3.4.1. Sampling method

Multi-stage sampling technique was used and employed in the study. Ezha district of Gurage zone is one of the top districts of the zone where exotic chicken breeds were distributed and located. Based on exotic chicken population size and accessibility Ezha district from Guraghe zone was selected purposively. Cluster sampling technique was employed to categorize Peasant Associations (PAs) in the district to highland and midland agro-ecologies. Again, based on exotic chicken population size, the Extent and intensity of improved chicken distribution and accessibility three PAs from each agro-ecology, participating in exotic chicken packages at least in the last one or more years were selected purposively. Accordingly, three PAs namely Kokera, Koter and Gedeb from highland and also another three PAs namely Ambagenet, Dessene and Zigbaboto from midland agro-ecology were identified and selected for the current study. List of households who have been participating in adopting exotic chickens from purposively selected six PAs was obtained from Ezha District Livestock and Fishery Resource Office (EDLFRO). After having a household list, a systematic sampling technique was finally employed to select household survey members.

3.4.2. Sample size determination

Assessment was made about the management practices, productive and reproductive performances of exotic chickens under different agro-ecologies using the list of households who adopted exotic chickens from each PAs, was used as the sampling frame. A total of 165 from 550 households and 115 from 383 households who adopted the improved chicken extension package from highland and midland agro-ecology were included. Therefore, a total of 280 households that adopted the improved chicken extension package were used for the study. The proportion of households was determined by using the simplified formula developed

by Yamane (1967) at 5% margin of error as follows:

$$n = \frac{N}{1 + N(e)^2} = n = \frac{933}{1 + 933(0.05)^2} = 280$$

Where:

n = Sample size to be studied

N= Population size

e = margin of error

Thus, based on the above formula, sample size for the study was 280 households.

Probability proportional to size approach (Kothari, 2004) formula is used to determine the number of sample households from the exotic chicken producer. The formula is:

$$Pi = \frac{ni}{N} = \frac{280}{933} = 0.30 = 30\%$$

Where:

Pi= proportion of producer households in the stratum

ni = total sample size

N= Total number of households which have exotic chicken extension package at least in the last one and more years.

Table 2**.** Survey sample size determination in the study districts

No.	Kebele	Total HHs	Total exotic chicken producer	Beneficiaries in EP	Proportion	Sample HHs
1	Kokera	650	349	200	0.3	60
2	Gedeb	675	471	200	0.3	60
3	Koter	450	250	150	0.3	45
4	Ambagenet	450	206	126	0.3	38
5	Dessene	250	200	152	0.3	45
6	Zigbaboto	350	200	105	0.3	32
Total	**Six**	**2825**	**1676**	**933**	**0.3**	**280**

HH = households, EP= Extension Package

3.5. Variables Measured

3.5.1. Exotic chicken management practices

The management practices of exotic chicken production were assessed through incorporation of recommended scientific husbandry systems and parameters applied for each household. Chicken housing, feeds and feeding systems, chicken healthcare management, agricultural extension system used and marketing were assessed through questionnaire survey.

3.5.2. Egg and meat production performance of exotic chickens

Data on chicken production performance (egg production, number of egg/clutches, number of days/clutch, and number of clutch/hen) including the performance of the distributed exotic chickens was collected using the prepared questionnaire.

The average age of slaughtering and live body weight at marketing age of chickens (males and females) by the selected households were recorded. From selected markets live weight recoding of laying hens and cocks were carried out with suspend balance to evaluate body weight performance under village conditions. Accordingly, mature body weights of disseminated male and female (greater than 20 weeks of age) exotic chicken was measured and recorded. The chicken age was determined by "recalling method" of interviewed farmers.

3.5.3. Reproductive performances of exotic chickens

Data on reproductive performances of exotic chicken (age at sexual maturity, hen age at first egg, and cock age at first mate, reproductive lifespan of hen and cock and also livability) was collected using the questionnaire developed and taken by interview households.

3.6. Data Analysis Method

The qualitative and quantitative data were analyzed using the appropriate Statistical Package for Social Science (SPSS) software version 21. More specifically, descriptive statistics, Crosstabs were used for this study. Figures and tables were used to present summary statistics such as mean, percentages and SD. The means of the quantitative traits were compared using Independent-samples T Test. As regards the qualitative variables, the values were compared using Chi-square test. The values were considered significant at 5% levels. The following statement used during analysis of quantitative data:

ANOVA statement regarding the effect of agro-ecology differences on various productive and reproductive parameters of the study of chicken was used.

$$Y_{ij} = \mu + A_i + e_{ij}$$

Where, Y_{ij} is the chicken performance parameter estimate for chicken j in agro-ecology i,

μ is the overall mean,

A_i is the fixed effect of agro-ecology, i=2 (highland and midland) and

e_{ij} is the residual

4. RESULTS AND DISCUSSIONS

4.1. Demographic Characteristics of the Households

4.1.1. Household Characteristics

The sex, educational status and family size of the respondents in the study area are presented in table 3. The majorities (72.9%) of the survey members were males and the remaining (27.1%) of the respondents were females (Table 3). There was no variation (P>0.05) in the proportion of both sexes of the respondent between the two agro-ecologies. In the present study extension packaged exotic chicken production, the males reported to have been needs household activities like recommended housing, frequent feeding, health care and marketing in addition to farming activities. The result was in line with the report of Shishay (2014) from Western zone of Tigray. North-West Amhara Fisseha (2009), in which proportions of males (83.8% and 74.4%) were higher than females (16.2%, 25.6%) headed households, respectively. In addition, Alemayehu (2017) report that (90%) of the respondent households are male-headed while the remaining (10%) are female-headed in Lume district, East Shoa Zone, Ethiopia. However, the result of the present study on sex of females was smaller than that of Mekonnen et al. (2017), who report (52.9%) in Assosa Town, Beneshangul Gumuze Region, Ethiopia.

The average family size (mean) identified in the area of study was 5.4 persons/households (ranging from 1-12 people); this is similar to the national average of 5.2 persons CSA (2003) and the report 5.4 for North-West Amhara (Halima, 2007). However, the result of the present study has smaller than that of Fisseha *et al.* (2007) and Asefa (2007), who report 6.2 and 7.0 persons/household for the Burie district of Amhara Region and Hawassa zuria woreda of the SNNPR, respectively.

Regarding education status (17.5%), the respondents were illiterate, while (45%) of them are found to be capable of reading and writing. About (24.3%) and (10%) of respondent were primary education and secondary education respectively and only (3.2%) of the respondent were diploma and degree holders. The proportions of education status of the respondent were varied between agro-ecologies. In the study area, illiterate (26.1%) and primary education (30.3%) were recorded in highland than (5.2%) and (15.6%) in midland agro-ecology, respectively. However, more (67%) read and write were recorded in midland than (29.7%) in highland agro-ecologies. Generally, the highest populations of the respondent were read and

write and primary education in both agro-ecologies but the lowest population of respondent education status were diploma and degree in chicken production in the study area. This might be in exotic extension packaged chicken production needs a high level of education to understand the chicken farming system like housing, feeding, health care, and marketing.

Education status better than illiterate (41.5%, 41.3%) report from South-West Showa, Gurage zone of Ethiopia (Emebet, 2015) and Western zone of Tigray, Northern Ethiopia (Shishay, 2014), respectively. The present result has somewhat similar with Alemayehu (2017) report that, (21%) of the respondents were illiterate while (28%) of them are found to be capable of reading and writing. About (33%) and (9%) of respondent are primary education and secondary education respectively and (5% and 4%) of the respondent are diploma and degree holder respectively in Lume district, East Shoa Zone. The results of formal education (37.5%) are lower than (82.1%) report for North-West Ethiopia (Halima, 2007). Also, the number of illiterates and read & write (62.5%) observed in this study was higher than (39.3%) report by Fisseha *et al.* (2010) from Bure woreda of Northwest Amhara.

The mean landholding/household of the Ezha district was (1.47±0.879ha) (ranging from 0.125-4.75 ha) which was higher than (1.25±1.255) and lower than (2.2±1.98ha) reported by Desalew (2012) in East Shewa Zone and Almaz (2015) in Dugda woreda, east- Shewa zone respectively. Farmer's landholding/household of the study district was (1.49ha and 1.47ha) in highland and midland agro-ecologies respectively. Similarly, Negatu (2005) report, most Ethiopian rural farmers hold less than 2 hectares of farmland per household. Only 1 (0.3%) of the respondents were landless in both agro-ecologies. There was significantly difference ($P<0.05$) among agro-ecologies in the study district.

Table 3. Sex, educational status and family size of the respondents in Ezha district

Household characteristics	Agro-ecological zones				
	Highland (n=165) n (%)	Midland (n=115) n (%)	Overall (N=280) N (%)	X^2-test	P-value
Sex of the respondents				**2.498(ns)**	**0.114**
Male	126 (76.4)	78 (67.8)	204 (72.9)		
Female	39 (23.6)	37 (32.2)	76 (27.1)		
Educational status				**45.078(*)**	**0.000**
Illiterate	43[a] (26.1)	6[b] (5.2)	49 (17.5)		
Read and write Grade	49[a] (29.7)	77[b] (67)	126 (45)		
1-8 education	50[a] (30.3)	18[b] (15.6)	68 (24.3)		
Grade 9-12 education	16 (9.7)	12 (10.4)	28 (10)		
College and university	7 (4.2)	2 (1.8)	9(3.2)		
Family size (Mean± SD)	5.64 ±1.736	5.1 ±1.813	5.42 ±1.784	(ns)	
Land holding (Mean ± SD)	1.49[a]±0.992	1.47[b]±0.879	1.486±0.946	(*)	

*[a-b]= Least square means with different superscripts within a row are significantly different (P< 0.05); *= Significant at P<0.05; ns= not significant at P>0.05; n= Number of households from the two agro-ecologies; N= Total number of households.*

Table 4 presents the study area respondents occupation, age group and marital status. The result of the present study revealed that the majority (72.5%) of the respondents belong to the age group of 30-50 years which, are followed by age group of >50 years (21.1%) and between 15-29 years of age was (6.4%). There was significant difference (P<0.05) between age groups of the agro-ecologies was observed. Abi (2018) reports that majority of respondents (46.1%) belong to the age group 15-30 years implies that greater than present result, followed by age group of 30-50 years (31.67%) both groups of which are considered to be within economically productive ages (Table 4). The result of the current study indicated that the majority of the major occupations of the respondents (91.1%) of the respondent are farmers. The rest (4.2%), (2.9%)

and (1.4%) were government worker, merchant and carpenter respectively. There was no significant difference (P>0.05) between the two agro-ecologies in occupation of respondents. This result has consistent with Kedir (2016) the majority of the respondents (86.7%) have farmers in Bora District, East Shoa Zone.

The present survey revealed that majority (89.3%) of the respondent were married whereas the remaining (6.1%) and (3.9%) of the respondent were widow/widower and single, respectively (Table 4). However, the proportion of respondent's marital status was not varied between agro-ecologies. The married respondents of the current result has fairly similar proportion report from Alemayehu (2017) (88%) and Worku *et al.* (2012) (90.3%) in Western Amhara administrative region but lowers than report by Meseret (2010) (97.2%) in Gomma woreda, Jimma zone and higher than report by Shishay (2014) (82.1%) in Western zone of Tigray.

Table 4. Occupation, age group and marital status of the respondents in Ezha district

Variables	**Agro-ecological zones**				
	Highland (n=165) n (%)	Midland (n=115) n (%)	Overall (N=280) N (%)	X^2-test	P-value
Major occupation				**5.972(ns)**	**0.983**
Farmer	150 (90.9)	105 (91.3)	255 (91.1)		
Merchant	2 (1.2)	6 (5.2)	8 (2.9)		
Government worker	10 (6.1)	3 (2.6)	13 (4.6)		
Carpenter	3 (1.8)	1 (0.9)	4 (1.4)		
Age group				**6.295(*)**	**0.043**
Between 15-29 years of age	11 (6.7)	7 (6.1)	18 (6.4)		
30-50 years of age	111[a] (67.3)	92[b](80)	203 (72.5)		
>50 years of age	43[a] (26)	16[b] (13.9)	59 (21.1)		
Marital status				**0.168(ns)**	**0.983**
Married	147 (89.1)	103 (89.6)	250(89.3)		
Divorced	1 (0.6)	1 (0.8)	2(0.7)		
Widow/Widower	10 (6.1)	7 (6.1)	17(6.1)		
Unmarried	7 (4.2)	4 (3.5)	11(3.9)		

*[a-b]= Least square means with different superscripts within a row are significantly different (P< 0.05); *= Significant at P<0.05; ns= not significant at P>0.05; n= Number of households from the two agro-ecologies; N= Total number of households.*

4.1.2. Livestock holding and flock composition of the respondents

Livestock holding and flock composition of the respondents in the study district is presented in table 5. Respondents of the highland prefer livestock rearing over the major crop production like enset, barley, wheat and potato, whereas midlands agro-ecologies prefer livestock rearing over the major crop production like enset, chat, coffee, avocado, teff & maize due to potentiality of altitude. About 100% of the respondents reported to have reared livestock especially poultry and cattle followed by sheep, goat and equines in the study district.

The mean number of livestock holding/respondents in the current study was 4.89, 4.01, 0.86, 1.62, for cattle, sheep, respectively. This study's mean chicken flock size is comparable to that of Gueye (1997) who report flock size ranging between 5 and 20 chickens per household in the African villages. But, the result of the present study were lower than the mean flock size of (17.7) chickens per household report from Gorogutu district of Eastern Hararghe Zone (Ahmedin, 2016). On the contrary, the results of this study were higher than that of Meseret (2010) who report mean flock size of (6.24) chickens/household from Gomma district of Jimma Zone. The respondents reported that chicken flock size varies from season to season mainly based on the availability of feed, the occurrence of diseases, presence of predators and the production performances of the chickens.

Table 5 also shows the chicken flock size and structure are described in terms of proportion of the flock's different sex and age groups. This study showed that the mean flock size/household was 10.5±12.38. This study indicates that the exotic village chicken population of Ezha district is dominated by hens, followed by cocks and then pullets. The present study (60.7%, 16.9%, 14.4% and 7.9%) of hens, cocks, pullets and cockerels are report by Abi (2018) higher than flock composition of hens (38.4%) & cocks (11%) and almost similar with pullets (15.3%) & cockerels (6.9%) in Hidabu Abote district of North Shoa, Ethiopia. CSA (2021) report also (34%, 11%, 11%, 5% and 33%) of hens, cocks, pullets, non-laying hens and chicks respectively are the distribution of chickens. There were a consistent higher proportion of hens in the flock in the study area regardless of the agro-ecology. The higher proportion of hens followed by cocks

in the flocks was an indication of strong desire for egg and meat production respectively in the Ezhadistrict.

Table 5. Livestock holding and flock structure of the respondents in the district

Livestock holding	Agro-ecological zones			
	Highland (n=165) n (%)	Midland (n=115) n (%)	Total (N=280) N (%)	P-value
Number of Cattle	5.5±1.758	3.92±1.349	4.89±1.785	(*)
Number of Sheep	4.35±6.005	0.35±0.956	4.01±5.719	(*)
Number of Goat	0.19±0.715	1.39±1.950	0.86±1.620	(*)
Number of Equine	1.62±1.211	0.00±0.000	1.62±1.221	(ns)
Flock size	10.11±8.138	11.05±16.716	10.5±12.382	
Flock composition				
Mature female (>20 weeks)	5.59±4.870	6.77±13.149	6.07±9.216	(*)
Mature male (>20weeks of age)	1.64±2.646	1.76±4.714	1.69±3.633	(ns)
Pullet (8-20 weeks of age)	1.44±2.816	1.43±1.864	1.44±2.466	(ns)
Cockerel (8-20 weeks of age)	0.83±3.245	0.72±1.203	0.79±2.605	(ns)

**= Significant at P<0.05; ns= not significant at P>0.05; n= Number of households from the two agro-ecologies; N= Total number of households.*

4.2. Source and Population Dynamics in the Study Areas

Regarding the source of the exotic chickens table 6, it was revealed that about 64.6%, 18.2% and 14.6% of the respondents purchased chicks, pullets and cockerels from private farms, and market and received their chickens from NGO's, respectively. Government development agents, NGO, market, and private farms were the primary sources of improved chicken in the study areas. The respondents indicated that they obtain these breeds easily either on the government

side or by purchasing from the market and the private farm. The current result implies that, the private farm (Ethio-chicken poultry farm) gave the day old-chicks, feeds and vaccines for youths to grow them until 45 days. Then the government and the growers/youths distribute it to the respondents. So, there is no lack of supply of exotic chickens.

The present study was somewhat agreeing with the earlier findings of Aman *et al.* (2017) report that most of the farmers obtain Sasso breed chickens purchasing from private farm (Ethio-chicken poultry farm) in the form of cockerels and pullets (42 days age); accordingly (58.2%) purchased from private farms, (24.7%) is given by government through livestock development. Kedir (2016) also report that the source of exotic chicken breeds are (96.4%) and (3.6) from district livestock agency and private company respectively in Bora District of East Shoa zone.
The experience of exotic chicken farming in present study revealed that, majority of the respondents started exotic chickens based production 1-5(44.7%) and 6-10 years (49.6%) . The rest (3.2%) and (2.5%) are start rearing on >15 and 11-15 years, respectively. This implies that (49.6%) of the respondents experienced >6 years exotic chicken production and the rest respondents to select at least one and above years experienced to collect better information (Table 6).

