POULTRY FEED RESOURCES AND CROP CONTENT DURING EARLY DRY SEASON IN GENJI DISTRICT OF WEST WOLLEGA ZONE OF OROMIA REGIONAL STATE, ETHIOPIA

MSc THESIS

BY

ADMASU SHUNA GUTETA

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JIMMA, ETHIOPIA

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A Thesis Submitted to the School of Graduate studies of Jimma University College of Agriculture and Veterinary Medicine, Department of Animal Science in partial fulfillment of the requirements for the Masters Degree in Animal Production

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We, the undersigned, member of the Board of Examiners of the final open defense by **Admasu Shuna** have read and evaluated his/her thesis entitled **"Poultry Feed Resource and Crop Content During Early Dry Season in Genji District of West Wollega Zone of Oromia Region"** and examined the candidate. This is therefore to certify that the thesis has been accepted in partial fulfillment of the requirements for the degree Master of Science in **Animal Production.**

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DEDICATION

I dedicate this MSc Thesis work to my wife Dinke Etefa, my father Shuna Guteta and my mother W/ro Kulene Kiduse for all the love they have given me, their dedicated partnership in the success of my life and for their prayers and support.

STATEMENT OF AUTHOR

I declare that this thesis is my original work and all sources or materials used have fully been acknowledged. This thesis having been submitted in partial fulfillment of the requirements for MSc degree in Animal production at Jimma University College of Agriculture and Veterinary Medicine (JUCAVM) and is deposited in the University Library to be made available under the rules of the library. I declare that this thesis is not submitted to any other institutions any where for the award of any academic degree, diploma or certificate. Brief quotations from this Thesis are allowable without special permission if the source is accurately acknowledged. Requests for permission for comprehensive citation from, duplicate of this manuscript in whole, or in part may grant by JUCAVM and/ or the School of Graduate Studies of Jimma University. In all other instances, however, permission should obtain from the author.

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BIOGRAPHICAL SKETCH

The author, Admasu Shuna was born on 22 November 1986 in Genji district, West Wollega Zone of Oromia Regional State. He attended his elementary education grade 1-3 at Busano Birbir Elementary School from 1993-1995, grade 4-6 at Walgo Aira elementary school from 1996-1998, grade 7-12 at Lalo Aira Secondary and preparatory school from 1999 - 2005 . Admasu obtained his BSc degree from Jimma University Ambo College in June 2007. Admasu Shuna has worked for GenjiWoreda Livestock Development&Fishery Resource Office , as an expert for 9 years. Finally he joined Jimma University College of Agriculture and Veterinary Medicine in the academic year of 2017 to persue his MSc study in animal production.

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LISTS OF ABBREVATION

AME	Average Metabolizable Energy
AOAC	Association of Official Analytical Chemists
CACC	Central Agricultural Census Commission
CF	Crude Fiber
CP	Crude Protein
CRDA	Christian Relief and Development Agency
CSA	Central Statistical Agency
DM	Dry Matter
DZARC	Debre Zeit Agricultural Research Centre
EE	Ether Extract
FAO	Food and Agricultural Organization
FCE	Facilitator of Change in Ethiopia
GLM	General Linear Model
Ha	Hectare
HH	Household
HHL	Household left
ME	Metabolizable energy
ND	Newcastle Disease
NFE	Nitrogen Free Extract
NGO	Non Governmental Organization
NRC	National Research Council
RIR	Rhod Island Red
SD	Standard Deviation
SE	Standard Error
SFRB	Scavengable Feed Resource Base
SNNP	Southern Nation Nationality People
TME	True Metabolizable Energy
WLH	White Leghorn

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POULTRY FEED RESOURCE AND CROP CONTENT DURING EARLY DRY SEASON IN GENJI DISTRICT OF WEST WOLLEGA ZONE OF OROMIA REGION

ABSTRACT

The study was conducted in Genji district of West Wollega Zone with the objectives of characterization of scavenging poultry feed resource base(SFRB) and evaluation of composition of crop content of scavenging indigenous chicken. A total of 183 households were randomely selected fromthree kebeles of midland(126 respondents) and two kebeles of lowland (57 respondents) were used to collect primary data on SFRB of the study area. A total of 60 sampledgrower chickens (50% female and 50% male) at an age of 4-6 month, were parchased from rural farmers and slaughtered during early dry season to study the physical characteristics and chemical composition of the crop content.The major poultry feed resources of the study area was reported to be full day scavenging with supplementary feeding with locally available feed materials. About 50.7,23.85, 12, 8.4 and 5.2% of the crop contents of experimental chickens were cereal grains, house-hold leftover/kitchen waste, animal proteins(insects/worms), plant/leaves, and none feed materialsrespectively. There was variation incomposition with altitude and sex of birds slaughtered. The mean weight of the crop content obtained from the cockerels (25 g/day) was significantly lower (p<0.05) than that of the pullets (34g/day),but there were no significant difference between altitude in mean weight of crop content of the experimental birds slaughtered.According to the result of laboratory analysis,the dry matter, ether extract, ash,crude protein, crude fiber, nitrogen free extract and calculated metabolizable energycontentof the crop content were 89.37,2.48,14.82,10.88,9.35,62.61% and2552.3kcal/kg),respectively. The percent composition of dry matter, ash, crude fiber, and calcium were significantely(p< 0.05)higher in the crop content of pullets than in the crop content of cockerels, while crude fiber and crude protein level of the crop contents of the chcikens of the mid altitude were significantly higher(p<0.05) than that of the crop content of chickens of the low altitude. The average SFRB estimated for the Genji district was 237kg dry weight / family /year. The study showed that the nutrient contents of scavengable feed resources during early dry season were below the bird's requirements foroptimum productivity. However,Poultry keepers must provide sufficient supplementation to their birds rather than simply throwing leftovers "away to the birds".

Key Words*:* Chemical Composition,Crop Content, Indigenous Chicken ,Scavengable Feed Resources.

1. INTRODUCTION

The Ethiopian poultry industry is dominated by traditional management system in which the birds are left to scavenge for their nutrients with little or no supplementation and separate poultry housing. The scavenging village poultry is of enormous socio-economic significance in Ethiopia, in terms of contribution to human nutrition and family income (Muchadeyi *et al.*, 2007), indicating that the poultry sub-sector has the potential to provide relatively affordable animal protein.The Ethiopian chicken population is estimated to be 59.5 million of which 90.85% are indigenous, 4.76% hybrid and 4.39% are exotic (CSA, 2017). The Ethiopian indigenous chickens show a large variation in body conformation, plumage colour, comb type and productivity (Halima, 2007). According to (CSA,2017) about 37.93%, 16.04%, and 46.03% of the national poultry population are chicks up to 8 weeks, growers aged between 9 and 20 weeks and adult birds of more than 20 weeks of age respectively. About 36.21 % of the total national standing chicken population is hens of which about 2.74% are non-layers. The four major Regional States in terms of land area and human population (Oromia, Amhara, SNNP, and Tigray) collectively account for about 96.32% of the total national poultry population. Oromia region own about 34.4% of the total national chicken population and contributes 36% of the total annual national egg and poultry meat production. The region's rural areas constitute about 97.1% of the total regional chicken population while the urban areas constitute 2.9%. West Wellega Zone is accountable for about 6.65 % of the total regional chicken population(CSA, 2017).

However, the economic contribution of the Ethiopian poultry sub-sector is not proportional to the huge chicken population of the country, due to the presence of many productions, reproduction and infrastructural constraints (Aberra, 2000 and Halima, 2007). The major poultry production constraints are that of availability, quality and cost of feed ingredients. There is no planned feeding of chickens under traditional village production in Ethiopia and scavenging is almost the only source of diet. The scavenging feed resource base for local birds is inadequate and variable depending on season (Yami and Dessie, 1997). There may be deliberate supplementary grain feeding during food crop ripening and harvesting Period. The quantities of supplementation depend on seasonal variation. Scavenging chickens are vulnerable to predation as they need to leave the family dwelling to scavenge for feed.

Scavenging for feed away from the family dwelling also results in birds coming into contact with larger numbers of birds from other flocks, facilitating the spread of infection. Newcastle disease is usually cited as the most widespread, particularly during the rainy season.

The Scavenging Feed Resource Base (SFRB) used under the traditional production system, consists of household wastes and edible materials found in the immediate environment, together withasmall amount of grain supplements provided by the household (Mehari, 2016). Bangu(2016)indicated that shortage of feed restricted the potential productivity of scavenging local birds to 40-60 eggs/hen/year. According to (Hayat *et al,*.2016),the nutrient content of the scavenging feed resource base is below the requirements of the scavenging local chickens and the available scavenging feed resource is inadequate in quantity and deficient in all the nutrients required.

Unfortunately, however, the amount of feed available for scavenging in relation to the carrying capacity of the land areas and flock dynamics across the different seasons and agro-ecologies is still not adequately quantified. Scavenging poultry feed resources, its challenges and coping mechanisms are significant gaps that need to be assessed for the purpose of intervention . Feed is one of the cornerstone challenges of poultry production. The available scavenging feed resource base need to be identified aimed at the rational utilization of locally available feed resources. This being the case, the major objective of this research was characterization of scavenging poultry feed resource base and chemical compositionof crop content in Genji District of West Wollega Zone of Oromia Regional State with the following specific objectives.