Table 3. Source of chickens and experience of respondents in the study areas

Variables	**Agro-ecological zones**				
	Highland (n=165) n (%)	Midland (n=115) n (%)	Total (N=280) N (%)	X^2-test	P-value
Source of chickens				**27.909(*)**	**0.000**
Government /Private	91[a](55.2)	90[b](78.3)	181(64.6)		
NGO's	37[a](22.4)	4[b](3.5)	41(14.6)		
Market	30(18.2)	21(18.3)	51(18.2)		
Gov't/Private and NGO's	3(1.8)	-	3(1.1)		
Gov't/Private and Market	1(0.6)	-	1(0.4)		
NGO & Market	1(0.6)	-	1(0.4)		
Gov't/Private, NGO and Market	2(1.2)	-	2(0.7)		

Respondents to start farming exotic chicken				**6.724(ns)**	**0.081**
1-5 years	79(47.9)	46(40)	125(44.7)		
6-10 years	81(49.1)	58(50.4)	139(49.6)		
11-15 years	3(1.8)	4(3.5)	7(2.5)		
>15 years	2(1.2)	7(6.1)	9(3.2)		

*$^{a-b}$= Least square means with different superscripts within a row are significantly different (P< 0.05); *= Significant at P<0.05; ns= not significant at P>0.05; n= Number of households from the two agro-ecologies; N= Total number of households.*

In the present study table 7, the population size from time to start chicken production was increase (56.8%), decrease (29.3%) and stable (12.5%). 52(29.3%) of reported that there is a decline in the number of flock, because mainly for high cost of feed & more feed usage of exotic chickens (43.4%) and high loss by diseases & predators (31.3%) and less production performance compare with cost of production the others were destroys agricultural products leads to conflict with neighbors (9.6%), less production performance compare with cost of production (8.4%), increase cost of chick (3.6%), lack of capital (2.4%) and lack of knowledge (1.2%). A significant difference (P<0.05 was observed between agro-ecologies to decline the number of chickens. In the study area most youth's job opportunities contribute on rear exotic chicken production in extension package, but after a year some youths there are not continued on exotic chicken production, so that further research will be done mainly on intensive production system compare with cost of production and other challenges.

The respondents in the present study area revealed that chicken flock size varies from season to season (54.3%) and does not vary from season to season (45.7%). According to the respondents the flock size variation was mainly based on the availability of feed, the occurrence of diseases, presence of predators as well as the production performances of chickens' extension system (Figure 2).

Table 7. Population dynamics and flock change of chickens in the study district

Variables	**Agro-ecological zones**				
	Highland (n=165) n (%)	Midland (n=115) n (%)	Total (N=280) N (%)	X^2-test	P-Value
Population dynamic from time to start chicken				**27.798(*)**	**0.000**
Increase	112[a](67.9)	47[b](40.7)	159(56.8)		
Decrease	38[a](23.0)	44[b](38.3)	82(29.3)		
Stable	11[a](6.7)	24[b](20.9)	35(12.5)		
Unknown	4(2.4)	-	4(1.4)		
Flock change within season				**5.286(*)**	**0.021**
Yes	99[a](60)	53[b](46.1)	152(54.3)		
No	66[a](40)	62[b](53.9)	128(45.7)		

[a-b]= Least square means with different superscripts within a row are significantly different (P< 0.05); *= Significant at P<0.05; ns= not significant at P>0.05; n= Number of households from the two agro-ecologies; N= Total number of households.

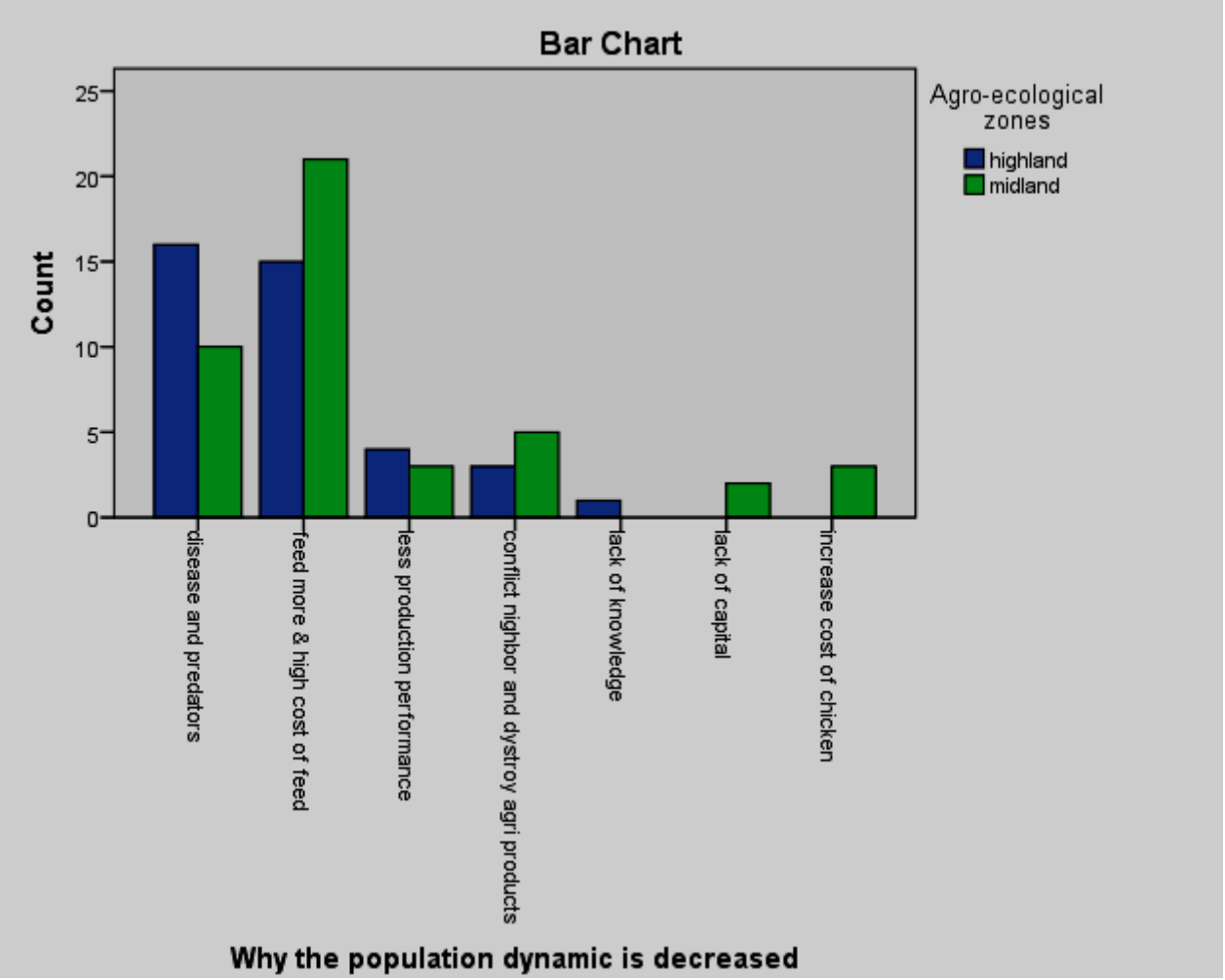

Figure 1. Reasons towards for the decrease in the flock size/population dynamics in the study district

4.3. Production Improvement, Source of Knowledge, Production System and Types of Exotic Breeds

About 92.1% of the respondents in present study revealed that interest in improve chicken production. The major feelings of respondents were attention to overall management, provision of technical support and monitoring by health technicians, provision of market and transport facilities for production inputs and preparation of mixed feeds at home with low costs. The source of knowledge for exotic chicken rearing in the study were acquired (30.7%) from parents, (34.6%) own interest, (30.4%) formal training and (4.3%) from colleagues and neighbors (Table 8).

Table 8. Improvement interest and source of knowledge for chicken production in the study areas

Variables	Agro-ecological zones				
	Highland (n=165) n(%)	Midland (n=115) n(%)	Total (N=280) N (%)	X^2-test	P-value
Respondents feeling to improve chicken production				**5.023(*)**	**0.023**
Yes	157[a](95.1)	101[b](87.8)	258(92.1)		
No	8[a](4.9)	14[b](12.2)	22(7.9)		
Source of knowledge for chicken production				**5.361(ns)**	**0.147**
Parents	42[a](25.5)	44[b](38.3)	86(30.7)		
College and neighbor	7(4.2)	5(4.3)	12(4.3)		
Own interest	62(37.6)	35(30.4)	97(34.6)		
Trainings	54(32.7)	31(27)	85(30.4)		

*[a-b]= Least square means with different superscripts within a row are significantly different (P< 0.05); *= Significant at P<0.05; ns= not significant at P>0.05; n= Number of households from the two agro-ecologies; N= Total number of households.*

The study results table 9 showed that the dominant exotic chicken production system was scavenging with additional supplement 99.3%. From this result, the proportion of respondents that used the system scavenging with conditional supplements were 73.6% and The proportion of farmers that used scavenging with regular supplementation were 25.7%. A significantly difference (P<0.05) in chicken production systems was observed between agro-ecologies in the exotic chicken production system. This is due to training and extension services leads to the difference in awareness of the respondents.

The identified proportion of respondents regarding additional supplementation (99.3%) was

agreement with Halima *et al.* (2007) who reports a 99.28% respondent proportion in Northwest Ethiopia. Moges *et al.* (2010) reports (98, 93 and 98%) of respondents in three districts of Bure, Fogera and Dale, respectively and Meseret (2010) report (97.8%) of the farmers in Gomma Woreda of Jimma Zone, provide additional supplementary feed to their village chickens. But the result is higher than Almaz (2015) (92.5%) in Dugda woreda, east Shewa zone, Ethiopia. According to Mekonnen *et al.* (2017) reports, the majority of sample respondents (67.6%) use semi-intensive production system of rearing exotic chickens. Thus, in this system, chickens are allowed to scavenge around their house and supplements cereal crops, house left over, cereal byproducts and mixed feeds.

The information on the type of exotic chicks to chicken owners table 9 showed that majority of the respondents (80%) in the Ezha district used Sasso breed, indicating the breed's popularity and accessibility among farmers in the area of study. There was a significant difference ($P<0.05$) between agro-ecologies in types of improved chicken the respondents currently rearing and their sources are Ethio-chicken private farms. The rest (20%) of exotic chickens used was Bovans brown breed and their sources are NGO's and private farms. Based on the information gathered from respondents, most of the farmers were currently rearing Sasso breeds in highland (70.3%) and midland 93.9%) agro-ecologies than Bovans brown, respectively. This should be attributed to the availability of Sasso breeds provided by private poultry farm.

Table 4. Chicken production system and types of breeds in the study households

Variables	**Agro-ecological zones**				
	Highland (n=165) n (%)	Midland (n=115) n (%)	Total (N=280) N (%)	X^2-test	P-value
Types of chicken production system				**39.625(*)**	**0.000**
Traditional (Scavenging only)	2(1.2)	-	2(0.7)		
Scavenging + Seasonal/conditional supplementation	143[a](86.7)	63[b](54.8)	206(73.6)		
Semi-scavenging (Scavenging + Regular supplementation)	20[a](12.1)	52[b](45.2)	72(25.7)		
Type of exotic chicken used				**23.610(*)**	**0.000**
Sasso	116[a](70.3)	108[b](93.9)	224(80)		
Bovans brown	49[a](29.7)	7[b](6.1)	56(20)		

*[a-b]= Least square means with different superscripts within a row are significantly different (P< 0.05); *= Significant at P<0.05; ns= not significant at P>0.05; n= Number of households from the two agro-ecologies; N= Total number of households.*

4.4. Exotic chicken Housing system

The survey indicates that 90.4% of households provide separate house for their chicken while the rest 9.6% of them do not construct separate house for their chicken table 10. This has an implication that continuous extension and training services had done leads to understand minimize human health also increase egg production and bio-security of exotic chickens. The present result agrees with Desalew (2012) report that majority of (93.3%) improve village chicken producers use separate house in Ada‟a and Lume districts, East Shoa. The result has higher than Mekonnen *et al.* (2017), Alemayehu (2017) and Haben *et al.* (2020) report (64.7%), (61.1%) and (50%) in Assosa Town, Lume district, and Damot Sore District, Ethiopia respectively.

Wooden made with grass roof (49.4%), wooden made with iron sheet (43.9%), stone wall with grass roof (5.9%) and stone made with corrugated iron sheet (0.8%) were reported to be the major chicken house constructing materials table 10. Mekonnen *et al.* (2017) report that

the houses have built from locally available materials such as bamboo, wood, mesh wire, grasses and corrugated iron sheets.

Table 10. Chicken housing practices in the study area

Variables	**Agro-ecological zones**				
	Highland (n=165) n (%)	Midland (n=115) n (%)	Total (N=280) N (%)	X^2-test	P-Value
Separate house for chicken				**0.739(ns)**	**0.259**
Yes	147(89.1)	106(92.2)	253(90.4)		
No	18(10.9)	9(7.8)	27(9.6)		
Housing constructional materials				**9.667(*)**	**0.022**
Stone wall with grass roof	9(6.1)	6(5.7)	15(5.9)		
Stone made with iron sheet	-	2(1.9)	2(0.8)		
Wood made with grass roof	83[a](56.5)	42[b](39.6)	125(49.4)		
Wood made with iron sheet	55[a](37.4)	56[b](52.8)	111(43.9)		

*[a-b]= Least square means with different superscripts within a row are significantly different (P< 0.05); *= Significant at P<0.05; ns= not significant at P>0.05; n= Number of households from the two agro-ecologies; N= Total number of households.*

Predator protection (67.6%) was reported to be the main driving force for the construction of chicken house in the study areas table 11. According to the survey results, predators were the major constrains of exotic chicken production in the study areas. The parameters of advantages of chicken house was similar but the respondent's usage and approach was somewhat different with Alemayehu (2017) report that construction of chicken house has advantage for their chicken to protect from the predator (26.7%), to protect form the predator and to protect from transmission disease (23.3%), to control meeting (4.4%) to protect from transmission disease (2.2%) and to feed without neighbor (1.1%).

Table 11. Advantages of chicken house in the study area by respondents

Variables	**Agro-ecological zones**				
	Highland (n=165) n (%)	Midland (n=115) n (%)	Total (N=280) N (%)	X^2-test	P-Value
Advantage of chicken house				7.616(ns)	0.179
Protect from predators	102(69.4)	69(65.1)	171(67.6)		
Protect from transition disease	8(5.4)	7(6.6)	15(5.9)		
Control meeting	28(19)	16(15.1)	44(17.4)		
Protect from predators and transition disease	6(4.1)	4(3.8)	10(4)		
Protect from predators, transition disease and control meeting	1(0.7)	5(4.7)	6(2.5)		
Protect from predators and control meeting	2^a(1.4)	5^b(4.7)	7(2.6)		

*$^{a-b}$= Least square means with different superscripts within a row are significantly different (P< 0.05); *= Significant at P<0.05; ns= not significant at P>0.05; n= Number of households from the two agro-ecologies; N= Total number of households.*

From the overall separate house interviewed households table 12, the majority (98.4%) of the respondents clean their chicken house whereas only (1.6%) household interviewed does not. Cleaning once per day (36.5%), twice per day (30.8%), and three times per day (19.2%) were reported as the frequency of cleaning chicken house. From separate house respondents (83.2%) provide litter material and the rest (16.8%) was not used litter. This indicates that extension package exotic chickens were to given more attention due to monitoring of development agents. According to the survey respondents there is not given packaged exotic chickens by development agents without construct separate shelter. In addition, the study was reported in the present study, straw and sawdust 'sagatura' were commonly used litter types.

The present result was in agreement with Mekonnen *et al.* (2017) report, all respondents clean

chickens house, but cleaning interval and quality of cleaning differ from one respondent to another (personal observation). Majority of the respondents (86.5%) use to clean chicken house on daily basis and some (17.6%) in weekly basis in Assosa Town, Beneshangul Gumuze Region. The result greater than report by Addisu *et al.* (2013), (37.25%, 26.4%, 25.82%, 10.13%, and 0.33%) of the household clean their chicken's house twice a week, once a week, three times per week, four times per week and once a day, respectively in North Wollo zone of Amhara regional state. In addition, Alemayehu (2017) report (54.4%) cleans the chicken house whereas (45.6%) household interview not cleaning chicken house. Frequency of cleaning per day present result (82.4%) was greater than Alemayehu (2017) (26.7%) once per day, and (1.1%) two day interval. Shishay (2014), also report frequency cleaning chicken house (66%) of the total interview household clean their chicken house seven times per a week (once per day). Likewise the finding from North West Ethiopia (Halima, 2007) reported, frequency of cleaning the chicken house once a day and twice a day in week as report by 74.02% and 11.06%, respectively.

This result also higher than Haben *et al.* (2020) indicate that (62.50%) in the study districts clean their poultry house on daily basis followed by twice a week (19.79%), and weekly (16.67%) in Damot Sore district in Wolaita zone, Ethiopia. The present study was higher than Desalew (2012) report, only (22.2%) and (10%) of the respondents in Ada"a and Lume districts, respectively, used litter for rearing chicken..

Table 12. Practices, frequency of chicken house cleaning and provision litter materials in the study areas

	Agro-ecological zones				
Variable	Highland (n=165)	Midland (n=115)	Total (N=280)	X^2-test	P-
	n (%)	n (%)	N (%)		Value
Practice cleaning of chicken house				**0.454(ns)**	**0.449**
Yes	148(98)	106(99)	254(98.4)		
No	3(2)	1(1)	4(1.6)		
Frequency of cleaning/week				**43.175(*)**	**0.000**
Once	36[a](23.4)	59[b](55.7)	95(36.5)		
twice	47(30.5)	33(31.1)	80(30.8)		
Three	44[a](28.6)	6[b](5.7)	50(19.2)		
four	11[a](7.1)	-	11(4.2)		
Not clean per day	16(10.4)	8(7.5)	24(9.2)		
Provide litter material				**1.160(ns)**	**0.181**
Yes	133(85.3)	85(80.2)	218(83.2)		
No	23(14.7)	21(19.8)	44(16.8)		

*[a-b]= Least square means with different superscripts within a row are significantly different (P< 0.05); *= Significant at P<0.05; ns= not significant at P>0.05; n= Number of households from the two agro-ecologies; N= Total number of household*

4.5. Feeding and Feed Resources

4.5.1. Feeding, feed resource & supplementation time

The results obtained on chicken feeds and feeding system used in the study area are given in table 13. From table 13 it can be seen that scavenging with additional supplements (83.9%), homemade feed (11.1%), purchased feed (4.3%) and scavenging only (0.7%) identified as the main feeding systems in the study district. There was significant difference ($P<0.05$) between agro-ecologies.

Gebrewahd (2017) report, as more than half of respondents give supplement feed for their chicken. As the respondents who give some types of supplement feed to chicken about (30.21%) grain (maize, wheat, etc); (10.42%) mix feed; (1.04%) frushika and (25.00%) give both grain and frushika. But, remain (33.33%) did not give any supplement feed. Haben *et al.* (2020) report that (28.12%) of chicken have scavengers whereas (44.80%) have scavenging with the supplementary feed, only (9.37%) process or purchase feed which contains a high nutritional value and (17.71%) were homemade feed. Most chicken owners provide supplementary feed for their chickens about (66.67%) and some have not about (33.33%) village chicken production in Damot Sore district in Wolaita Zone, Ethiopia.