- To assess the available scavenging chicken feed resources in Genji District.
- To assessthe amountand type of available daily supplementary poultry feed during early dry season in Genji District.
- To evaluate the physical characteristics and chemical composition of crop content of scavenging local chicken in the study area.
- To estimate theadequacy of scavenging feed resource and biomass during early dry period in Genji District.

2. LITERATURE REVIEW

2.1 Ethiopianpoultry resource

Chickens originated in Southeast Asia and were introduced to the rest of the world by sailors and traders. Nowadays, indigenous village chickens are the result of centuries of cross-breeding with exotic breeds and random breeding within the flock. It is not possible to standardize the characteristics and productive performance of indigenous chickens. Poultry includes all domestic birds kept for the purpose of human food production (meat and eggs) such as chickens, turkeys, ducks, geese, ostrich, guinea fowl, doves and pigeons. In Ethiopia ostrich, ducks, guinea fowls, doves and pigeons are found in their natural habitat whereas, geese and turkey are uncommon. Thus poultry production is synonymous with chicken production under the present Ethiopian conditions (Solomon, 2007).

2.2 PoultryPopulation and distribution in Ethiopia

Ethiopia has huge number of indigenous chickens distributed in different agro-ecologies and regional states. Indigenous chickens that live in different geographical regional areas of the country have different names. The chickens are named after the names of the area of origin. For instance, Tilili, Horro, Tepi, Konso and Jarso are areas located in the northwest, west, southwest, south and east of the country, respectively. Chicken population distribution varies with regional states in that higher in Oromia followed by Amhara Regional State. Harari Regional State has lower chicken population. Poultry includes cocks, cockerels, pullets, laying hens, non-laying hens and chicks. Most of the poultry are chicks (41.35 percent), followed by laying hens (32.18 percent). Pullets are estimated to be about 5.85 million in the country. Cocks and cockerels are also estimated separately, and are 5.32 million and about 3.11 million, respectively. The others are non-laying hens that make up about 2.53 percent (1.51 million) of the total poultry population in the country(CSA,2017).

Table 1. Regional Poultry population and distribution in Ethiopia

Region	Indigenous breed	Hybrid	Exotic breed
Tigray	4,287,585	556,107	892,280
Afar	192,652	-	-
Amhara	18,019,984	1,012,055	929,822
Oromia	19,604,089	512,849	291,361
Somali	160,996	-	-
Benshangul- Gumuz	1,224,932	20,405	4,241
SNNP	9,996 ,531	715,352	485,241
Gambella	377,695	4,321	3,752
Harari	91,210	-	-
Dire Dawa	98,250	2,994	-
Total	**54,053,925**	**2,830, 619**	**2,610, 482**

Source (CSA, 2017)

2.3 Characteristics of indigenous chicken

There are local breeds of chicken mostly called by their local name, which are named after the color of their feather or their location. Most of the urban and peri urban community keeps these indigenous breeds, because they are well adopted to current environmental condition. The local birds in Ethiopia are entirely nondescript breeds closely related to the jungle fowl *(Gallus gallus*); show a great variation in their body size, conformation, plumage colour comb type and feather cover (Alemu and Tadelle, 1997). The commonest comb-types of indigenous chicken are rose, pea, walnut/strawberry, single and V-shape. Most of the indigenous chickens have no shank feathers and shanks are yellowish in color. The commonest egg color of indigenous chicken is white (Bogale, 2008, Faruque *et al*., 2010, Nigussie *et al*., 2010). Solomon (2007), recognized that, Ethiopian indigenous chickens have a variety of morphological appearances. They vary in colour, comb type, body conformation and weight, and may or may not possess shank feather. Eggs have thick shells and deep yellow coloured yolk. Reta (2006) and Halima (2007) reported that the names of the indigenous chicken groups were being called as chicken-ecotypes and native-chickens, respectively. According to Bushura (2012), indigenous chickens are studied so far in two approaches as criteria for their differentiation and identification. (1) Based on their ecological or main habitat, thus the chickens are named after their area of geographical origin. (2) Based on morphological characteristics for identification specially feather type and color. And they have superior merits with regard to traits such as disease resistance, tolerance to cold and heat, ability to escape from predators, scavenging and brooding behaviors and hatchability of eggs which are important in adaptation to the village environment; and those traits, such as taste of egg and meat, affecting consumption preference and consequently market value **(**Matiwos *et al*., 2015**).**

There are large variations in morphological appearances, conformation and body weights(Qualitative traits**)** of indigenous chicken in Ethiopia. Reta (2009**),** reported the morphological characteristicsof some Ethiopian indigenous chickens that inhabit the highland vary from the lowland in terms of body size, color and other morphologies. Such variation also exists within specific chicken population dwelling in a particular geographical area (Tadelle, 1996).These morphological variations of indigenous chicken ecotypes (between and within) are described in terms of comb types, shank types, ear lobe types, plumage colors and other qualitative traits. Plumage color of Ethiopian indigenous chicken is very much diversified. Commonly observed plumage colors of indigenous chickens are: red, white, black, multicolor, black with red strips, white with red strips and red-brownish (Bushura ,2012). Chicken morphology is linked to the socio-cultural and religious sacrifices. Red and white cock is sacrificed for good rain and harvest, red and black spotted color (giracha) cock for New Year celebration, white and black spotted (gebsima) cock to prevent evil and calamities and red pullet for dead ancestors (animism) (Tadelle and Ogle,2001).

2.5 Socio Economic role of indigenous chickens

Chickens in developing countries have more diverse use and benefits to household. The use of indigenous chicken in tropics varies from region to region and from community to community within a region (Kumar, 2016)**.** Chickens are play an important socioeconomic roles many poor rural households in developing countries (Alders,2004; Salam, 2005). Chicken are the most important avian species for the resource challenged families of the developing world, because they are sources of income, animal protein and have cultural values, and can be raised in varying agro climates with limited resources, feed and housing (Kondombo, 2005).In Ethiopia, there is no reliable data indicating the annual contribution of village poultry for the national economic development. Nevertheless, it is believed that rural poultry accounts for 99 percent of the national total production of poultry meat and eggs in Ethiopia (Tadelle *et al.,* 2000). According to FAO(2008), mean annual egg and poultry meat production in Ethiopia was estimated at 68 million USD between the agricultural year of 2000 and 2005.And local chickens in Ethiopia play a vital role in many poor rural households, they provide scarce animal protein in the form of meat and eggs and can be sold or bartered to meet essential family needs such as medicine, clothes, food items that are not grown under farmers' field, sanitary items like soap and school fees and they are required for special festivals and for many traditional ceremonies (Bangu, 2016).

Similarly, Meseret (2010) reported that, about 94% of the respondents consume eggs 1-6 times a year whereas as 4% of the respondents do not consume eggs from the study conducted at Gomma woreda. A bout 80% of the respondents consume poultry meat 1-2 times a year and 78% of the total egg produced are meant for sale. According to Addisu *et al.*(2013) result of study conductedin North Wollo; egg (47.71%) and meat (43.79%) were the major chicken products of home consumption and market supply. study conducted in rift valley of Oromia by Dinka *et al*.(2010) reported that village chicken production used as a source of income for immediate household expenses. Particularly, chicken keepers use chickens and chicken by products as a source of income/cash or for home expenditure (44%), home consumption (24%), ceremony and/or sacrifice (22%) and as deposit (10%). On the other hand, eggs from village chickens used for hatching for replacement stock, sale for cash income and home consumption. According to Harun *et al*.(2001),Village poultry plays a key role in the home economy and its increased production has the potential to improve food security, assist in poverty alleviation and mitigate the adverse economic impacts of HIV/AIDS for rural people. Socio economical status of farmers can vary according to poultry production systems. Mekonnen (2007) reported that efforts have to be made to shift the chicken production paradigm to semi intensive in Ethiopia with holistic support of services such as health, housing and feed to make it productive and sustainable. Generally, in Ethiopia, village poultry is the first step on the ladder for poor households to tackle poverty (Tadelle *et al.,*2000).

2.6 Indigenous chicken production improvement strategy in Ethiopia

The diversity in agro-ecology, climatic conditions and variation in the purpose of chicken rearing in different regions and production environments in the tropics are believed to contribute to the current high diversity in chicken genetic resources. However, genetic improvements in the tropics on native indigenous chicken genetic resources are either rare or non-existent (Dessie, 2011). Reports on native ecotypes in the tropics showed that their potential for egg production and growth is very low under smallholder farmer's management conditions. However, under improved feeding, housing and healthcare conditions, levels of production increased significantly (Dessie, 2011).The mean body weight gain of local chickens of Ethiopia under on station management was higher than traditional management (Taddele, 2003 ; Tadelle &Ogle, 2001).