Feeding their chicken three times a day (morning, afternoon & evening) (32.5%), provide two times a day (morning & afternoon) (30.7%) and provide one times a day (21.8%) were reported as the feeding frequency of chicken in the study areas. The proportions chicken feeding system, frequency of giving supplementary feed and home available feeds was significantly different ($P<0.05$) across agro-ecologies.

The result of frequency of supplementary feeding report by Alemayehu (2017) has somewhat similar three time a day (morning, afternoon and evening) (46%), twice a day (morning and afternoon) (34%) and morning (8%) are the predominant practice feed supplementation times per day in the Lume district, East Shoa, Ethiopia. The result obtain the finding Shishay (2014) lower than (58.4%) chicken owners offered supplementary feed to their chicken three times a day (morning, afternoon and evening) and higher than (9.9%) of them provide supplementary feeds two times a day (morning and afternoon). Also lower than Emebet (2015) that (44.6%) of them provide supplementary feeds two times a day and similar with (31.7%) of them provide supplementary feeds three times a day in the Southwest Showa and Gurage zones of Ethiopia.

In addition, somewhat similar result has been report by Addisu *et al.* (2013) (37.9%) of the households provide supplementary feeds two time per day (morning, evening) while (34.96%) and (27.12%) of them offer feeds to their chickens once per day (morning/evening) and three times per day (morning, midday and evening) respectively. The finding of the study conduct by Meseret (2010) reveal that (48.3%) of the households offer feed to the chicken two times per day (morning and afternoon) and (22.2%) of them provide three times per day (morning, afternoon and evening) while (14.4%, 2.2%, 1.7% and 1.1%) of them offering one times (morning, afternoon, evening and morning & evening, respectively. This implies that the perception of farmer towards to proper feed supplementation of chickens improves chicken productivity (egg and meat yields) and health increase as time goes through their past experience training and extension services.

Table 13. Feeding, feed resource & supplementation time in the study district

Variables	**Agro-ecological zones**				
	Highland (n=165) n (%)	Midland (n=115) n (%)	Total (N=280) N (%)	X^2-test	P-Value
Chicken feeding system				**8.074(*)**	**0.045**
Scavenging only	-	2(1.7)	2(0.7)		
Scavenging with supplement	133(80.6)	102(88.7)	235(83.9)		
Purchased feed	8(4.8)	4(3.5)	12(4.3)		
Homemade feed	24[a](14.5)	7[b](6.1)	31(11.1)		
Time of feed supplementation				**40.070(*)**	**0.000**

Morning	30[a](18.2)	7[b](6.1)	37(13.2)
Afternoon	17(10.3)	5(4.3)	22(7.9)
Evening	2(1.2)	-	2(0.7)
Any time during the day	15[a](9.1)	27[b](34.5)	42(15)
Morning & afternoon	35[a](21.2)	51[b](44.3)	86(30.7)
morning, afternoon & evening	66[a](40)	25[b](21.7)	91(32.5)

*[a-b]= Least square means with different superscripts within a row are significantly different (P< 0.05); *= Significant at P<0.05; ns= not significant at P>0.05; n= Number of households from the two agro-ecologies; N= Total number of households.*

Almost all (99.6%) of the respondents practice provision of supplement feeding to their chicken table 14, which is fairly similar with the result report by Shishay (2014) (100%), Worku *et al.* (2013) from West Amhara of Ethiopia (100%), by Alemayehu (2017) Lume district, East Shoa, Ethiopia (100%), by Meseret (2010) (97.8), Mogas *et al.* (2010) (97.5) and by Tadesse *et al*. (2013) (97.8%). The present study also reveal that about (60%, 17.8%, 11.1% and 11.1%) of the respondent's types of supplementary feed use for exotic chickens were both home and commercial feed, home available feeds, commercial feeds and home mixed feeds, respectively.

Table 14, also indicates that season of additional feed had variation among the agro-ecology (P<0.05). Summer (39.6%), spring (10.7%), winter (7.9%) and autumn (6.4%) were reported as the major supplementation season but (35.4%) of the respondents had the experience of supplementing their chicken the whole year table 14. Their further explanation in present study indicated that during this time the grass grows vigorously and covers the ground and also most of the agricultural products harvest outside summer. Shishay (2014) indicate that (50.1%) of the total households interviewed said that season of critical extra feeding has rainy (summer), but higher than report by Mekonnen *et al.* (2017) reveal that about (20.6 %) feed shortage occurs in wet season.

Samson and Endale (2010) in mid rift valley of Oromia that reveal that (95%) of the respondents indicate that critical time of supplementary feeding has from June-August while the remaining (5%) of them indicate that March-May was the critical time of feed supplementation. As the result indicated that, feed is critical problems especially in wet season under village chicken production system that may be necessitate persuading the farmer to practice strategic regular supplementation to increase meat and egg production thereby to play role in food security.

Table 14. Type of supplemental feeds and season of supplementation in the study areas

Variable	**Agro-ecological zones**				
	Highland (n=165) n (%)	Midland (n=115) n (%)	Total (N=280) N (%)	X^2-test	P-value
Provide supplementary feed				**1.440(ns)**	**0.230**
Yes	165(100)	114(99.1)	279(99.6)		
No	-	1(0.9)	1(0.4)		
Types of supplementary feed				**11.104(*)**	**0.011**
Commercial	10^a(6.1)	21^b(18.3)	31(11.1)		
Home mixed ration	19(11.5)	12(10.4)	31(11.1)		
Home available feeds	34(20.6)	16(13.9)	50(17.8)		
Both home and commercial	102(61.8)	66(57.4)	168(60)		

Season of additional feed most frequently				**66.925(*)**	**0.000**
Summer	91[a](55.1)	20[b](17.4)	111(39.6)		
Spring	19(11.5)	11(9.6)	30(10.7)		
Winter	7[a](4.2)	15[b](13)	22(7.9)		
Autumn	16[a](9.7)	2[b](1.7)	18(6.4)		
All the year	32[a](19.4)	67[b](58.3)	99(35.4)		

*[a-b]= Least square means with different superscripts within a row are significantly different (P< 0.05); *= Significant at P<0.05; ns= not significant at P>0.05; n= Number of households from the two agro-ecologies; N= Total number of households.*

About (52.5%) of the respondents in Ezha district revealed that home available feeds satisfy the nutrient requirements of their chickens but (47.5%) said not satisfy table 15. Table 15 also shows that (60%, 24.6% and 16.4%) of respondents said that the amount of supplement feed provide per chicken was unknown, for body requirement and hand full, respectively. This shows that most respondents (84.6%) received supplements above or below the body requirement, so training is necessary to minimize wastage and increase production. There was significant difference (P<0.05) between agro-ecologies of amount of supplement feed. Furthermore, additional commercial feeds especially essential amino acid like methionine and lysine are necessary for increase chicken production. Scavenging chicken did not get amino acid like methionine, lysine but it is state by Sheila and Sara (2007) feed lacking protein and other nutrients particularly the amino acid methionine will also cause birds to feather pecking.

The majority (90.7%) of the respondent's gives supplements by feeding trough but the remaining (9.3%) of them don't use feeding trough. According to the study, the respondents pay more attention to feeding containers to minimize wastage and improve hygiene due to extension services. The result was contrast with Shishay (2014) who reveal that (97.8%) respondents supply supplementary feeds to chicken on the ground (simply throwing the feed leveled ground) and (2.1%) of the respondents provide feeds to their chickens with local containers like plastic or metallic containers. Also, Bogale (2008) state that (16.7%) of households offer feed to chicken on containers while (81.9%) of them gave feeds to chickens

on ground for collective feeding from Fogera district.

Table 15. Home available chicken feeds and amount of supplementation in the study areas

Variables	Agro-ecological zones				
	Highland (n=165) n (%)	Midland (n=115) n (%)	Total (N=280) N (%)	X^2-test	P-Value
Home available feeds satisfy the nutrient requirement				**1.710(ns)**	**0.191**
Yes	92(55.8)	55(47.8)	147(52.5)		
No	73(42.2)	60(52.2)	133(47.5)		
Amount of supplement feed you provide per chicken				**62.392(*)**	**0.000**
Hand full	12[a](7.3)	34[b](29.6)	46(16.4)		
Unknown	129[a](78.2)	36[b](31.3)	165(60)		
Body requirement	24[a](14.5)	45[b](39.1)	69(24.6)		
Feeding trough				**1.993(ns)**	**0.119**
Yes	153(92.7)	101(87.8)	254(90.7)		
No	12(7.3)	14(12.2)	26(9.3)		

*[a-b]= Least square means with different superscripts within a row are significantly different (P< 0.05); *= Significant at P<0.05; ns= not significant at P>0.05; n= Number of households from the two agro-ecologies; N= Total number of households.*

4.5.2. Accessibility, affordability and problem associated with commercial feeds

Table 16 below indicates that the majority (85%) of the respondents did have access for commercial chicken feed. In addition, the majority (78.9%) of the respondents in the present study areas couldn't afford commercial feeds. Table 16 also indicates that the majority (77.9%) of the respondents witnessed that there was no problem associated with commercial feeds. There was a significant difference (P<0.05) between agro-ecologies of accessibility, affordability, and quality problems of commercial chicken feeds. According to the study, even

if a private company/merchant accesses commercial feeds, but the price of feeds varies according to the source of supply, so little attention is given to the least cost formulation of rations by home available feeds. It was understood that considerable scope exists to reduce the feed price in some areas of cooperatives without reducing its nutritive value. It is known that regular availability of good quality ingredients and a fully balanced complete feed are essential for efficient chicken production.

Poultry feed and nutrition is one of the most critical constraints to poultry production under both the rural small holder and large-scale systems in Ethiopia. When available, the problem is mainly associated with lack of processing facilities, inconsistent availability and distribution, and sub-standard quality of process feeds (Haftu, 2016). Regular availability of good quality ingredients and a fully balanced complete feed has essential for efficient poultry production. The most serious problems arise from the unavailability of suitable micro-nutrient sources: vitamins and minerals (Tadelle *et al.*, 2002; Demeke, 2004; Mazengia *et al*., 2012; Dessie *et al.*, 2013). According to Matawork (2016), the price of raw materials varies according to source of supply and region. Transport costs add significantly to the cost of feed in study areas distant from the source of supply. Most formulations available do not have vitamin/mineral premixes. Ingredients and processed feeds vary in nutritive value, and there is no common quality control mechanism in the country.

Table 16. Accessibility, affordability and problem associated with commercial feeds in the study area

Variables	**Agro-ecological zones**				
	Highland (n=165) n (%)	Midland (n=115) n (%)	Total (N=280) N (%)	X^2-test	P-value
Commercial chicken feeds are accessible				**11.002(*)**	**0.001**
Yes	150[a](90.9)	88[b](76.5)	238(85)		
No	15[a](9.1)	27[b](23.5)	42(15)		
Commercial chicken feed is affordable				**39.998(*)**	**0.000**
Yes	56[a](33.9)	3[b](2.6)	59(21.1)		
No	109[a](94.8)	112[b](97.4)	221(78.9)		

Quality problems on commercial chicken feeds			**15.517(*)**	**0.000**
Yes	50[a](30.3)	12[b](10.4)	62(22.1)	
No	115[a](69.7)	103[b](89.6)	218(77.9)	

*[a-b]= Least square means with different superscripts within a row are significantly different (P< 0.05); *= Significant at P<0.05; ns= not significant at P>0.05; n= Number of households from the two agro-ecologies; N= Total number of households.*

Table 17 of the current study indicates that the basis of providing supplementary feeds had variation among the agro-ecology (P<0.05). Egg yield was the first (51.2%) objective of offering supplementary feeds. The present study revealed that half of the respondent provided supplementary feed for egg yield. The result contrast with finding Shishay (2014) report that the majority of feed offered were to increase both meat and egg yields and to maintain health status (90.6%) and to increases both meat and egg yields (6.2%). In addition, Addisu *et al*. (2013) report that the primary objective of feed supplementation of chicken owners was to increase egg yields (33.99%), increase meat yields (34.97%), and maintain health (31.7%). In addition, Alemayehu (2017) report that the objective of offering supplementary feeds were to increase egg yield, improve growth & health (36.7%), increase egg yield and growth (26.7%), increase egg yield (14.4%) and increase egg yield, improve health, growth and broodiness (13.3%), growth and improve health (5.6%) and increase egg yield and improve health (3.3%).

Table 17. Basis of giving supplementary feeds in the study district

Parameters	**Agro-ecological zones**				
	Highland (n=165) n (%)	Midland (n=115) n (%)	Total (N=280) N (%)	X^2-test	P-Value
Basis of giving supplement				**29.630(*)**	**0.000**
Egg yield	72[a](43.6)	72[b](62.6)	144(51.2)		
Meat yield	5(3)	-	5(1.9)		
Growth	1(0.6)	-	1(0.4)		
Egg yield and meat	13(7.9)[a]	21[b](18.3)	34(12.1)		
yield Egg yield and	19[a](11.5)	8[b](7)	27(9.6)		
growth Meat yield and growth	5(3)	-	5(1.9)		
Egg yield, meat yield and growth	50[a](30.3)	14[b](12.2)	64(22.9)		

*[a-b]= Least square means with different superscripts within a row are significantly different (P< 0.05); *= Significant at P<0.05; ns= not significant at P>0.05; n= Number of households from the two agro-ecologies; N= Total number of households.*

4.6. Water Resources and Watering

Water plays an important part in the digestion and metabolism of the chicken in addition it serves as a media to administer some important vaccines. Almost all of the respondents (99.6%) provided water for their exotic chicken in table 18. Generally, (60.4% of the respondents) provided water for their chicken at all seasons of the year (*bega and kiremt*), and the rest (39.6%) of the respondents provided water for their chicken at dry season (bega) only. Despite variations (P<0.05) in source of water, provide season and provide watering trough; almost all of the respondents provided water and a watering trough for their chicken Table 18. This is a promising and good experience and could be considered as one aspects of their

concern to their chickens.

These results were somewhat similar to Alemayehu (2017) all of the respondents (100%) provided water for their chicken in the Lume district, East Shoa zone, Ethiopia. Furthermore, almost all of the respondents provide water for their chickens and (71%) of the respondents provide water for their chickens at "*bega*" (dry season). The rest of (29%) provided water for their chicken at all seasons of the years (*bega and kiremt*) report in Lume district East Shoa, Ethiopia.

Concerning the source of water, the present study revealed that the water given to the chickens was drawn from greater than half of the respondents who used to tap/pipe water (62.1%) because clean water coverage was high in the study district, other river water (18.9%), wale water (underground water) (12.9%) and pond water (6.1%) given was not fully covered by clean water in the study areas. In addition, all (100%) of the respondents in both agro-ecologies used water to provide containers for exotic chickens. The result was somewhat in line with *al.* (2020) report that the source of water supply for the chicken has about 48.96% tap water, 39.58% hole water, 8.33% river water, and 3.13% use pond water. This also seems with Kibreab *et al.* (2016) report that major water sources have a river, tap/pipe water, and locally construct underground water (hole water). According to Mekonnen *et al.* (2017) report that, (100%) of the respondents use pipe water as a water source in Assosa Town, Ethiopia.

Achievement of sustainable improved chicken productivity requires provision and adlib fresh water on clean waterier regularly. Training for chicken producers on the use of water on the chicken productivity there by to increase economic return and ensure food security on small farmers. According to Kathy (2012) water is critical important to chickens because it plays important role in regulating body temperature, digesting food and eliminating body wastes. Water is the single most significant constituent of body and represents about (70%) of total body weight. It is crucial for egg production since an egg constant of approximately (75%) water and without access to a regular clean supply of water; a hen was physically unable to produce eggs.

Table 5. Water provision, sources, season of supplementation and availability of watering trough in the study district

Variables	**Agro-ecological zones**				
	Highland (n=165) n (%)	Midland (n=115) n (%)	Total (N=280) N (%)	X^2-test	P-value
Provide water to your chicken				**0.699(ns)**	**0.589**
Yes	164(99.4)	115(100)	279(99.6)		
No	1(0.6)	-	1(0.4)		
Source of water				**46.517(*)**	**0.000**
Tap/pipe water	118[a](71.5)	56[b](48.7)	174(62.1)		
River	36(21.8)	17(14.8)	53(18.9)		
Pond	8(4.8)	9(7.8)	17(6.1)		
Underground	3[a](1.8)	33[b](28.7)	36(12.9)		
Season of the year provide water				**33.559(*)**	**0.000**
Bega	90[a](54.5)	23[b](20)	113(40.4)		
All season	75[a](45.5)	92[b](80)	167(59.6)		
Provide watering trough					
Yes	165(100)	115(100)	280(100)		

*[a-b]= Least square means with different superscripts within a row are significantly different (P< 0.05); *= Significant at P<0.05; ns= not significant at P>0.05; n= Number of households from the two agro-ecologies; N= Total number of households.*

Provision of water ad-libitum/free, twice a day, and once a day practiced by (78.9%, 15.7% and 5.4%) of the respondents of the study areas table 19. Similar table 19 indicates that plastic made (84.6%), wooden made (10.4%), earthen pot (3.9%), and metallic made (1.1%) were identified as the major drinking materials of chickens in the study areas. There was also a variation (P<0.05) in water supply containers and frequency of water across agro ecologies.

The present study was somewhat similar with Alemayehu (2017) report that, about (90%) of the respondents provided water for their chicken ad-libitum (freely), (6%) three times per day, (3%) twice a day and (1%) once a day they usually provide water when the chickens show sign of thirsty, and also the drinking materials (10%) plastic made formal waterier, (55%)

plastic made, (2%) earthen pot, (5%) wooden through, (21%) stone made, (1%) half of pot (broken) (4%) half plastic container (2%) metallic made in Lume district, East Shoa zone, Ethiopia.

Table 6. Watering frequency and watering materials for chicken in the study site

Variables	**Agro-ecological zones**				
	Highland (n=165) n (%)	Midland (n=115) n (%)	Total (N=280) N (%)	X^2-test	P-value
Water supply containers				**25.124(*)**	**0.000**
Plastic	152(92.1)[a]	85(73.9)	237(84.6)		
Earthen pot	-	11(9.7)[b]	11(3.9)		
Wooden	13(7.9)	16(13.9)	29(10.4)		
Metal made	-	3(2.6)[b]	3(1.1)		
Frequency of water				**7.038(*)**	**0.030**
Free access	138(83.6)[a]	83(72.2)[b]	221(78.9)		
Morning only	9(5.5)	6(5.2)	15(5.4)		
Morning & evening	1810.9)[a]	26(22.6)[b]	44(15.7)		

*[a-b]= Least square means with different superscripts within a row are significantly different (P< 0.05); *= Significant at P<0.05; ns= not significant at P>0.05; n= Number of households from the two agro-ecologies; N= Total number of households.*

4.7. Exotic Chicken Health Management

4.7.1. Chicken disease outbreak, prevention, and medication practice

Health care is one of the management types of village chicken production to improve productivity. The present study indicates that about (68.6%) of respondents used annual vaccination for exotic chicken but the rest (31.4%) of them not used table 20. The majority (80.8%) of respondents vaccinated their chickens against Newcastle disease, the rest for Gumboro, fowl thiphoid, and fowl pox (8.8%, 2.6%, and 1.6%), respectively. Interestingly, 6.2% of the respondents do not know which type of disease occurred and give vaccines for. There was statistical difference (P<0.05) between agro-ecologies on vaccination, types and disease occurrence due to variation of extension services and accessibility of vaccines between cluster (kebeles). This result was higher than Alemayehu (2017) report (97.8%) of

the respondent not used vaccination of chicken. Haben *et al.* (2020) also indicated that about (72.92%) of respondents did not vaccinate their chickens to prevent diseases and some of them about (27.08%) use vaccines. Some respondents used vaccines depending on the different types of diseases like Newcastle (22.92%), fowl pox (1.04%), and fowl typhoid (3.13%). But most (72.92%) do not know which type of disease occur and give vaccines in Damot Sore district in Wolaita zone, Ethiopia. Similar with the present study Woldemichael *et al.* (2019) and Yitbarek *et al.* (2016) report that Newcastle disease has the most commonly prevalent in the study area, and almost all producers did not know the types of disease that occurred in their chicken in North Shewa zone, Ethiopia and in and around Debre Markos, Ethiopia, respectively.

Table 20. Annual vaccination practices of respondents in the study areas

Variables	**Agro-ecological zones**				
	Highland (n=165) n (%)	Midland (n=115) n (%)	Total (N=280) N (%)	X^2-test	P-Value
Practice annual vaccination of chicken				**4.227(*)**	**0.040**
Yes	121[a](73.3)	71[b](61.7)	192(68.6)		
No	44[a](26.7)	44[b](38.3)	88(31.4)		
Against which disease vaccinate				**24.187(*)**	**0.000**
Newcastle	86[a](70.5)	70[b](98.6)	156(80.8)		
Fowl thiphoid	5(4.1)	-	5(2.6)		
Gumboro	17[a](13.9)	-	17(8.8)		
Fowl pox	2(1.6)	1(1.4)	3(1.6)		
Do not the name	12[a](9.8)	-	12(6.2)		
Chicken disease in your area				**14.942(*)**	**0.000**
Yes	131[a](79.4)	110[b](95.7)	241(86.1)		
No	34[a](20.6)	5[b](4.3)	39(13.9)		

*[a-b]= Least square means with different superscripts within a row are significantly different (P< 0.05); *= Significant at P<0.05; ns= not significant at P>0.05; n= Number of households from the two agro-ecologies; N= Total number of households.*

4.7.2. Traditional disease control measures and chicken movement practice

The current study result indicates that utilization of traditional treatment (45%), modern drugs (35.7%), keeping until recovery (7.5%) and using both traditional treatment and medicine (7.1%) were the main measures to be taken when birds are sick as shown in table 21. There was no variation (P>0.05) between agro-ecology. The survey also indicates that lemon juice (24.3%), white onion/garlic (16.4%), separate from diseased chickens (15.4%), herbs (endod, grawa, feto, koseret, damakese) (10.4%), hygiene and biosecurity (10%), green pepper & Chill powder (11.1%), Areke/Local alcohol with Green pepper (7.9%) and Smoking chicken house by weira (3.2%) were the main traditional disease control measures practiced by the respondents of the study area. There was significant variation (P<0.05) among agro-ecologies due to the accessibility of local medicines in the study area. The result indicates the use of medication was lower due to accessibility of drugs, extension service of health professionals, awareness of respondents, and cost of drugs in the study areas.

These results were somewhat similar and report by Alemayehu (2017) farmers mainly used neem leaf, local alcohol (locally termed as "Areke"), green pepper, white onion, hyena onion and Almond "senafich" (35.6%) followed by neem leaf (25.6%). Moges *et al*. (2010) state, provision of a mixture of local alcohol ("Areke'), lemon and onion to sick birds against NCD was the most widely use (42.9%) type of traditional treatments and some plant materials (herbs like 'semiza' and 'endod') (33.2%), use of tetracycline capsule (11.8%) and cutting around the wing of chicks to remove "infected" blood (7.1%). Mekonnen *et al*. (2017) also report, (11.8%) of the respondent use traditional methods for controlling disease they explained that they treat sick birds by administration of lemon, garlic, local alcoholic drinks "areke", spice "tinadam" by adding with feed and water.

In Ezha district predators such as shelemetmat, eagle/hawk, wildcats, dogs and monkeys were the leading causes of losses in exotic chickens table 22. The results of the present study revealed that about (70%) of respondent's encountered predator, also (41.1%), (21.1%), (19.3%), (9.3%) and (8.2%) were shelemetmat, eagle/hawk, wildcats, dogs and monkeys respectively. According to Abi (2018) report, (42.8%) and (38%) of the chickens mortality are attribute to wildcat (locally known as Adala) and eagle especially during the rainy season and

during the dry season respectively in Hidabu Abote district of North Shoa, Ethiopia. Thefts are another important cause for the loss of adult birds. According to Aberra (2007), about 46% of the respondents in Southern Ethiopia report, the wild birds (an eagle, hawk, etc.) are the most common predators during the dry season, while wild cat (locally known as Shelemetmat) is the most dangerous predator during the rainy season. Habte *et al.* (2017) report, NCD is the major causes of death for village poultry production followed by predation in rift valley of Oromia, Ethiopia. Similarly, chilfit/chulule, shelemetmat and wild cats are the major predators in poultry production.

Table 7. Measures on sick chickens, traditional control measures and most common predators in the study areas

Variables	**Agro-ecological zones**				
	Highland (n=165) n (%)	Midland (n=115) n (%)	Total (N=280) N (%)	X^2-test	P-value
Measure chickens are sick				**3.658(ns)**	**0.600**
Use traditional treatment	74(44.8)	52(45.2)	126(45)		
Use modern medicine	55(33.3)	45(39.1)	100(35.7)		
Slaughter	1(0.6)	-	1(0.4)		
Sale	9(5.4)	3(2.6)	12(4.3)		
Keep until recovery	12(7.3)	9(7.8)	21(7.5)		
Traditional & Medicine	14(8.5)	6(5.2)	20(7.1)		
Traditional control measures				**80.726(*)**	**0.000**
Gas + Oil with feed	4(2.4)	-	4(1.4)		
Green pepper & Chill powder	21(12.7)	10(8.7)	31(11.1)		
Local alcohol + Green pepper	3^a(1.8)	19^b(16.5)	22(7.9)		
White onion /Garlic	35^a(21.2)	11^b(9.6)	46(16.4)		
Lemon juice	20^a(12.1)	48^b(41.7)	68(24.3)		
Medicinal plants	28^a(17)	1^b(0.9)	29(10.4)		
Separate from diseased	23(13.9)	20(17.40)	43(15.4)		
Hygiene and biosecurity	22^a(13.3)	6^b(5.2)	28(10)		
Smoking chicken house by	9^a(5.5)	-	9(3.2)		
Most common predators				**33.148(*)**	**0.000**

Wild cat	31(18.8)	23(20)	54(19.3)
Eagle/hawk	36(21.8)	23(20)	59(21.1)
Shelemetmat /weasel	79[a](47.9)	36[b](31.3)	115(41.1)
Dog	16(9.7)	10(8.7)	26(9.3)
Aner	2(1.2)	1(0.9)	3(1.1)
Monkey	1[a](0.6)	22[b](19.1)	23(8.2)

*[a-b]= Least square means with different superscripts within a row are significantly different (P< 0.05); *= Significant at P<0.05; ns= not significant at P>0.05; n= Number of households from the two agro-ecologies; N= Total number of households.*

4.8. Exotic Chicken Culling Practice

The information record for culling practices of chicken is presented in table 22. Most (93.6%) of the respondents cull chicken due to different factors. The main factors for culling chickens were for sale (61.8%), consumption (26.4%), both consumption and sale (11.1%) and consumption, sale & sacrifice (0.7%).

In the study area about (94.6%) of respondent was cull due to expected disease outbreak and (5.4%) cull due to already sick the chicken. In addition, the old age for hens to be culled 29.6 ± 9.515 month. According to the study's result, midland chickens are to be culled later age than highland chickens. There was a significance difference (P<0.05) between agro-ecologies of culling chicken, factors for culling, and old age of hens to be culled. Somewhat similar results have report by Almaz (2015) most of the respondents (87.5 %) cull chickens due to different reasons. The main reasons for culling record are old age (38.1%), old age and sickness (20%) poor productivity (16.3%), old age with poor productivity and sickness (8.1%) and old age with poor productivity (5%). From the total (12.5%) of the respondents are not culling their chickens by any means in Dugda woreda, East- Shewa Zone, Ethiopia.

Table 22. Culling practices and determinant factors in the study area

Variables	**Agro-ecological zones**				
	Highland (n=165) n (%)	Midland (n=115) n (%)	Total (N=280) N (%)	X^2-test	P-value
Cull Chickens purposely				**7.713(*)**	**0.011**
Yes	160(97)[a]	102(88.7)[b]	262(93.6)		
No	5(3)[a]	13(11.3)[b]	18(6.4)		
Culling practices				**19.345(*)**	**0.000**
Consumption	38(23)	36(31.3)	74(26.4)		
Sale	96(58.2)	77(67)	173(61.8)		
For consumption and sale	29(17.6)[a]	2(1.7)[b]	31(11.1)		
For consumption, sale and sacrifice	2(1.2)	-	2(0.7)		
Old age for hens to be culled (in months)	27.64±8.830	32.4±9.796	29.6±9.515		**0.018(*)**

*[a-b]= Least square means with different superscripts within a row are significantly different (P<0.05); *= Significant at P<0.05; ns= not significant at P>0.05; n= Number of households from the two agro-ecologies; N= Total number of households.*

4.9. Agricultural Extension services

The information obtained on access to agriculture extension services to respondents to improve chicken production in the study area is presented in table 23. This table shows that the majority (97.1%) of the respondents get access to extension services, while only (2.9%) has no access to extension service on chicken production. There was no significant difference (P>0.05) between agro-ecologies.

The result in the present study was higher than Almaz (2015) report that only (33.1%) of the respondents are access to extension services, while the majority of the respondents (66.9%) are no access to the extension service for poultry production. Reasons for not using extension service indicate, respondents have not heard of extension service (23.8%), cannot easily reach extension people (36.9%), and did not feel any need of the service (6.3%). In addition, Haben *et al.* (2020) report that most respondents (89.58%) did not get the extension service from the health centre and only (10.42%) of the respondents got this service.

The result in the present study revealed that (87.9%) of the respondents confirmed they had discussed their chicken production-related problems with the extension agent whereas (12.1%) of the household had not discussed their chicken production problems. This might be because the development agent assigned in the area were focused on animal production due attention towards improving animal productivity by separating agriculture & natural resource development from Livestock & Fishery resource development Bureau up to offices in the last five years and also the sample respondents were chicken produce relatively in extension package. These extension agents were specialized in animal science, plant science or natural resources conservation and found acted mainly on their profession and status their education varies from diploma to degree. There was no significant different at (P>0.05) between agro-ecologies.

The result in present study was higher than Alemayehu (2017) reveal that (42%) of the respondents confirm they have discuss about their chicken production related problems with the majority development agent whereas (58%) of the household has not discuss about their chicken production, because of the development agent assign in the area were focus only on crop production. Therefore, three development agents per farmer kebeles of most administrative districts of the region, including the study district assigned by the ministry of

agriculture and rural development, have given due attention towards improving agricultural productivity.

The result was also higher than Fisseha (2009) reveal that (37.5%) of chicken owner farmers getting proper agricultural input, facilities extension services related to village chicken production like; advisory service, training, credit & also lack of access to get extension agents (31.8%) in Bure Woreda, North West Amhara and Halima (2007) report that (52.5%) in north-west, Ethiopia.

The frequency of extension service available the household gets the service in study area once in a week, once in two weeks, once in a month and not seen were (56.1%), (29.6%), (12.9%) and (1.4%), respectively according to the number of development group within PA's and performance of development agent that needs governmental intervention to increase the frequency and the effectiveness to play role in the food security and increase available protein source food table 23.

Table 23. Provision of extension service on exotic chicken production in the study district

Variables	**Agro-ecological zones**				
	Highland (n=165) n (%)	Midland (n=115) n (%)	Total (N=280) N (%)	X^2-test	P-Value
Access to extension service				**0.043(ns)**	**1.000**
Yes	160(97)	112(97.4)	272(97.1)		
No	5(3)	3(2.6)	8(2.9)		
Frequency of extension				**2.439(ns)**	**0.486**
Once in a week	89(53.9)	68(59.1)	157(56.1)		
Once in two weeks	48(29.1)	35(30.4)	83(29.6)		
Once in a month	25(15.2)	11(9.6)	36(12.9)		
Not seen	3(1.8)	1(0.9)	4(1.4)		
Discuss production problem				**1.275(ns)**	**0.270**

Yes	148(89.7)	98(85.2)	246(87.9)
No	17(10.3)	17(14.8)	34(12.1)

*[a-b]= Least square means with different superscripts within a row are significantly different (P<0.05); *= Significant at P<0.05; ns= not significant at P>0.05; n= Number of households from the two agro-ecologies; N= Total number of households.*

Provision of training for chicken owner on exotic chicken production practices is given in table 24. Accordingly, majority (74.3%) of the respondents got training on exotic chicken production management practices and (25.7%) respondents did not get any training. More than half (57.5%) of the respondents got training before starting chicken production but less than half (42.5%) of them got training after starting of exotic chicken production. There was a significant different at (P<0.05) between agro-ecologies of training on exotic chicken production.

There was provision of credit facility to the chicken owners (51.4%) but there was no provision of credit facility (48.6%) for use of exotic chicken production in the district table 24. This might be because of NGO combine the farmers within kebele in a group, join weekly and then saving money and used for credit services for improvement of chicken production. The purpose to use credited money was almost half for buying chicken (48.3%), for buying chicken feed (30.3%), for chicken equipment (9%), for construct chicken house (6.9%) and for all chicken input (5.5%). There was significant different at (P<0.05) between agro-ecologies of got credit service and purpose to use credit. This observation has the opposite of Alemayehu (2017) and Aklilu *et al.* (2007); Moges *et al.* (2010) and Takele and Oli (2011) report, Credit service for exotic chicken production has not provide in the district.

Provision of training for chicken owner on exotic chicken production and relevant technical extension package seems to be a better performance in the area of rural household chicken production. This is because of NGO found in the district to provide training before start to rearing, to provide packaged exotic chickens and to facilitate credit service. This is higher than Meseret (2010) and Mengesha *et al.* (2011) and also Desalew *et al.* (2013) report better extension services (47.2%) on collective basis in south Wollo, Jamma district and Ada'a and Lume districts respectively. The opposite of Haben *et al*. (2020) report, most of the poultry owners (93.75%) didn't get the training about production to improve breeding and increase the sector. However, only (6.25%) of owners got training in Damot Sore District in Wolaita Zone and Hailemichael *et al.* (2017) only one-fourth of the households participated in

training on improved poultry.

Table 24. Training and credit service to respondents in the study areas

Variables	**Agro-ecological zones**				
	Highland (n=165) n (%)	Midland (n=115) n (%)	Total (N=280) N (%)	X^2-test	P-Value
Any training on production				**32.238(*)**	**0.000**
Yes	143[a](86.7)	65[b](56.5)	208(74.3)		
No	22[a](13.3)	50[b](43.5)	72(25.7)		
When given training				**1.021(ns)**	**0.367**
Before starting the business	89(59.7)	34(52.3)	123(57.5)		
After the business started	60(40.3)	31(47.7)	91(42.5)		
Credit service to start Business				**17.360(*)**	**0.000**
Yes	102[a](61.8)	42[b](36.5)	144(51.4)		
No	63[a](38.2)	73[b](63.5)	136(48.6)		
Purpose did use the credit				**29.781(*)**	**0.000**
For chicken	35[a](34)	35[b](83.3)	70(48.3)		
For chicken feed	39[a](37.9)	5[b](11.9)	44(30.3)		
For equipment	13[a](12.6)	-	13(9)		
For construct house	9(8.7)	1(2.4)	10(6.9)		
For all input	7(6.8)	1(2.4)	8(5.5)		

*[a-b]= Least square means with different superscripts within a row are significantly different (P<0.05); *= Significant at P<0.05; ns= not significant at P>0.05; n= Number of households from the two agro-ecologies; N= Total number of households.*

4.10. Marketing

The result of the current study obtained for market access to buy chicken production inputs is presented in table 25, and it indicates that (96.1%) of respondents got market access for procurement of production inputs and (97.1%). There was a significant difference (P<0.05) between agro-ecologies of market access for chicken products due to more suppliers in midland agro-ecology main town, Agena, but there was no significant difference (P>0.05) between agro-ecologies of market access for chicken production inputs.

This result was the same as Tegegne (2012) reveal that (94.4%) has good market access and only (5.6%) has poor market access to sale eggs and chicken under village production system in East Shewa, Ethiopia. But this result has higher than the result of Almaz (2015) for market access to buy chicken production inputs and almost similar to sale of poultry products (81.9%) of the respondents for procurement of production input and (94.6%) for marketing of eggs and chicken in study district has good market access. Also Desalew *et al.* (2013) for good market access for production inputs (75.6%) and good market access for eggs and chicken (81.7%) in East Shewa, Ethiopia. In addition this result was higher than Haben *et al.* (2020) reveal that the marketing of the poultry and its products were about (93.75%) of the respondent has market access; because it depends on the holydays or festivals. According to Tilahun and Mitiku (2019) higher product price has recorded in secondary market both in chicken and egg. The price of products has almost double when compared between farm gate and secondary market in Central Ethiopia.

Government & private company (32.9%), private company & merchant (28.9%), government (28.2%), NGO (7.5%) and cooperative (2.5%) were the identified selling Institution of chicken production inputs in the study areas table 25. There was significant difference (P<0.05) across agro-ecologies. In this report, the respondent buys medicine and vaccine from the government and commercial feed and equipment from private company.