Improvement of the genetic potential of the local chicken could be done through selection within and/or upgrading through crossbreeding with exotic breeds. In Ethiopia, scientists and the government have beenpromoting a crossbreeding scheme through distribution of cockerels from selected exotic breeds with the intention of improving the productive performance of the local chicken. An alternative scheme to improve poultry production is introduction of exotic poultry breeds. The extension system has been disseminating exotic chicken breeds (dominantly White Leghorn [WLH] and Rhode Island Red [RIR]) as a poultry extension package to improve the productivity of local chickens(Emebet,.2015). In Ethiopia, evaluations of crossbred chicken at the DebreZeit Agricultural Research Centre indicated that 62.5% white leghorn crosses showed superior egg production to the locals and pure white leghorns (DZARC, 1991; DZARC, 2007) under intensive system. In a cross breeding program at Assela, (Brannang & Persson ,1990) also compared different York x local crosses, and their results indicated that egg production declined with increasing level of exotic inheritance (above 50%). Increasing the level of exotic blood also resulted in loss of broody behaviour, a trait of considerable economic value under village systems. Although the cross breeding programs produced successful results under experiment stations almost all of them were discontinued decades ago for various reasons (Dana *et al*,.2011).

In the 1970s and 1980s the Ministry of Agriculture in Kenya and Ethiopia initiated a cockerel distribution and exchange scheme. This involved importation and distribution of cockerels to be used as breeding males in villages. In Ethiopia, the scheme failed because of lack of appropriate design of crossbreeding scheme, it is logical to crossbreed after pure line selection of indigenous chicken which was not a case in this scheme. Secondly, farmers were unwilling to remove their local cocks and the exotic cocks failed to adapt in the village environments (Dana *et al* ,.2011).Attention to be given, to introduce different exotic poultry breeds to small holder farming systems of Ethiopia because of low performance of indigenous chicken. With the aim of improving poultry productivity, different breeds of exotic chickens (Rhode Island Red, Australorp, New Hampshire and White Leghorns) were imported to Ethiopia since the 1950's. 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).

According to FAO(2008), reported that the Government of Ethiopia during the period of early 1990s boost the productive basis of domestic birds within a genetic improvement programme. Here it has been concerted effort to introduce and distribute exotic breeds, provide improved extension advice and services and to generally exploit the capacity of the sector to boost rural productivity (with the implications there in for raising incomes, providing employment and alleviating poverty). The areas of involvement of the government include infrastructure development & formulation and supervision of disease control legislation and policies and development of National Strategic Preparedness and Response plan for the avian human influenza pandemic threat.

Tamir *et al*. (2015) indicated 41.9% non adopter, 18.4% discontinued and 39.6% adopter exotic chicken breeds in Western part of Amhara region. The main reasons for discontinued in using the exotic poultry breeds are lack of sustainable supply of the breed, disease and improved feed problem and predation problem. Generally, the most important inputs have been the introduction of improved (exotic) breed, improved feed, vaccine and medicaments and credit aiming at increased productivity (Tamir *et al.,*2015). The past genetic improvement efforts of the Ethiopian village chicken via exotic chicken extension was constrained by lack of comprehensive poultry technology package extension to the end users (Teklewold *et al.*, 2006; Reta, 2009). Currently, one of the extension options to attempt is the use of full packages jointly with improved exotic breeds that are better in terms of productivity, adaptability and disease resistance(Bangu, 2016).

2.7 Poultry production system in Ethiopia

In Ethiopia, poultry production could be characterized into three major production systems based on some selected parameters such as breed, flock size, housing, feeding, health care and bio-security (Bush, 2006; Goutard & Magalhaes, 2006). Alternatively, the FAO classifies poultry production systems into four sectors, depending on the level of bio-security. Based on this system of classification, Ethiopia has three poultry production systems: village or backyard production with minimal bio-security, small commercial poultry production with "low to minimal" bio-security and large commercial poultry production with "moderate to high bio-security" (Nzietcheung, 2008).

2.7.1 Village poultry production system

Village poultry production system in Ethiopia is a low in-put/low out-put farm enterprise where chicken usually scavenge to find their own feed with little or no supplementary input by poultry keepers. In many instances, family poultry production is not the main household income-generating activity, and formal marketing links for production inputs and outputs are generally non-existent (FAO, 2014). The traditional system is the most common type of poultry production in most developing countries. Possible feed resources for the local birds raised in this system include: i) household wastes; ii) materials from the environment (insects, worms, snails, greens, seeds, etc.); iii) crop residues, fodders and water plants; and iv) by-products from local small industrial units (cereal by-products, etc.). The survival and growth of extensive poultry systems are determined by the competition for feed resources in villages. This system works well where biomass is abundant, but in areas with scarce natural resources and low rainfall, the competition for natural resources with other animals can be extreme.