Table 25. Market access for chicken products and buying production inputs in Ezha district

Variables	**Agro-ecological zones**				
	Highland (n=165)	Midland (n=115)	Total (N=280)		
	n (%)	n (%)	N (%)	X^2-test	P-value
Market access to buy input				**0.091(ns)**	**0.764**
Yes	159(96.4)	110(95.7)	269(96.1)		
No	6(3.6)	5(4.3)	11(3.9)		
Buying production inputs				**22.051(*)**	**0.000**
NGO	19[a](11.5)	2[b](1.7)	21(7.5)		
Government	55[a](33.3)	24[b](20.9)	79(28.2)		
Private company and	37[a](22.4)	44[b](38.3)	81(28.9)		
merchant Cooperative	6(3.6)	1(0.9)	7(2.5)		
Government and private company	48(29.1)	44(38.3)	92(32.9)		
Market access for products				**5.912(*)**	**0.020**
Yes	164[a](99.4)	109[b](94.8)	273(97.5)		
No	1[a](0.6)	6[b](5.2)	7(2.5)		

*[a-b]= Least square means with different superscripts within a row are significantly different (P<0.05); *= Significant at P<0.05; ns= not significant at P>0.05; n= Number of households from the two agro-ecologies; N= Total number of households.*

During Holidays & festivals (38.6%), for personal money requirement (21.8%) and a specific weight gain (19.6%) was the top three times to sell chicken products to the market table 26. A more number of respondents in the study districts were selling their chickens during holidays & festivals in Ezha district. The results obtained for selling time and consumer preference report by Desalew *et al.* (2013) show that mostly (73.3%) selling time has according to their money requirement in both districts. However, (24.4%) and (23.3%) respondents sold their chicken and eggs during festivals and holydays in Ada‟a and Lume

districts, respectively.

In both agro-ecologies, respondents sell chicken and eggs using a calendar system to look for a reasonable price and consumers during festivals and holidays. This reflected to the fact that respondents preferred to sell at higher prices, as the price of eggs and chicken is highly demanded and agreed to the report of Halima (2007); Wilson (2010) and Dinka *et al.* (2010). According to Tilahun and Mitiku (2019), even if the price of chicken is higher at all festive periods, the price of chicken became double at Ethiopian New year. compare to any other festive period of the year in Central Ethiopia.

The same table 26 also shows beneficial marketing structure in study district obtained from the study results was the majority sell by a nearby town, Agena (59.3%), village market (14.3%), sale at home (13.6%) and middlemen or trader (12.9%). There was a significant difference ($P<0.05$) across agro-ecologies when sold chicken products and beneficial marketing structure.

Table 8: Time for chicken product selling and beneficial market in Ezha district

Variables	**Agro-ecological zones**				
	Highland (n=165) n (%)	Midland (n=115) n (%)	Total (N=280) N (%)	X^2-test	P-value
Time of sell products				**38.991(*)**	**0.000**
Specific weight/age	34(20.6)	21(18.3)	55(19.6)		
Money requirement	22[a](13.3)	39[b](33.9)	61(21.8)		
Holiday and festival	58(35.2)	50(43.5)	108(38.6)		
Specific wt /age, money requirement and holidays	39[a](23.6)	5[b](4.3)	44(15.7)		
Specific wt/age and personal money requirement	3(1.8)	-	3(1.1)		
Specific wt/age and holidays	9(5.5)	-	9(3.2)		
Beneficial market				**47.561(*)**	**0.000**

Sale at home	10^{a}(6.1)	28^{b}(24.3)	38(13.6)
Village market	38^{a}(23)	2^{b}(1.7)	40(14.3)
Middle men	29^{a}(17.6)	7^{b}(6.1)	36(12.9
Nearby town	88^{a}(53.3)	78^{b}(67.8)	166(59.3)

*$^{a-b}$= Least square means with different superscripts within a row are significantly different (P< 0.05); *= Significant at P<0.05; ns= not significant at P>0.05; n= Number of households from the two agro-ecologies; N= Total number of households.*

4.11. Production Performances of Exotic Chickens

The production performances of exotic chicken breeds under village management system are shown in (Table 27).

4.11.1. Egg production performance

The average egg production performances of exotic chicken breed under village management system were shown in table 27. The average number of egg laid/hen/year was 223.99±26.881 (224.37±28.477 highland & 223.44±24.522 midland) eggs in Ezha district. There was significant difference (P<0.05) between agro-ecology. Egg production is characterized by the number of eggs in a clutch and the period between clutches, where oviposition fails to occur because of pause, which results in missing egg between clutches (Sakunthaladevi *et al.* 2011). The current study was lower than those report by Almaz (2015) the average number of egg laid/hen/year of improved breeds Isa brown, White leghorn and Fayoumi breeds are (248.82±33.211, 256.21±40.364 and 253.33±31.920) eggs, respectively in Dugda district East Shewa, Ethiopia; and also lower than those report by Desalew *et al.* (2013) for IB (276.1) and BB (266.3). Aman *et al.* (2017) average egg production per month of Bovans brown was (22.2) in three agro-ecologies of SNNPR and also Gebremariam *et al.* (2017) (235.86±3.02) for exotic chickens in Southern Tigray, North Ethiopia.

On the other side, the result of the current study was higher than PK (187.04 eggs) report by Desalew *et al.* (2013), Sasso per month (16.2 eggs) report by Aman *et al.* (2017) and exotic chicken (184 eggs/hen/year) report by Abi (2018) in East Shewa, Ethiopia, in three agro-ecologies of SNNPR, Ethiopia and in Hidabu Abote district of North Shoa, Ethiopia respectively. As Assefa *et al*. (2019) report that, the number of eggs per hen per year for Sasso was (133±22.3) in two agro ecologies under the traditional management system. Tilahun and Mitiku (2019) also report that (174.27±1.12) eggs /hen/year in crossbred village chickens in

Central Ethiopia. According to respondents in the present study exotic layers mainly BB chicken requires balanced diet to sustain maximum egg production overtime.

The egg production performance the Egyptian Fayoumi, Rhode Island Red and White Leghorn has report to be (156, 185 and 176 eggs/year) respectively (Abraham and Yayneshe, 2010). The variation in exotic chicken's performance of this study relative to other studies could be associated to many factors, mainly variations in availability of feed resources for scavenging, agro-ecological impacts, socio-economic status and management system of chicken owners.

4.11.2. Number of eggs per clutch

The average numbers of eggs per clutch of exotic chicken breed under village management system was shown in table 27. The average number of egg/clutch/hen was 53.59±12.235 (53.44±11.539 highland & 53.81±13.218 midland) eggs in Ezha district. There was no significant difference (P>0.05) between agro-ecology. The present study of egg production/clutch/hen was higher than reported by Alem (2014) (38.5 and 45.2) in lowland and highland agro-ecological zone of central Tigray in exotic chicken (RIR), respectively. In addition, the result has higher than Abi (2018) (35.2±2.457) in Hidabu Abote district of North Shoa, Ethiopia in exotic chickens, Sisay *et al.* (2017) (31.24) for BB, (34.5) for Koekoek, (40.1) for BW in North western Amhara, Serkalem *et al.* (2019) (26.2) for Koekoek, (25) for BB and (25.1) eggs for Sasso breeds of chickens and Tilahun and Mitiku (2019) (18.11±0.10) for crossbred in Central Ethiopia. As Assefa *et al.* (2019) report that, number of eggs per clutch for Sasso has (25.1±2.9) in two agro ecologies under traditional management system. But the current result was lower than CSA (2017/18) who report (169) eggs form exotic chickens. The number of eggs laid per clutch in Ethiopia is ranged from 10.10 to 21.0. The high productivity of the exotic hens obtained in this study could be due to good management practice (feeding, housing, and health care) and difference in breed of the exotic chickens.

4.11.3. Number of days/clutch (Clutch Length)

The average numbers of days per clutch of exotic chicken breed under the village management system were shown in table 27. The average number of days/clutch/hen was 76.10±14.644 (73.93±14.321 highland & 79.23±14.599 midland) eggs in Ezha district. There was no significant difference (P>0.05) between agro-ecology. The present study was higher than report by Alem (2014) (44.4) days for exotic chickens (RIR) in lowland and midland

agro-ecological zones of Central Tigray, Ethiopia, Sisay *et al.* (2017) (31.9) days for BB, (34.7) days for Koekoek and (42.5) days for BW. But the current result was lower than report by CSA (2017/18) (133) days for exotic chickens. In addition, the average length of egg-laying period/hen has also determined in breeds and environmental managements systems of which estimated numbers of days have (21, 36 and 105 days) for local, hybrid and exotic breeds, respectively (CSA, 2011). The observed differences between agro-ecologies regarding the number of clutches per year, eggs per clutch and clutch length could be due to genetic and environmental differences. Moreover, this difference might be due to differences in management (health care, feed type and feeding frequency) and weather conditions in agro-ecologies of the study districts. Clutch number and clutch length of exotic breed hens were hardly identified by the farmers because it was very difficult for the farmers to know whether the interruption of egg production is due to the nature of the hen or a shortage of feed because exotic breeds are sensitive to feed shortages.

4.11.4. Number of clutch/hen (Clutch Size)

The average numbers of clutch per year of exotic chicken breed under village management system was shown in table 27. The average number of clutch/year/hen was 3.69±0.763 (3.65±0.888 highland & 3.73±0.535 midland) in Ezha district. There was significant difference ($P<0.05$) between agro-ecology. Despite their breed, the overall number of clutch size observed in different parts of the country under Smallholders' is various, and it ranges between (2.7 and 4.3) per year. The observe differences among countries with respect to number of clutches per year might be relate to the practices taken by the farmers to break broodiness. This concurred to Nebiyu *et al.* (2013), who report that farmers break broodiness by taking the hen to other places for few days, piercing the nostrils with feathers, hanging the hen upside down for about 2 to 3 hours per day for consecutive 3 days so as to increase the number of clutches. The present study of number of clutches/year/hen (clutch size) was higher than (3.2) Alem (2014) for exotic (RIR) chicken breed and lower than Sisay *et al.* (2017) (4.3) for BB, (3.9) for BW and (3.9) for Koekoek breeds. According to Sisay *et al.* (2017) Bovans Brown, Bovans white, and Koekoek exotic breed hen didn't show broody nature but having clutch nature when they are out of production due to poor management practices (during feed shortage) because of commercial layer (BB and BW) has sensitive for feed shortage.

4.11.5. Market (slaughter) age of cock

Market (slaughter) age of cock per month of exotic chicken breed under village management

system was shown in table 27. The Market (slaughter) age of cock/month was (6.26±1.497) (6.41±1.865 highland & 6.05±0.632 midland) eggs in Ezha district. There was a significant difference (P<0.05) between agro-ecology. This result has report by Aman *et al.* (2017). The average age of slaughter in all agro-ecologies of SNNPR, Ethiopia, has higher than Sasso (5.3±1.3 months) but lower than Bovans brown (6.6±1.3 months) chicken.

4.11.6. Market (slaughter) age of hen

The average market (slaughter) age of hen per month of exotic chicken breed under village management system was shown in table 27. The Market (slaughter) age of hen/month was (6.74±4.932) (6.93±6.404 highland & 6.46±0.629 midland) eggs in Ezha district. There was significant difference (P<0.05) between agro-ecology. The current study was higher than Kejela (2020) report that (5.83 ± 0.48) for Sasso and (6.08 ± 0.49) for BB chicken under farmers' management and their roles at urban household economy in Southern Ethiopia.

4.11.7. Market/slaughter weight of male chicken

The average market (slaughter) weight of cock in Kg of exotic chicken breed under the village management system was shown in table 27. The Market (slaughter) weight of Sasso cock in Kg was 3.13±0.812 (3.27±0.804 highland & 2.99±0.809 midland) in Ezha district. There was no significant difference (P>0.05) between agro-ecology. The present study was almost in line with CSA (2010/11) body weight of male Sasso chicken at sexual maturity has to be around (2.98 kg). The current study was in line with Melese *et al.* (2010) record that Sasso chicken type has higher weights (2.6-3.2 kg at 28 weeks). Also, Aman *et al.* (2017) report that the body weight of male Sasso chicken at sexual maturity has to be around (2.98 kg) and Kejela (2020) report that, (2.99 ± 0.31) for Sasso (2.91 ± 0.41) for BB chicken under farmers' management and their roles at urban household economy in Southern Ethiopia. The variation in observations could be attributed to the differences in market age of the chicken and feeding management.

4.11.8. Market/slaughter weight of hen

The average market (slaughter) weight of hen in Kg of exotic chicken breed under village management system was shown in table 27. The Market (slaughter) weight of adult Sasso hen in Kg was (2.94±0.760) (3.00±0.797 highland & 2.88±0.729 midland) in Ezha district. There was no significant difference (P>0.05) between agro-ecology. The current survey was almost similar with Kejela (2020) report that, (2.82 ± 0.39) for Sasso chicken under farmers'

management and their roles at urban household economy in Southern Ethiopia. This result was higher than Desalew *et al*. (2013) report the adult female body weights are (1.54 kg, 1.55 kg and 1.64 kg) for IB, BB and PK chicken groups, respectively and also Almaz (2015) reported the average body weight of mature egg laying hen are observed as (1.49±0.168 kg) for IB, (1.48±0.212 kg) for WLH and (1.47±0.204 kg) for Fayoumi breed of chickens. Kejela (2020) reported that (2.65 ± 0.24) for BB chicken under farmers' management and their roles at urban household economy in Southern Ethiopia. The present study was somewhat similar with CSA (2011) reveal that the weight of female Sasso chicken at the age of greater than 20 weeks was (2.73 kg). Aman *et al.* (2017) also report that, the weight of female Sasso chicken at the age of greater than 20 weeks are (2.73 kg). The variation in observations could be attributed to the differences in market age of the chicken and feeding management.

Table 9. Production Performances of exotic chickens in the study area

Variables	Agro-ecological zone	N	Mean	SD	P-value
Mean number of eggs laid/hen/year	Highland	165	224.37	28.477	(*)
	Midland	115	223.44	24.522	
	Total	280	223.99	26.881	
Mean number of egg/clutch	Highland	165	53.44	11.539	(ns)
	Midland	115	53.81	13.218	
	Total	280	53.59	12.235	
Mean number of days/clutch	Highland	165	73.93	14.321	(ns)
	Midland	115	79.23	14.599	
	Total	280	76.10	14.644	
Mean number of clutch/hen	Highland	165	3.65	0.888	(*)
	Midland	115	3.73	0.535	
	Total	280	3.69	0.763	
Mean market (slaughter) age of cock/month	Highland	165	6.41	1.865	(*)
	Midland	115	6.05	0.632	
	Total	280	6.26	1.496	
Mean market (slaughter) age of hen/month	Highland	165	6.93	6.404	(*)
	Midland	115	6.46	.6288	
	Total	280	6.74	4.932	
Market/slaughter weight of cock in Kg	Highland	30	3.27	0.804	(ns)
	Midland	30	2.99	0.810	
	Total	60	3.13	0.812	
Market/slaughter weight of hen in Kg	Highland	30	3.00	0.797	(ns)
	Midland	30	2.88	0.730	
	Total	60	0.76	0.760	

**= Significant at P<0.05; ns= not significant at P>0.05; SD=Standard deviation; N= Total number of households*

4.12. Reproduction Performances of Exotic Chickens

The reproduction performances of exotic chicken breed under village management system were shown in (Table 28).

4.12.1. Sexual maturity of female chickens

The average age of hen at sexual maturity/month of exotic chicken under village production systems are given in table 28. The average age of hen at sexual maturity of present study was 5.02±0.739 (4.91±0.852 highland and 5.19±0.494 midland). There was a significant difference ($P<0.05$) between agro ecology. The difference in observations could be attributed to the genetic and environmental reasons (management system), which agrees with the reports of (Demeke, 2004; Fasil *et al.*, 2010; Lemlem and Tesfaye, 2010). The present study was somewhat similar with Demeke (2007) report that, the sexual maturity of White Leghorn under intensive and extensive management ranged from 149-169 days and almost in line with Abi (2018) report that, mean sexual maturity (months) has (4.8±0.057) in Hidabu Abote district of North Shoa, Ethiopia. But the current study was lower than Alem (2014) (6.4) months exotic female chickens, Sisay *et al.* (2017) (6.5) months BB, Serkalem *et al.* (2019) (5.6) months Sasso and BB in Central Tigray, North Western Amhara and Boricha district, Sidama zone, respectively.

4.12.2. Age of hen at first egg laying

The average (Mean ± SD) age of hen at first egg laying under village production systems are given in table 28. The average age of hen at first egg laying in months was 5.86±0.702 (5.88±0.773 highland and 5.83±0.588 midland). There was significant difference ($P<0.05$) between agro-ecology. This result was almost similar with Aman *et al.* (2017) report average first egg lay of Sasso breeds (5.9±1.5) and Almaz (2015) report (5.8 ±18 days) for Fayoumi breed in three agro-ecologies of SNNPR, and in Dugda woreda, East- Shewa zone, Ethiopia respectively. Relatively later in the study of Desalew (2012) which report (5.35 ± 0.45, 5.52 ± 0.44 and 5.11± 0.2) months for Isa Brown, Bovans Brown and Potchefstroom Koekoek respectively under village production system in East-Shoa, Ethiopia and also IB and White leghorn (5.5 ± 23 and 5.5 ±19), respectively. As Assefa *et al.* (2019) report, the age at first egg laying, for Sasso was (5.16 ± 24.6) in two agro- ecologies under traditional management system. The variation in observations of present study could be attributed to the differences in

reaching age at first egg among breeds and management practices (feeding, housing and disease).

4.12.3. Cock age at first mate

The average age of cock at first mate under village production systems are given in table 28. The average age in month of cock at first mate was 5.10±0.755 (5.03±0.899 highland and 5.20±0.463 midland). There was a significant difference (P<0.05) between agro-ecology. The current study is in line with Habte *et al.* (2017) reveal that, the overall mean age of exotic cock at first mating has (4.9 months) in Mezhenger and Sheka and in the Benchi-Maji zone, Ethiopia. The variation in observations of present study could be attributed to the differences in feeding management and temperature.