According to Aklilu *et al*.(2007), village poultry keeping farmers in Ethiopia face large market constraints. The Village poultry are produced and consumed in local areas with poor linkages to urban markets due to distance from urban areas and poor transportation facilities. Consequently, poultry marketing system in rural Ethiopia is primarily characterized by local selling and buying and it usually has two major poultry marketing channels. Farmers either directly sell to consumers or to small retail traders who take the chicken to large urban markets (Kenea *et al*,. 2003). However, the most common market for chicken in rural areas is local communities and farmers rarely have access to poultry products market in urban areas.

In Ethiopia the local birds are set free on free range whereby they move freely during the day and spend the night in the main house. Overnight housing, perched in trees or on roofs and overnight housing within the main house are the common patterns of housing prevailing in the country (Bashura, 2012). According to Meseret, (2010), study conducted in Gomma woreda said that, the birds scavenge around the household during day times and closed into family living areas at night along with other domestic animals. Among the households who have no separate poultry houses and their birds perch in the kitchen, cattle yard and on trees during night time. Also housing facilities include the use of baskets and cartoons placed on the bare floor of the family house. Bamboos and sticks are occasionally used for construction of perches within the family house.

Similarly, Kock *et al*.(2007) reported at night they are sheltered in small hen houses or in a room of the family house, to protect them from predators and bad weather. During the day, the chickens seek their food around the house. They receive bran, cereals and residues from the kitchen when available, with supplementary food given during the rainy season. Generally ,in Ethiopia , the chicken rearing system is characterized by extensive scavenging management, no immunization programs, increased risk of exposure of birds to disease and predators, and reproduction entirely based on uncontrolled natural mating and hatching of eggs using broody hens ,where there is no or minimum intervention to maximize their production and reproductive performance(Bashura, 2012). The low productivity of indigenous poultry can also be part attributed to the fact that traditionally chickens receive little care and under these conditions, bio security issues arise for both the health of birds and associated risks to people.

2.7.2 Small - Scale production System

Small-scale poultry is defined as family poultry keeping by households using family labor and,wherever possible, locally available feed resources. The poultry may range freely in the household compound and find much of their own food, getting supplementary amounts from the householder and rural poultry as a flock of less than 100 birds, of unimproved or improved breed, raised in either extensive or intensive farming systems. Between the two extremes of traditional/family production system and commercial production systems is the semi-commercial system, which is characterized by small to medium-sized flocks (50 to 500 birds) of local, crossbred or “improved” genotype stock, and the purchase of at least part of their feed from commercial compounders. Several feeding strategies may be used in this system: i) on-farm mixing of complete rations, using purchased and locally available feed ingredients; ii) dilution of purchased commercial feeds with local ingredients; and iii) blending of a purchased concentrate mixture with local ingredients or whole grains (FAO. 2008)

According to Sonaiya (1990b) reported that, under small scale production labor is not salaried, but drawn from the family household. Family poultry was additionally clarified as “small flocks managed by individual farm families in order to obtain food security, income and gainful employment for women and children. Dessie *et al*. (2013), reported that, small scale chicken production system account for more than 95% of poultry production in Ethiopia. The traditional small scale production can be classified in three and these include the traditional free range chicken production system (having <10 chickens), improved free range chicken production system (having 10-50 chickens) and small scale confined chicken production systems (some hybrid inclusive) and having range from 50-1000 chickens (FAO, 2008; FAO, 2009).

The small scale chicken production ranges from traditional free-range to small scale confined in Ethiopia.Reta *et al* .(2009) and Addis *et al*.(2014), differ in their characteristics of production and the level of the management of the chickens in the country. The medium scale chicken production systems produce from 1,000 to 10,000 chicks and the number of medium scale chicken producing are estimated to reach around fifteen to twenty and these are mainly concentrated in cities in and/or around Addis Ababa/Debre Zeit/Mojo/Adama area but also growing in number around the other larger regional cities such as Mekelle, Dire Dawa, Gondar, Awassa, Bahir Dar and still emerging in moderate zonal towns in the country (Nyaga,2009;FAO,2008). In Ethiopia small scale intensive production system is characterized by medium level of feed, water and veterinary service inputs and minimal to low bio-security. Most small-scale poultry farms obtain their feed and foundation stock from large-scale commercial farms (Genesis or Alema) (Nzietcheung, 2008). They are also involved in the production and supply of table eggs to various supermarkets, kiosks and small road side restaurants through middlemen. Solomon (2007), reported that, donors and NGOs involved in training on small modern poultry of exotic breeds included (among others) CIDA, GTZ and FCE (Facilitator of Change in Ethiopia). Many NGOs which operate under the umbrella of the Christian Relief and Development Agency (CRDA) are involved in training and chicken distribution.

2.7.3 Large scale commercial poultry production

The large-scale commercial system is the dominant production system in developed countries, and this sector has also recently expanded in many developing countries. Commercial systems are characterized by large vertically integrated production units and use high-producing modern strains of birds. In these systems, feed is the most important variable cost component, accounting for 65 to 70 percent of production costs. High productivity and efficiency depend on feeding nutritionally balanced feeds that are formulated to meet the birds' nutritional requirements.Large-scale Commercial Systems Modern poultry production started in Ethiopia,mainly in colleges and on research stations. The activities of these institutions mainly focused on the introduction of exotic breeds to the country and the distribution of these breeds to farmers, including management, feeding, housing and health care packages.The history of poultry production in the industrialized countries may offer some basic knowledge and guidelines for poultry development in the developing countries as a whole and in Ethiopia in particular, but in view of the particular conditions in different countries and regions, specific research and development approaches are needed to determine which are the optimum production systems and development strategies (Tadelle, 2000).

In Ethiopia there are few number of private large scale commercial poultry farms, all of them are located in DebreZeit. Alema, Elfora and Genesis are the largest commercial poultry production and modern farms with processing facilities. Elfora and Alema farms annually delivers eggs and broilers to the Addis Abeba market every year respectively. Large-scale investment is following the boom of the small-scale urban and peri-urban poultry. Producer and a number of companies have industrial facilities under construction. Large scale commercial chicken production systems have large number of birds of great grandparent stock, parent stock and commercial hybrid (> 10.000 chicks) and these are not yet both horizontally and vertically integrated with the emerging regional medium scale chicken producers and are remained to depend only on their production for the chicken input output system importing exotic chickens and these three large scale commercial chicken farms including parent stock and these are one layer chicken farm (Maranatha), and two broiler farms (Almaz, Dubai investment near Mojo). Embet *et al.(*2010) and Nyaga (2009), also cited by Hailemariam and Amaha,(2017) reported that the Large scale commercial chicken production systems have large number of birds of great grandparent stock, parent stock and commercial hybrid (>50,000 chicks) and have been remained to rely on importation highly producing exotic chickens as the indigenous chickens are fully characterized and improved to the level of commercialization.

Similarly, there are only two integrated large scale commercial chicken farms with great grandparent and parent stock and having their own hatcheries (Alema, Elfora) in the country and explained that integrated large scale chicken production system dynamics and have required high technology with large production and profitability threshold level even though the integration of the farms elaborated in terms of crop production not with the use of chicken input output systems (Nyaga,2009 ; FAO,2008).

2.8 Feed resources and feeding practices of chicken in Ethiopia

2.8.1 Scavengable Poultry feed Resource

Ethiopia has diverse agro-climatic conditions favoring production of many different kinds of crops, providing a wide range of ingredients and alternative feed stuffs suitable for poultry feeding. Making use of these resources to complement the scavenging resource base promises a considerable potential for success (Tadelle *et al*,. 2001). Under the free-range and backyard systems, feed supplies during the dry season are usually inadequate for any production aboveflock-maintenance level. When vegetation is dry and fibrous, the scavenging resources shouldbe supplemented with sources of minerals, vitamins, protein and energy. Under most traditional village systems, a grain supplement of about 35 g per hen per day is given, there is no purposeful feeding of chickens and scavenging is almost the only source of diet (FAO, 2004).The major components of Scavenging Feed Resource Base (SFRB) are believed to be insects, worms, seeds and plant materials, with very small amounts of grain and table leftover supplements from the household provided by the women (Bashura, 2012 and Meseret,2010).

The largest proportion of the feed of village chickens in Ethiopia is based on free range ScavengingFeedResources(SFR) constituting ofmaterials from the surrounding environment, by products from harvesting and processing of grains and cultivated and wild vegetation, which are frequently supplemented by householdwastes (Tadelle and Ogle, 2001). According to Bangu (2016)andHayat *et al.*(2016), study conducted inSidama Zone and Seka chokorsa woreda locally available or mostly used chicken feed are wheat grain, maize grain, cereal debris, kitchen left over's and scavenging type of feeding with different percent. Among the cereal grains, maize constituted the largest proportion of the crop contents followed by sorghum, both of which are widely grown staple food and both maize andsorghum aregood source of energy for poultry feeding.