4.12.4. Reproductive lifespan of hen and cock

The average reproductive lifespan of hen under village production systems are given in table 28. The average reproductive lifespan of hen/year was 2.91±0.44 (2.82±0.252 highland and 3.04±0.626 midland). There was a significant difference (P<0.05) between agro-ecology. The average reproductive lifespan of cock/year was 2.77±0.767 (2.50±0.685 highland and 3.15±0.719 midland). There was no significant difference (P>0.05) between agro-ecology. The current study was lower than report by Abi (2018) the Mean length of reproductive life of exotic chickens has (4.4±0.240) in Hidabu Abote district of North Shoa, Ethiopia, Gebremariam *et al.* (2017) (3.48±0.05) for hens exotic chickens and (3.51±0.05) for male exotic chickens in On-Farm Southern Tigray, North Ethiopia. The lower reproductive lifespan of both sexes in the current study was due to strong extension service and accessibility of replacement of exotic chicken breeds in the study district, i.e. the respondents to replace early as the age of the exotic chicken increases, the production performances decreases.

4.12.5. Livability of exotic chickens

The average survival rate of chickens under village production systems are given in table 28. The average number of chickens received/purchased, survived till production, and mortality percentage was 12.61±15.708, 10.65±13.022 and 16.51%, respectively. There was no significant difference (P>0.05) between agro-ecology of chicken received, survived and mortality percentage. In an attempt to increase poultry production; hatchability and high level of survivability cannot be overlooking (Ajayi and Agaviezor, 2016). The current survey was similar with Aman *et al.* (2017) report that (22.70±17.9, 19.00±16.77 and 16.30%) for number

of chickens received, survived till production and mortality percentage respectively for Sasso breeds in SNNPR, Ethiopia, Kumar *et al.* (2014) (17.5%) for BW, and higher than report by the same authors (23.70±19.67, 20.40±19.83 and 13.92%) for number of chickens received, survived till production and mortality percentage respectively for BB breeds. The present report is lower than Birhane *et al.* (2017) (38.12%) mean mortality of exotic chickens, Addis and Malede (2014) (48.8%) for White leghorn & (33.3%) for RIR, Ewonetu (2017) (18.83%) for White leghorn & (44.5%) for Fayoumi, Tilahun and Mitiku (2019) (49.15) for crossbred, Kumar *et al.* (2014) (18.9%) for RIR and Reta *et al*. (2012) (18.6-25.4%) for RIR chickens. The present study was also lower than the report of Addis and Malede (2014) Rhode Island Red chicken breeds (33.3±8.25%) and White Leghorn (48.8±8.75%).

The major causes of mortality in the study district were lack of standard housing, and scavenging feeding practice leads to disease and predators especially in the early ages /till production/ of exotic chickens. Thus, improvement in managerial practices is necessary to reduce mortality of exotic chickens, since it is an important indicator for good welfare. Under village poultry production, prevailing diseases, predators, lack of proper health care, poor feeding and poor marketing information are report as constraint by Moges *et al*. (2010), Dinka *et al.* (2010) and Mengesha and Tsega (2011). The high mortality of chicks under village chicken production in the central highlands of Ethiopia is due to diseases, parasites, predation, lack of feed, poor housing and insufficient water supply (Tadelle, 2001).

Sonaiya and Swan (2004) report 50 to 100% mortality in Africa due to Newcastle disease whereas Moreki (2010) report higher rate of chicken mortality due to mismanagement, predator and diseases in the continent. This variation in mortality rate of chickens in different parts of Ethiopia and other African countries might be due to the variation in breed type or ecotype, agro-ecological differences, chickens health management, prevalence of predators, density of chickens kept, and season of the year (LayWel, 2006).

Table 10. Reproduction Performances of exotic chickens in the study area

Variables	Agro-ecological zone	N	Mean	SD	P-value
Mean age of hen at sexual maturity/month	Highland	165	4.91	0.8519	**(*)**
	Midland	115	5.19	0.494	
	Total	280	5.02	0.739	
Mean hen age at first egg laying	Highland	165	5.88	0.773	**(*)**
	Midland	115	5.83	0.588	
	Total	280	5.86	0.702	
Mean cock age at first mate	Highland	165	5.03	0.899	**(*)**
	Midland	115	5.20	0.463	
	Total	280	5.10	0.755	
Mean reproductive lifespan of hen/year	Highland	165	2.82	1.252	**(*)**
	Midland	115	3.04	0.626	
	Total	280	2.91	1.046	
Mean reproductive lifespan of cock/year	Highland	165	2.50	0.685	**(ns)**
	Midland	115	3.15	0.719	
	Total	280	2.77	0.767	
Mean number of chicks received at 6 weeks	Highland	120	12.23	9.208	**(ns)**
	Midland	115	13.01	20.437	
	Total	235	12.61	15.708	
Mean number of chickens survived till production	Highland	120	10.41	8.830	**(ns)**
	Midland	115	10.90	16.327	
	Total	235	10.65	13.022	
Mortality percentage/year	Highland	120	18.02	17.068	**(ns)**
	Midland	115	14.92	13.559	
	Total	235	16.51	15.496	

**= Significant at P<0.05; ns= not significant at P>0.05; SD=Standard deviation; N= Total number of households.*

5. CONCLUSIONS AND RECOMMENDATION

5.1. Conclusions

The study area's major exotic chicken production system was scavenging with seasonal/conditional supplements. The mean flock size/household in the study area was 10.5 chickens. The flocks were consistently dominated by laying hens for the purpose of egg production in both agro-ecologies. The large segment of extension packaged exotic chicken management practices were reported to be performed by men and chickens were kept for income generation, while most of the respondents reported using the chicken product, especially meat for household consumption mainly during holidays and festivals.

The performance of the exotic chicken breeds (Sasso and Bovans brown) was well in the study area, their contribution to the income of the households is very low and there are no any works that have been done on improved managements to enhance the production of chicken for livelihoods and their income. Most respondents' feeding practices were not fed as body requirements, means to give feed below or above the nutritive value of their chickens for growth, egg, and meat production Thus, improving the overall management system such as improved feeding, recommended housing and health care extension packages could be a better strategy to increase the egg and meat production potential of exotic chickens under village management conditions. Diseases and predators are reported to be the major causes of mortality in village exotic chickens in the Ezha district.

The survey presented in this study had produced a range of insights use fully for further research and development activities. More generally the finding of the study indicates options for up scaling and intensifying of exotic chicken production in the study area. There should be more use of inputs (Feeding, housing and disease control practices). From this study, it is concluded that there is variation exists between agro-ecologies in chicken productive and reproductive performance of the exotic chickens including the same breed in relation to available feed, temperature, disease and other environmental factors.

5.2. Recommendation

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

- Technical support needs for respondents and extension staff focusing on diseases control, improved recommended housing, and standard supplementary feeding system should be arranged to be successful in improving the productivity of exotic chickens.
- The respondents should be advised to provide adequate quality and quantity of feeds prepared at home at least cost in a regular manner for better production performance of exotic chickens.
- Thus, the livestock and fishery resource development office and producers should collaborate in the area of diseases and predators control and prevention, feed and breed improvement, and other management aspects.
- Outstanding effort has been done to improve farmers raising a small number of exotic chickens to increase their chicken number under intensive production system to improve chicken production and productivity. Generally in village chicken production, as number of chicken increased per household the chicken production also get attention and chicken management like type of feed, frequency of feeding, watering, recommended housing and marketing were improved. Finally, poultry owners should be creating a strong relationship with the veterinary and extension service center.
- Government, research institutions, private hatcheries and developmental organizations should give attention to village exotic chicken sector and its development.
- Locally available feed ingredients aim experimental study to minimize cost of production, and improving productivity in the Ezha district seems to be urgently needed.

6. REFERENCES

Aberra, M. 2000. Comparative Studies on Performance and Physiological Responses of Ethiopian Indigenous (Angete Melata) Chickens and Their F1 Crosses to Long Term Heat Exposure. PhD Dissertation. Martin-Luther University, Halle -Wittenberg Germany, pp: 127.

Aberra, M., 2007. Poultry Production and Management in the Tropics: Teaching material, Hawassa University, Colleague of Agriculture, Hawassa, Ethiopia. pp: 77-192.

Abera, B. and Geta. T., 2014. "Study on Challenges and Opportunities in Haramaya District, Eastern Ethiopia". International Journal of Science Research Publication 4.12, pp: 2250-3153.

Aberra, M. and Tegene N., 2011. Phenotypic and morphological characterization of Indigenous chicken population in Southern Region of Ethiopia. Animal Genetic Resource, 49, pp: 19-31.

Abi, T.S., 2018. Assessment of production performances and egg qualities of household poultry in Hidabu Abote district of North Shoa, Ethiopia. MSc Thesis, Jimma University, Ethiopia.

Abou-Elewa, E.M., Enab, A.A., Abdou, F.H., 2017. Sexual Maturity of Male Chickens According To Early Response of Semen Collection. IOSR Journal of Agriculture and Veterinary Science, 10, pp: 58-63.

Abraham, L. and Yayneshet, T., 2010. Performance of exotic and indigenous poultry breeds managed by smallholder farmers in northern Ethiopia. Livestock Research for Rural Development, 22, pp: 29.

Addis, G. and Malede, B., 2014. Effect of gene segregation on existing performance of chicken ecotypes in Ethiopia. Middle-East Journal of Scientific Research, 21, pp: 675-680.

Addisu, H., 2013. Phenotypic characterization of indigenous chicken ecotypes in North Wollo, Amhara Regional State, Ethiopia. Master's thesis, pp: 87.

Addisu, H., Hailu M. and Zewdu W., 2013. Indigenous chicken production system and Breeding practice in North Wollo, Amhara Region, Ethiopia. Poultry, Fisheries and Wild life science. Doi: org/10.41172/pfw.1000108.

Adugna, AA., et al., 2020. Effects of Fish By-product Meal Inclusion in Broiler Feeds on Growth Performance. Journal of Experimental AgricultureInternational 42.7,pp:76-81.

Ahmedin, A., 2016. Study of production practices, fertility, hatchability and egg quality of rural chicken in Gorogutu district, eastern Hararghe, Ethiopia. Asian Journal of Poultry Science 10, pp :111-116

Ajayi, F.O. and Agaviezor, B.O., 2016. Fertility and Hatchability Performance of Pure and Crossbred Indigenous Chicken Strains in the High Rainforest Zone of Nigeria. International Journal of Livestock Production, 7, pp: 141-144.

Aklilu H., Almekinders C., J.M., Van der Zijpp and A.J., 2007. Village poultry consumption and marketing in relation to gender, religious festivals and marketaccess. Tropical Animal Health and Production 39, pp: 165-168. DOI:10.1007/s11250-007-9002-8.

Alders, R., 2004. Poultry for profit and pleasure. FAO Diversification Booklet 3. Rome.

Alem, T., 2014. Production and Reproduction Performance of Rural Poultry in Lowland and Midland Agro-Ecological Zones of Central Tigray, Northern Ethiopia. British Journal of Poultry Sciences, 3, pp: 06-14.

Alemayehu, G.S., 2017. Characterization of Scavenging and Intensive Chicken Production and Marketing System in Lume District, East Shoa Zone, Oromia Region State, Ethiopia. MSc Thesis, Haramaya University, Haramaya.

Alemu, Y. and Tadelle, D., 1997. The Status of Poultry Research and Development in Ethiopia, Research Bulletin No.4, and Poultry Commodity Research Program Debre Zeit agricultural Research centre. Alemaya University of Agriculture, Ethiopia. pp: 62

Alemu, Y., H. Teklewold, L. Dadi and N. Dana, 2006 Determinants of adoption of poultry technology: a double-hurdle approach Livestock Research for Rural Development, 18(3).

Alemu, D., 2009. Overview and background paper on Ethiopia's poultry sector: Relevance for HPAI research in Ethiopia. A Collaborative Research.

Alganesh, T., Matewos, B. and Gizaw, K., 2003. Survey on traditional livestock production system. Proceeding 11th Annual Conference of Ethiopian Society of Animal production, Addis Ababa, Ethiopia, August 28-30, 2003, Pp: 141-150.

Almaz, A., 2015. Assessment of production performance of improved chickens under rural management practices in Dugda woreda, East- Shewa zone, Oromia region, Ethiopia. MSc Thesis, Addis Ababa University, Ethiopia.

Aman, G., Addisu, J., Mebratu, A., Kebede, H.G., Bereket, Z. and Teklayohannes, B., 2017. Management practices and productive performances of Sasso chickens breed under village production system in SNNPR, Ethiopia. J. Bio, Agri and Healthcare, 7, pp:

120-135.

Ararsa, B., Chala, E., 2020. Review on Productive and Reproductive Performance of Exotic Chicken Breed in Ethiopia. Acad. Res. J. Agri. Sci. Res. 8(3): 244-251

Asefa, T., 2007. Poultry management practices and on farm performance evaluation of Rhode Island Red (RIR), Fayoumi and local chicken in Umbullo Wachu watershed.

Assefa, M., Amanuel,. B., Tekalign, T., 2019. Characterization of Village Chicken Production and Husbandry Practices in Dedo District, Jimma Zone, South West Ethiopia. International Journal of Veterinary Science and Agriculture Research, 1, pp: 13-24.

Avery, A., 2004. Red meat and poultry production and consumption in Ethiopia and distribution in Addis Ababa. The World Food Prize Internship Report, International Livestock Research Institute (ILRI), Addis Ababa, Ethiopia, June-August 2004, pp: 1-64.

Bogale, K., 2008. Insitu characterization of local eco-type for functional traits and production system in Fogera woreda, Amhara regional state. MSc. Thesis, Haramaya University, Haramaya, Ethiopia.

Branckaert, R., Gaviria L., Jallade J., and Seiders R., 2000. Transfer of technology in Poultry production for developing countries.S6 D dimension. FAO http://www.fao.or/sd/cddirect/cdre0054.htm.

Brhane, G., Hailu, M., Tikabo, G., 2017. On-Farm Productive and Reproductive Performance of Local, Exotic and Crossbred Chickens in Southern Tigray, North Ethiopia. Journal of Biology, Agriculture and Healthcare, 7, pp: 42-50.

Bush, J., 2006. The Threat of Avian Flu Predicted Impacts on Rural Livelihoods in Southern Nation, Nationalities and Peoples Region (SNNPR), Ethiopia. The Food Economy Group, May 2006.

Byarugaba, D., 2007. The Structure and Importance of the Commercial and Village based Poultry Systems in Uganda. FAO -Consultancy Report.

Chiemela, P.N., Jun. H.L., Egbu, C.F., Seung-Hwan, L., 2018. Review on the Genetic Potential of Nigerian Local Chickens. Journal of Animal Breeding and Genomics, 2, pp: 199-211.

CSA (Central Statistical Agency), 2003. Central Statistical Authority, Statistical report on livestock and farm implements, part 4, Addis Ababa, Ethiopia.

CSA (Central Statistical Agency), 2010/11. Agricultural sample survey 2010/11, Volume

2: Report on livestock and livestock characteristics (prevent peasant pholdings). Statistical Bulletin 505, Addis Ababa, February 2011, pp: 1-21.

CSA (Central Statistical Authority), 2011. Agricultural sample survey vol. II; statistical bulletin no. 331, Addis Ababa, Ethiopia.

CSA (Central Statistical Agency), 2013. Agricultural sample survey 2012/13. Report on livestock and livestock characteristics, Statistical Bulletin Addis Ababa, Ethiopia, 2, pp: 570.

CSA (Central Statistical Agency), 2015. Report on area and production of crops, Agricultural Sample Survey: Time series data for national and regional level from 1995/96 to 2014/15. Addis Ababa.

CSA (Central Statistical Agency), 2017/18. Agricultural sample survey report on livestock and livestock characteristics. Volume II, Addis Ababa, Ethiopia.

CSA (Central Statistical Agency), 2020/21. Agricultural sample survey report on livestock and livestock characteristics. Volume II, Addis Ababa, Ethiopia.

Dawit, A., Tamrat, D., Stotaw, F., Nzietcheung, S. and Roy, D., 2008. Overview and Background Paper on Ethiopia's Poultry Sector. Relevance for HPAI Research in Ethiopia www.hpai-research net. Accessed 06 April 2011.

Demeke, S., 2004. Egg production performance of local and white leghorn hens under intensive and rural household conditions in Ethiopia. Livestock Research Rural Development Volume 16.

Demeke, S., 2007. Suitability of hay-box brooding technology to rural household poultry production system. Livestock Res. Rural Dev., Vol. 19.

Demeke, S., 2008. Study on egg production of white leghorn under intensive, semi-intensive and rural household conditions in Ethiopia. Livestock Res. Rural Dev. 1996; 8http://www.lrrd.org/lrrd8/2/ethiop1.htm.

Derbie, Z. and Mebrate, G., 2020. Review on Village Chicken Husbandry Practices, Productive and Reproductive Performances in Ethiopia. British Journal of Poultry Sciences 9, pp: 34-41

DANRD (Department of Agriculture and Natural Resource Development of Gurage Zone), 2016. Annual report. DANRD, Wolkite, Gurage Zone, southern Ethiopia.

DFED (Department of Finance and Economic Development of Gurage Zone), 2015. The Gurage zone 2015 socio economy abstract document. DFED, Wolkite, Southern Ethiopia.

Desalew, T., 2012. Management practices, productive performances and egg quality traits of exotic chickens under village production system in East Shoa, Ethiopia. MSc thesis, Addis Ababa University, Debre Zeit, Ethiopia.

Desalew, T., Sing, H., Ashenafi, M., Wendmenhe, E. and Tadelle, D., 2013. Study on productive performance and egg quality traits of exotic chickens under village production system in East Shewa, Ethiopia. African Journal of Agriculture Research.

Dessie, T., Alemu, Y. and Peters, K.J., 2000. Indigenous chicken in Ethiopia: Genetic potential and attempts at improvement. World Poult. Sci. Journal, 56, pp: 45-54.

Dessie, T. and Ogle, B., 2000. Nutritional status of village poultry in the central high lands of Ethiopia as assessed by analyses of crop contents. Eth. J. Agri. Sci., 17, pp: 47-57.

Dessie, T., 2001. The role of scavenging poultry in integrated farming systems in Ethiopia. Debre Zeit Agricultural Research Center, DebreZeit, Ethiopia. Livestock feed resources within 55 integrated farming systems. pp: 377-399.

Dessie, T. and Ogle, B., 2001. Village poultry production system in the central highlands of Ethiopia. Tropical Animal Health. Proceeding. 33, pp:521-537

Dessie, T., Nigusie, Alemu, Y. and. Peters, K..J., 2002. The feed resource base and its potentials for increased poultry production in Ethiopia. World's Poultry Science. Journal, 58, pp 77-87.

Dessie, T., Million, T., Alemu, Y. and Peters, K., 2003c. Village chicken production systems in Ethiopia: 2. Use patterns and performance valuation and chicken products and socio-economic functions of chicken. Lives. Res. for Rural Dev. 15 (1). http://www.lrrd.org/lrrd15/1/tadeb151.htm (accessed 19 May, 2012).

Dessie, T., Wondimeneh, E., L.V. Waaij, F. Zegeye, S. Gizaw, O., Mwai and J. van Arendonk., 2013. Village Chicken Production in the Central and Western Highlands of Ethiopia: Characteristics and Strategies for Improvement. International Livestock Research Institute, Nairobi, Kenya, ISBN-13: 9789291463411.

Dinka, H., Regassa, C., Fufa, D., Endale. B. and Leta, S., 2010. Major Constraints and Health Management of Village Poultry Production in Rift Valley of Oromia, Ethiopia. American-Eurasian J. Agric. Environ. Sci., 9 (5): 529-533.

Dirsha, D., 2009. Assessment of village Rhode Island Red chicken management practices in cheha woreda and evaluation of different levels of brewers dried grain on growth performance of the chicks. MSc Thesis, Haramaya University, Haramaya, Ethiopia.

Dolberg, F., 2007. Actors: Poultry as a Tool in Human Development. FAO, Rome, Italy.

Duncan, D. B., 1995. Multiple Range and F tests. Biometrics 11:1-42.

Dwinger, R.H., Bell, J.G. and Permin A., 2003. A program to improve family poultry production in Africa. B.P. 6268, Rabat-Institutes, Morocco.

Emebet, M. B., 2015. Phenotypic and genetic characterization of Indgenous chicken in southwest Showa and Gurage zones of Ethiopia. PhD dissertation, Addis Ababa University, Addis Ababa, Ethiopia. p 127.

Emebet, M. and Kidane, G. M., 2016. Importance of Traditional, Small Scale and Commercial Poultry Production in Ethiopia: A Review. British Journal of Poultry Sciences 5, pp: 01-08.

Endale, B., Hunduma, D., Regassa, Ch., Fufa, D., Samson, L., 2010. Socio- economic importance and management of village chicken production in rift valley of Oromia, Ethiopia Livestock Research. Rural Development. 22(11).

Ewonetu, K.S., 2017. Growth Performance and Rearing Costs of Fayoumi and White Leghorn Chicken Breeds. East African Journal of Sciences, 11, pp: 37-42.

Eyob, T.H., 2019. Morphological Characterization of Indigenous Chicken and their Production System in Silte, Dalocha and Wulbareg Woredas of Silt'e Zone, South Region, Ethiopia. MSc Thesis, Addis Ababa University, Ethiopia.

Fassill, B., Adnoy, T., Gjoen, H.M., Kathle J., Girma, A., 2010. Production Performance of Dual-Purpose Crosses of Two Indigenous with Two Exotic Chicken Breeds in Sub-tropical Environment. International Journal of Poultry Science, 9, pp: 702- 710.

Fanu, W.M., and Melkamu, E.G., 2019. Productivity and Egg Quality Traits of Sasso T44 Chicken in North Showa Zone, Ethiopia. Journal of Animal & Plant Sciences (J. Anim. Plant Sci.), 2019. Vol.39, Issue 3, pp: 6478-6486

FAO, 2007. Poultry sector country review, Animal Production and Health Division, Emergency center for trans- boundary animal diseases socio economics, production and biodiversity unit, Food and Agriculture Organization of the United, Nations, Rome., Italy.

FAO, 2008. Poultry production systems in Vietnam Prepared by Nguyen Van Duc and T. Long.GCP/RAS/228/GER Working Paper No. 4. Rome.

FAO, 2010. Chicken genetic resources used in smallholder production systems and opportunities for their development, by P. Sorensen. FAO Smallholder Poultry Production Paper No. 5. Rome.

FAO, 2011. Poultry Production and Its Contributions, News & Features Archive.

FAO, 2019. Poultry Sector Ethiopia. FAO Animal Production and Health Livestock Country Reviews. No. 11. Rome.

Fisseha, M., Azage, T. and Tadelle, D., 2007. Indigenous chicken production and marketing systems in Ethiopia: Characteristics and opportunities for market- oriented development. International livestock institute, ILRI, working paper No. 4, www.ilri.org, Ethiopia.

Fisseha, M., 2009. Studies on production and marketing system of local chicken ecotypes in Bure Woreda, North West Amhara M.Sc. Thesis, Hawassa University, Hawassa, Ethiopia.

Fisseha, M., Abera, M. and Tadelle, D., 2010. Assessment of village chicken Production system and evaluation of the productive and reproductive performance of local Chicken ecotype in Bure district, North West Ethiopia. African Journal of Agricultural Research Vol. 5(13), pp. 1739-1748.

Forment, P., Ouste, C., Pelletier, R., Brillard, J.P., 2009. Rôle de L'AMP-activated protein kinase dans l'activitē des cellules de Sertoli de coq immature (Gallus domesticus). Huitimes Journēes de la recherché avicole, St Malo., pp25-26.

Gebrewahd, T.T., 2017. A study on the constraints in housing and feeding management of chickens in intensive and free-range production systems in Minjar Shenkora district, Amhara Regional State, Ethiopia. Ethiopian Journal of Veterinary science and Animal production (EJVSAP) 1.1: 1-8.

Guni, F.S, Katule, A.M., Mwakilembe, P.A.A., 2013. Characterization of local chickens in selected districts of the Southern Highlands of Tanzania: II. Production and Morphometric traits. Livestock Research for Rural Development, 25 (11).

Getinet, H., 2007. Marketing and sales strategies of elfora agro-industries plc, Addis Ababa Ethiopia Google.com.

Getiso, A., Addisu, J., Mebratu, A., Kebede, H., Bereket, Z. and Teklayohannes, B., 2017. Management Practices and Productive Performances of Sasso Chickens Breed under Village Production System in SNNPR, Ethiopia. Journal of Biology, Agriculture and Healthcare. Vol.7, No.7, pp. 2224-3208.

Gueye, E. F., 2003. Poverty alleviation, food security and the well-being of the human population through family poultry in low income food-deficit countries. Senegalese Institute of Agricultural research (ISRA), B.P.2057, Dakar-hann,

Senegal.

Haben, F., Alemu, A., Saliman, A., 2020. Study on Management Practices and Constraints of Village Chicken Production in Damot Sore District in Wolaita Zone, Ethiopia. Acta Scientific Pharmaceutical Sciences 4.11, pp: 38-48.

Habte, T., Amare, A., Bettridge, J., Collins, M., Christley, R. and Wigley, P. 2017. Guide To chicken health and management in Ethiopia. ILRI Manual 25. Nairobi, Kenya: International Livestock Research Institute (ILRI).

Haftu, K.S., 2016. Exotic chicken status, production performance and constraints in Ethiopia: a review.

Hailemichael, A., Berhanu, G., & Azage, T., 2017. Status and drivers of village poultry production and its efficiency in Ethiopia, NJAS: Wageningen Journal of Life Sciences, 83:1, 30-38, DOI: 10.1016/j.njas.2017.09.003

Halima, H., Neser, F., Van Marle-Koster, E., De Kock, A., 2007. Village-based indigenous chickens' production system in north-west Ethiopia. Journal of Tropical Animal Health and Production, 39, pp: 189-197.

Hunduma, D., Regassa, C., Fufa, D., Endale, B. & Samson, L. 2010. Major Constraints and Health Management of Village Poultry Production in Rift Valley of Oromia, Ethiopia. American-Eurasian J. Agric. Environ.Sci., 9, pp: 529-533.

Kebede, H., Omer, D., Hussen, and Melak, A., 2012. Study on Status and Constraints of Village Poultry Production in Metema Woreda, North-Western Ethiopia. DOI: 10.5829/idosi.aejsr.2012.7.6.7233 American-Eurasian Journal of Scientific Research, 7, pp: 246-251.

Kedir, A.T., 2016. Studies on Poultry Management Practices, Marketing System and Effect of Feeding Fish Meal on Growth Performance and Carcass Characteristics of Koekoek Chickens in Bora District, East Shoa Zone. MSc Thesis, Hawassa University, Hawassa.

Kejela, Y., 2020. Production Performance of Chicken under Farmers' Management and Their Roles at Urban Household Economy in Southern Ethiopia. Agricultural Sciences, 11, pp: 178-190.

Kibreab, Y.W., Zelalem, A., Kassa, T. and Dekamo, F., 2016. Poultry Production, Management and Marketing System at Selected Districts of Kafa and Benchmaji Zone, South West Ethiopia". Journal of Biology, Agriculture and Healthcare 6.11, pp: 83-96.

Kothari, C.R., 2004. Quantitative Techniques, New Delhi, Vikas Publishing House Pvt. Ltd., .64, pp: 1978.

Kreuzer, S.M., M. Siegrist, K. Mannale, R. E. Messikommer, and I. D. M. Gangnat. 2018. Carcass and meat quality of dual-purpose chickens (Lohmann Dual, Belgian Malines, Schweizerhuhn) in comparison to broiler and layer chicken types Zurich, Switzerland. Poult. Sci. 0, pp:1–12.

Kumar, N., Zinabu, N.B, Abebe, M.S, Habtamu, T., 2014. Comparative Study of Performance of Rhode Island Red and Bovans White under Intensive Management in Mekelle, Ethiopia. International Journal of Livestock Research, 4, pp: 2277- 1964.

Lawrence, Y. K., Senyo, A., Isaac, K. A., Kwamena, M. N., 2015. The Challenges and Prospects of the Commercial Poultry Industry in Ghana: A Synthesis of Literature. International Journal of Management Sciences, 5, pp: 476-489.

Lay Wel., 2006. Welfare implications of changes in production systems for laying hens: a European project. (In particular Work Package 1: Laying hen welfare definitions and indicators. Available from: http://www.laywel.eu.

Lemlem, A. and Tesfaye, Y., 2010. Performance of exotic and indigenous poultry breeds managed by smallholder farmers in northern Ethiopia. Live. Res. for Rural Dev., 22:133. Retrieved from: http://www.lrrd.org/lrrd22/7/leml22133.htm.

Lohmann, T., 2016. Management Recommendations for the Rearing of Parent stocks in deep Litter, Perchery and free-Range systems (company's manual). Cuxhaven, Germany.

Mengesha, M., Tamir, B. and Dessie, T., 2011. Village Chicken Constraints and Traditional Management Practices in Jamma District, South Wollo, Ethiopia. Lives. Res.for Rural Dev., 23. Retrieved from: http://www.lrrd.org/lrrd23/2/meng23037.htm.

Matawork, M., 2016. Review on Exotic Chicken Status, Production Performance and Constraints in Ethiopia. Journal of Biology, Agriculture and Healthcare. Vol.6, No.15.

Mazengia, H., G. Siraw and M. Nega., 2012. Challenges and prospects of village-based exotic chicken development strategy in Amhara regional state, Northwest Ethiopia. Global J. Sci.Front. Research. Agriculture. Veterinary Science, Volume. 12.

McKay, J., 2008. The genetics of modern commercial poultry Proceedings of the 23 World's Poultry Congress, Brisbane, Australia, pp: 48.

Mekonnen, N., Begna, F. & Abraha, S., 2017. Husbandry Practices and Egg production Performances of Exotic Chicken Breeds in Assosa Town, Beneshangul Gumuze Region, Ethiopia; Advance Research Journal of Multidisciplinary Discoveries.18.0,C-14(2017):72-80; available at : http://www.journalresearchijf.com

Melkamu, B.Y., 2017. Management Practices and Constraints of Small-Scale Commercial Poultry Farms, and Performance Evaluation of Broilers Fed Diets Containing Graded Levels of Dried Blood Rumen Content Mixture. PhD Dissertation Addis Ababa University, Ethiopia.

Melesse, A., S. Maak and V.G. Lengerken, 2010. Effect of long-term heat stress on egg quality traits of Ethiopian naked neck chickens and their F1 crosses with Lohmann White and New Hampshire chicken breeds, Livestock Research Rural Development, 22(71).

Mengesha, M. and Tsega, W., 2011. Phenotypic and genotypic characteristics of indigenous chickens in Ethiopia: A review. African Journal Agriculture Research, 6(, pp: 5398-5404

Mersha, S.F. and Senbeta, E.K., 2020. Chicken Reproductive Performance in Ethiopia: Review. Turkish Journal of Agriculture - Food Science and Technology, 8(8): 1755-1762.

Meseret, M., 2010. Characterization of Village Chicken Production and Marketing System. MSc. Thesis, Jimma University, Ethiopia.

Mitiku, G., 2018. Poultry Production, Consumption, Marketing and Associated Challenges in Ethiopia. Jimma University, College of Agriculture and Veterinary Medicine, Department of Animal Sciences, Jimma, Ethiopia, British Journal of Poultry Sciences 7, pp: 16-28

MoA (Ministry of Agriculture), 1997. National Ruminant Livestock development strategy of Ethiopia, Addis Ababa, Ethiopia.

Moges, F, Mellesse, A. and Dessie, T. 2010. Assessment of village chicken production system and evaluation of the productive and reproductive performance of local chicken ecotype in Bure district, Northwest Ethiopia. African Journal of Agricultural Research. 5, pp, 1739-1748.

Moreda, E., 2015. Phenotypic and genetic characterization of indigenous chicken in southwest Showa and Gurage zones of Ethiopia. Ph.D. Dissertation, DebreZeit, Ethiopia.

Mube, H.K., Kana, J.R., Tadondjou, C.D., Yemdjie, D.D., Manjeli, Y.M. and Teguia, A., 2014. Laying Performances and Egg Quality of Local Barred Hens under Improved Conditions in Cameroon. Journal of Applied Biosciences, 74, 6157-6163.

Nebiyu, Y., Berhan, T., Kelay, B., 2013. Characterization of village chicken production

performance under scavenging system in Halaba district of southern Ethiopia, Ethiopian Veterinary Journal, 17, pp: 69-80.

Nebiyu, Y., 2016. Assessment of urban poultry production practices in Addis Ababa with emphasis on egg production, product marketing, feed quality and waste management, in Department of Animal Production Studies, College of Veterinary Medicine and Agriculture, Addis Ababa University.

Nigist, B. and Haben, F., 2020. Vaccine Failure in Poultry Production and its Control Methods: A Review. Biomedical Journal of Scientific and Technical Research 29.4: 22588-22596.

Negussie, D., 1999. Evaluation of the performance of local Rhode Island Red (RIR) and Fayoumi breeds of chicken under different management regimes in the high lands of Ethiopia. Tropical Animal Health and Production, 33, pp: 521-537.

Nzietchueng, S., 2008. Characterization of poultry production systems and potential pathways for the introduction of highly pathogenic avian influenza in Ethiopia. Draft Report. International Livestock Research Institute.

Padhi, M.K., 2016. Importance of Indigenous Breeds of Chicken for Rural Economy and Their Improvements for Higher Production Performance. Scientifica, 2016, Article ID: 2604685. https://doi.org/10.1155/2016/2604685

Ravindran, V., 2012. Poultry feed availability and nutrition in developing countries. Food and Agriculture Organization of the United Nations, Poultry Development Review.

Reta, D, Negussie, D, and Alemu, Y., 2012. Comparative production performance of two exotic chicken breeds under two different feed regimes in three agro-ecologies of central Oromia, Ethiopia - a step forward for distribution or contract rearing of day old exotic chicks under rural setting. Livestock Research for Rural Development 24 (9).

Sakunthaladevi, K., Ramesh, G.B., Gnana, P.M., Qudratullahi S, Rajasekhar RA., 2011. Genetic analysis of production, reproduction and clutch traits in Japanese Quails. Tamilnadu Journal of Veterinary and Animal Sciences, 7, pp: 126-132.

Salam, K.R., 2005: Improvement of village chicken production in a mixed (chicken-ram) farming system in Burkina Faso. PhD Thesis. Wageningen Institute of Animal Sciences, Animal Nutrition Group, Wageningen University, the Netherlands.

Salo, S, Tadesse G, Hilemeskel D., 2016. Village Chicken Production System and Constraints in Lemo District, Hadiya Zone, Ethiopia. Poult Fish Wildl Sci 4: 158.

Doi: 10.4172/2375- 446X.1000158.

Samson, L. and Endalew, B., 2010. Survey on Village Based Chicken Production and Utilization System in Mid Rift Valley of Oromia, Ethiopia. Global Veterinarian. Vol. 5, No. 4, pp: 198-203.

Schmidt, G.S., Figueiredo, E.A.P., 2005. Selection for Reproductive Traits in White Egg Stock Using Independent Culling Levels. Brazilian Journal of Poultry Science,7, pp: 231 -235.

Sekeroglu, A., Sarica, M., Demir, E., Ulutas, Z., Tilki, M. and Saatci, M., 2008. The effects of housing system and storage length on the quality of eggs produced by two lines of laying hens. Archivfür Geflügelkunde, 72, pp: 106-109.

Serkalem, A., Aberra, M. and Sandip, B., 2018. Egg production and linear body measurement traits of local and three exotic chicken genotypes reared under two agro-ecological zones. International Journal of Ecology and Ecosolution. 5(2), pp: 18- 23.

Serkalem, A., Aberra, M. and Sandip, B., 2019. Egg Production and Egg Quality Traits of Local and Exotic Chicken Breeds Reared in Two Agro-ecologies under Traditional Management System", Research Journal of Food and Nutrition, vol. 3, no. 1, pp: 11-17.

Sheila and Sara., 2007. Poultry industry review, Department of Animal Science, University of Ruhuna. Published in Poultry Science, Volume 86.

Shishay, M., 2014. Phenotypic characterization of local chicken ecotypes in Western zone of Tigray, Northern Ethiopia, MSc Thesis, Jimma University, Ethiopia.

Sisay, T., Kefeyalew, A., Zewdu, W., 2017. Population Dynamics and Performance of Exotic versus Indigenous Chickens Population in the Selected Districts of North Western Amhara, Ethiopia. Tropical Dry lands, 1, pp: 90-99.

Sisay, F.M., and Ewonetu K. S., 2020. Chicken Reproductive Performance in Ethiopia: Review. Food Science and Technology, 8, pp: 1755-1762.

Solomon, D., 2007. Poultry Sector Country Review: Ethiopia. Food and Agriculture Organization of the United Nations 2007, Re-edited September 2008. Jimma, Ethiopia.

Solomon, D., 2008. The structure, marketing and importance of the commercial and village poultry industry an analysis of poultry sector in Ethiopia. A consultancy report to FAO, Addis Ababa, Ethiopia.

Sonaiya, E.B, Swan, S.E.J., 2004. Incubation and Hatching, Small-scale Poultry Production Technical Guide, Animal Production and Health, Food and Agriculture Organization of

the United Nations, Rome.

SPSS (Statistical Package for Social Sciences), 2007. SPSS for windows. User's guide Statistics version 21.

Tadesse, D., Singh, H., Ashenefi, M., Wondimeneh, E. and Tadelle, D., 2013. Study on management practices and marketing systems of village chicken in East Shewa, Ethiopia. African Journal on Agriculture Research, 8(22):2696-2702.

Takele, T. and Oli, W., 2011. Uses and flock management practices of scavenging chickens in Wolaita Zone of southern Ethiopia. Trop. Anim. Health Prod., 44, pp: 537-544.

Tegegne, D.T., 2012. Management practices, productive performances and egg quality traits of exotic chickens under village production system in East Shewa, Ethiopia. MSc Thesis, Addis Ababa University, Debre Zeit, Ethiopia

Tilahun, M. and Mitiku, M., 2019. Determinants of Village Chicken Products Price and Productivity in Central Ethiopia. Journal of Natural Sciences Research. ISSN 2224-3186 (Paper) ISSN 2225-0921 (Online); Vol.9, No.19.

Tumova, E., Uhlirova, L., Tuma R., Chodova, D., Machal, L., 2017. Age related changes in laying pattern and egg weight of different laying hen genotypes. Animal Reproduction Science, 183, pp: 21-26.

Woldemichael, F., Yitbarek, M., Getachew, E., 2019. Sanitation and Health status of Sasso T44 Chickens under Traditional Production System in North Shewa Zone, Amhara Region, Ethiopia. Journal of Poultry and Fisheries Sciences 3, pp:1: 1-5.

Wilson, R.T, 2010. Poultry production and performance in the Federal Democratic Republic of Ethiopia. World's Poult Sci J., 66, pp: 441-454.

Wilson, R.T., 2015. Poultry production and performance in the Federal Democratic Republic of Ethiopia. World's Poultry Science Journal · September 2010

Wondmeneh, E., 2015. Genetic improvement in indigenous chicken of Ethiopia. PhD Theses, Wageningen University, Wageningen, Netherlands.

Wright, D., Rubin, C., Schutz, K., Kerje, S., Kindmark, A., Brandström, H., Andersson, L., Pizzari, T. and Jensen, P., 2012. Onset of Sexual Maturity in Female Chickens Is Genetically Linked to Loci Associated with Fecundity and a Sexual Ornament. Reproduction in Domestic Animals, 47, pp: 31-36.

Yamane, T., 1967. Statistics, an Introductory Analysis, 2nd Ed., New York: Harper and Row.

Yami, A., 1995. Poultry production in Ethiopia. World Poultry. Sci. J., 51, pp: 197-20.

Yenesew, A., Agrawamane. Yihenew, G.S. and Dessalegn, M., 2015. Poultry Production

Manual. BDU-CASCAPE working paper 14. PP.

Yitbarek, M. B., Birhan, T.M. and Ashenafi, M.W., 2016. Disease management and biosecurity measures of small-scale commercial poultry farms in and around Debre Markos, Amhara Region, Ethiopia. Journal of Veterinary Medicine and Animal Health 8.10, pp: 136-144.

Zekarias, B. and Abera, A., 2017. Management and Marketing System of Local Chicken in Boloso Sore Woreda, Wolaita Zone, Southern Ethiopia. Int. J. Adv. Res. Biol. Sci. 4, pp: 213-218.

7. APPENDICES

Appendix 1. Questionnaire on Characterization of management practices, productive and reproductive performances of exotic chickens under different agro-ecologies in Ezha district of Gurage zone, Southern Ethiopia.

INSTRUCTION TO THE ENUMERATORS:

Please introduce yourself by name before beginning the interview, the purpose and objective of the study. Please ask each question patiently until the respondent gets the point. For open questions, fill the farmers' response in short and for closed ones circle where necessary.

Enumerator's Name_____ Date of Interview_____Code no____

A. DEMOGRAPHIC CHARACTERISTICS OF THEHOUSEHOLDS

1. Kebele/PA_____ Name of the respondent_____Phone No_____

Altitude _____m.a.s.l

2. Agro-ecology a. High land b. Mid-land

3. Name of household head_____Sex:_____ Age_____

4. Family sex? a. Male_____b. Female_____c. Total_____

5. Level of education of the household head? a. Illiterate b. Read and write

c. Elementary School (grade1-8) d. High School(9-12) e. College and University Education

6. Major occupation a. Farmer b. Merchant

c. Government worker d. Carpenter

7. Marital status of households a. Married b. Divorced

c. Widow/Widower d. Unmarried

8. Major crops grown in thearea1st_____2nd_____ 3rd_____ 4th_____

9. Land size? Please indicate the available land in the following table.

No.	Land use type	Land unit	
		Hectare (ha)	Local measurement
A	Land for crop production		
B	Land for fodder production		
C	Grazing land		
D	Forestry land		
	Total		

10. Livestock holding

Type of livestock	Total number	Order of importance
Cattle		
Sheep		
Goats		
Equine		
Chicken		

11. Chicken holding in the Household

No	Chicken type	Number	Breedtypes			
			Local	Cross	Exotic layers	Broilers
1	Hens (mature female)					
2	Cocks (mature male)					
3	Pullets (growing female) (8-20wks)					
4	Cockerels (growing male) (8-20wks)					

5	Chicks (0-8wks)					
	Total					

B. CHICKEN PRODUCTIONSYSTEM

1. Where do you get your chicken?

a. Purchased from Govt. /Pvt. Hatchery b. Provided from agriculture research center

c. Provided from NGO‟s d. Market e. Others _____

2. When did you start rearing chicken? a.1-5yrs b.6-10yrs c. 11-15 d.>15yrs

3. What population dynamics from time you start keep chicken? a. Increase b. Decrease

c. Stable d. unknown e. Others _____

4. If the population dynamics is decreased, why?_____ _____ _____

5. Number of chicken owned a.1-4 b.5-19 c.20-49 d. 50-1,000 e.>1,000

6. Does your chicken flock change within season? a. Yes b. No

7. If yes which month highest? _____ _____ _____

8. If yes which month lowest? _____ _____ _____

9. Do you feel there is need to improve your chicken production? a. Yes b. No

10. If yes, how? 1st_____ 2nd _____ 3rd _____4th _____

11. If no why rank? a. Land scarcity___ b. Capital scarcity_____ c. Technical lack___

d. Market problem. Disease_____f. Thief_____g. Predator____h. Others_____

12. How do you start chicken raring (Source of knowledge for chicken production)?

a. Learning from my parents' b. From colleagues and neighbors

c. From my own interest d. Formal Training e. Others _____

13. What type of chicken production system do you practice? a. Traditional

b. Scavenging +Seasonal/conditional supplementation c. Semi Scavenging

(Scavenging +Regular supplementation) d. Intensive system

14. Type of exotic chick used? a. Sasso b. Bovans Brown c. Others specify

C. CHICKEN MANAGEMENTPRACTICE

1. Chicken Housing

1.1. Do you have a separate house for your chicken? a. Yes b. No

1.2. If yes, what type of chicken house do you have? a. Stone wall + grass roof

b. Stone made with corrugated iron sheet c. Wooden made with grass roof

d. Wooden made with corrugated iron sheet e. Other_____

1.3. What is the advantage of house for you? a. Protect from the predictors

b. protect from transmissions disease c. Control meeting d. others _____

1.4. Did you construct chicken house based on the recommendation given by extension agents? a. Yes b. No

1.5. If yes, do you keep the chicken by constructed chicken house at the time of?

a. Day only b. Night only c. Both day & night d. Did not use the chicken house

1.6. If no, why not you construct a house for your chicken? a. Lack of knowledge (Awareness) b. Lack of attention to chicken c. Lack of construction materials (availability and cost) d. Risk of predators e. Risk of Thief f. Other(specify)

1.7. If no, where do you keep your chicken at night? a. Night perch inside the house

b. On ceilings of the house c. On the ground (Floor) covered by bamboo or grass made material d. On the eve of the house (Barandah) e. in kitchen

1.8. Do you practice cleaning of chicken house? a. Yes b. No

1.9. How frequent clean chicken house? a. once/day b. twice/day c. three/day

d. four/day e. not clean/day f. others_____

1.10. Do you provide litter material in the chicken house? a. Yes b. No

1.11. If yes, what type of litter martial do you use? a. Teff straw b. Wheat/Barley straw

c. Sawdust d. If others (specify) _____

2. Chicken Feed and Feeding

2.1. How do you feed your chicken? a. Scavenging only b. Scavenging with Supplement c. Purchased feed d. Homemade feed (readymade feed)

2.2. When do you usually offers/gives the supplementary feed?

a. Morning before go out for scavenging b. Afternoon while scavenging

c. In the evening after scavenging d. Any time during day time e. A&B

f. A, B, &C g. Every other day h. Every 3 day i. Others

2.3. Do you provide supplementary feed for your chicken? a. Yes b. No

2.4. If yes, specify the type of supplement? a. Commercial feeds b. Home mixed Ration

c. Home available feeds d. both commercial & home available feeds

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

a. Summer (Jun–Aug) b. Spring (Sep–Oct) c. Bega (Dec.–Feb

d. Autumn (Mar–May) e. All the year

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

a. _____ b. _____ c. _____d. _____

2.7. Do you think home available feeds can satisfy the nutrient requirements of your chicken? a. Yes b. No

2.8. Is the commercial chicken feed accessible? a. Yes b. No

2.9. Is the price of commercial chicken feeds affordable? a. Yes b. No

2.10. Did you face quality problems on commercial chicken feeds so far? a. Yes b. No

2.11. If yes, what problems you observed? a._____b. _____

2.12. What is the basis of your giving supplements? a. Egg yield b. Meat yield

c.Growth d. other, specify_____

2.13. If there is no practice supplementary feeding, what is the reason?

a. Lack of awareness about feed b. Unavailability of feed and feed ingredients

c. High cost of feed and feed ingredients d. Shortage of time

e. Lack or shortage of financial resource e. Others, specify_____

2.14. How do you reduce the risk of chicken rearing during the time of

2.14.1..Feed shortage a. Purchase b. Sale the flock c. give rib d. Others_____

2.14.2. Predators a. House constructs b. Use dog c. Sale chicken d. Others_____

2.14.3. Diseases a. Buy drug b. Use Traditional drug c. Nothing d. Others _____

2.14.4. Cropping seasons a. Women manage chicken b. Children manage chicken

c. Early morning manage chicken d. Afternoon (after cropping) e. Others____

2.15. Do you have feeding trough (feeder)? a. Yes b. No

2.16. If yes, what type of feed trough you have? a. Plastic made b. earthen pot

c.Wooden trough d. Stone made e. others____

2.17. What amount of supplemental feed you provide per chicken?

a. Hand full b. Unknown c. Body requirement d. Other(specify)_____

2. 18. Do you provide water to your chicken? a. Yes b. No

2.19. If yes, what is the source of water? a. Tap/pipe water b. River

c. Rain Water d. Pond water e. Wale water (under ground water)

2.20. If yes, which season of the year you provide water? a. Bega b. Kiremit

c. All season (Both)

2. 21. How frequent do you provide water? a. Free access b. Morning only

c. Morning and evening only d. If other(specify) _____

2.22. Do you have watering trough (Waterier)? a. Yes b. No

2.23. If yes, what type of watering trough you have? a. Plastic made b. Earthen pot

c.Wooden trough d. Stone made e. Other _____

3. Chicken Health Care

3.1. Do you practice annual vaccination of your chicken? a. Yes b. No

3.2. Against which diseases vaccinate your chicken? a. Newcastle diseases/NCD/

b.Coccidiosis c. Fowl thiphoid d. Gumboro (infectious bursa disease)

e. Foul pox f. Do not the name

3.3. Is there any chicken disease in your area? a. Yes b. No

3.4. If yes, what types of symptoms see on your chicken?_____

3.5. Do you experience serious disease out breaks? a. Yes b. No

3.6. What are common diseases of poultry in your area? (Local name & order of occurrence),_____,_____, _____.

3.7. How do you recognize (identify) the sick chicken?_____, _____

3.8. What do you do when birds are sick? a. Use traditional treatment b. Give medicine bought from market c. Slaughter them for consumption

d. Sale them immediately e. keep until recovery or death

3.9. What type of traditional control measures (indigenous knowledge) you used to prevent the disease?_____, _____, _____

3.10. Do you control the free movement of chickens all the times? a. Yes b. No

3.11. If yes, would you mention the reason?

a. To protect from predators attack b. To avoid risk of contagious diseases

c. To protect from mixing with the village flock d. To increase egg production

e. To protect chickens from picking and destroying crops/ vegetables

3.12. What do you think source of infection of the chicken? a. Brought from neighbors

b. Comes from big animal's c.Unknown d. Fluctuation of season e. Others

3.12. Do you control the free movement of chickens at a time of disease outbreak?

a. Yes b. No

3.13. If your chickens die what is your measurement? a. throw b. put pit c. Burning

3.14. Do you use anti-ectoparasites? a. Yes b. No

3.15. Do you practice deworming? a. Yes b. No

3.16. Mortality of adult chicken including predation? a. High b. Low

3.17. Is there any predator loss you have encountered this year? a. Yes b. No

3.18. If yes, what are the most common predators found in your locality? Put them in their order of importance1st_____, 2nd_____,3rd_____

4. Culling Practices

4.1. Do you purposely cull your chicken at any time? a. Yes b. No

4.2. Factors for culling chicken a. For consumption b. For sale c. For sacrifice

d. Other (specify) _____

4.3. Factors to cull hens? a. Poor productivity b. diseased c. Old age

d. Other (specify) _____

4.4. Old age for hens to be culled (in months) _____

4.5. To cull due to disease is to? a. Avoid expected disease outbreak

b. When the chicken is already sick and not to lose

5. Extension Service

5.1. Do you have access to the extension service? a. Yes b. No

5.2. If you say no, state the reasons? a. Have no heard of them b. Can't easily Reach them c. There is no need d. If others (specify) _____

5. 3. How frequently do you see the extension agent? a. Once in a week b. Once in two weeks c. Once in a month d. Not Seen

5. 4. Do you discuss your production problems with extension agents? a. Yes b. No

5.5. Have you ever got any training on chicken production? a. Yes b. No

5.6. If yes, When? a. Before starting the business b. After the business started

5.7. Did you get credit service when you start chicken business? a. Yes b. No

5. 8. If yes, for what purpose did use the credit? a. For chicken b. Chickenfeed

c.Chicken equipment d. If others (specify)_____

6. MARKETING (Products and Production Input)

6.1. Do you have market access to buy chicken production inputs? a. Yes b. No

6.2. Where do you buy chicken production inputs? a.NGO b. Government

c.Private Company's d. Cooperative union e. If others (Specify)_____

6.3. Do you have market access for your chicken products? a. Yes b. No

6.4. When do you sell your chicken products? (Time of selling) a. Specific wt. gain/age of Chicken b. Personal money requirement c. During holydays and festivals

d. If others (specify) _____

6.5. To who do you sale your chicken products (rank)? a. Farmer b. Consumers

c. Trader (middlemen) d. Hotel e. If others (specify) _____

6.6. Which marketing structure is more beneficial? a. Sale at home b. village market

C.Middle men d. Nearby town

6.7. Which breed type meat is most preferred by consumers? a. Meat from improved breed b. Meat from local chicken c. Equally preferred by consumers

6.8. Write your reasons?_____

6.9. Which breed type egg is most preferred by consumers? a. Eggs from improved breeds b. Eggs from local chicken c. equally preferred

6.10. Write your reasons? _____

D. CHICKEN PRODUCTIVITY ANDREPRODUCTIVETY

1. State the productivity of your exotic chickens in the following table:

No.	Parameters	Chicken types adopted		
		Sasso	Bovans brown	Others specify
1	Pullets age at first egg (weeks)			
2	Total number of eggs laid per hen/year			
3	No. of eggs laid per clutch			
4	No. of days per clutch			
5	No. of clutches/hen/ year			
6	Market/slaughter age of cock (Mature male)(months)			
7	Market/slaughter age of hen (Mature female) (months)			
8	Market/slaughter weight of cock (Mature male) (Kg)			
9	Market/slaughter weight of hen (Mature female) (Kg)			
10	Weight of grower male (Cockerel) at 6 weeks			
11	Weight of grower female (Pullet) at 6 weeks			

2. State the reproductivety of your exotic chickens in the following table:

No	Parameters	Chicken types adopted		
		Sasso	Bovans	Others

			brown	specify
1	Age at sexual maturity (month)			
2	Hen (Mature female) (age at 1st egg)			
3	Cock (Mature male) (age at 1st mate)			
4	Reproductive life span of hens (years)			
5	Reproductive life span of male chickens (years)			
6	Number of eggs incubated/Set			
7	Number of eggs hatched/Set			
8	Hatchability percentage/Set			
9	Number of chicks disseminated (6weeks)			
10	Number of chickens survived (12 weeks)			
11	Exotic breed chickens mortality percentage/year			

Hatchability % = $\frac{\text{No of chicken hatched}}{\text{No of eggs incubated}} * 100 =$ _____%

Mortality%= $\frac{\text{No of dead chicken}}{\text{Total No of chicken nurtured}} * 100 =$ _____%

E. What do you suggest to improve your chicken business? ----------

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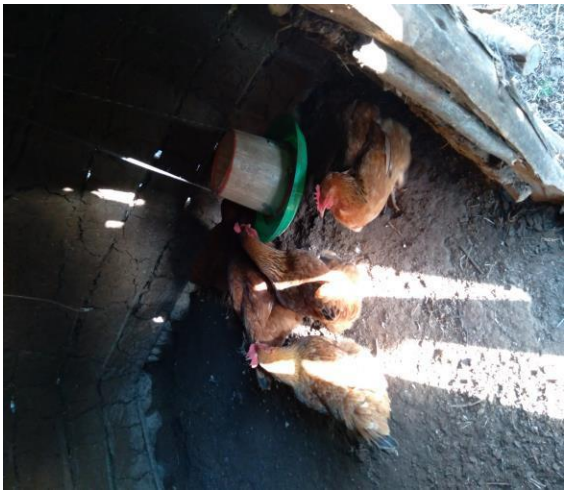
THE QUESTIONER IS COMPLETED THANK THE FARMER AND LEAVE!

Appendix 2. Images of exotic chickens (Sasso and Bovans brown) found in the study areas.



Appendix 3. Housing system used with facility of feeding and watering trough in the study district.