Similarly,Kibreab*et al.*(2015*),*reported that the grains feed for village birds at Kaffa and Benchmaji Zone were: maize, sorghum, rice, wheat, maize and sorghum, maize + rice,sorghum + rice, maize + wheat ,and the major green forage village birds feed were:

different edible green grass including keppo, weeds leaf, different cereals leaf,different fruit leafs, inset leafe, cabbage, and research conducted at Awassa by Mekonnen, (2007) also reported that in the dry season the chicken at different parts of the Ensete ventricosum including the corn. Similarly, (Dessie *et al*,. 2013) reported that grass as source of scavenging for village chicken in Ethiopia. Insects are natural food sources for many backyard poultry and using alternate feed resources for poultry (G. Jayaprakash.2016). Most edible insects are a good source of protein, fat, minerals. Insect proteins are more valuable protein sources for monogastric animals (Makkar *et al.*, 2014).

2.8.2 Commercial Poultry Feed resources

Commercially produced feeds will contain ingredients such as corn, soybean meal, meat and bone meal, feather meal, porcine meal, wheat meals, bakery meal (by product of the bakery industry), vitamins, minerals, and preservatives. They will all utilize a preservative (usually ethoxyquin) so the feeds will have a longer shelf life. Feeds may require a 6-month shelf life if they are manufactured at one central location, then warehoused and then distributed throughout a large area to smaller retail outlets. At the retail outlet they may be warehoused an additional 30-60 days prior to sale to the consumer (Mattocks, 2002).

2.9Crop Contents of Scavenging Chickens.

2.9.1 Physical Characteristics of Crop Contents of Scavenging Chicken.

The physical composition of the diet consumed per day varied considerably between individual birds within the households in the farming systems, and also between seasons (Goromela et al.,2008).The crop contents were used to determine the amount or intake and types of feeds consumed by scavenging chickens. According to Goromella et al.(2008), scavenged feed consisted of two major components: household materials and environmental materials.

During the rainy season, there is an abundance of insects, worms and green forage materials whilst in the dry season there is a high supply of cereal grains and cereal by-products and a low supply of insects, worms and green forages (Goromela *et al*., 2006).

The high composition of grains in the dry season was due to the fact that this season came soon after the harvest period, hence there were a lot of spilled grains around which the birds could pick. During the wet rainy season grains are very scarce even forhuman consumption and therefore no grains can easily be found on the range and even grains from the wild plants will not have ripen during this season (Mutayoba et al., 2011).

According to Raphulu et al.(2015), the amount of household waste accounted for the major proportion of the total crop contents, with 78.6%, 91.1% and 75.8% in autumn, winter and spring, respectively from study conducted in South Africa. The high proportion of household waste is that the birds' owners can add supplements through the portion of the diet if deficiencies are identified (Goromela *et al,.* 2008 ; Rashid *et al.,*2005).

2.9.2 Chemical Composition of Crop Contents of Scavenging Chicken.

The feed components in the crop at a specific time of day represent only a fraction of total DM intake per day, the concentrations of nutrients in the crop content can be used only as an indication of diet composition. Thedifferences of chemical composition of crop contents between localities are determined by climate, which are type of vegetation and availability of feed in the environment. A bird kept under scavenging systems cannot find all its required nutrients all year round. The scavenging feed resources vary and are critically deficient or unbalanced with season (Charles Hanyani, 2012; Tadele, 1996; Mwalusanya *et al.*, 2002; Rashid *et al*., 2005).Mekonnen *et al*. (2010)andGoromela *et al.*(2006) reported that, the crude protein,energy calcium and phosphorus levels were below the requirements for egg production and growth.

Similar resultswere obtained by Tadele (1996) and Rashid et al. (2005) who reported low CP content of 76 and 102 g per kgDM respectively, in the crop contents of scavenging hens in the dry season. However, Pousga et al. (2005) in Burkina Faso reported that the CP in the crop contents was higher in the dry season (115 g kgDM-1) compared to the wet season (105g kgDM-1) for both local and crossbred birds, resulting from higher consumption of green grass/leaves, larvae, insects and worms due to occasional showers occurred at the end of dry season. The low concentrations of energy, protein and minerals in the crop and gizzard contents indicates that diets consumed by birds could not meet optimum requirements of scavenging birds for growth and egg production(Goromela *et al* .,2007). Supplementation of these nutrients would be necessary to attain reasonable growth and egg performance for rural poultry.

2.9 Factors affecting availability of scavengeable poultry feed resource base

Factors determining the size of the SFRB are: climate; number of households; number and type of livestock owned; crops grown; land size and the religion of the household. Land preparation and management of feed resources at household level are major factors affecting availability of scavengeable feed resources (Goromela, 2007**).**If theavailable SFRB is exceeded, then production falls (birds die and hens lay fewer eggs). If there isa surplus SFRB (such as a good harvest or fewer birds due to disease or stock sale), then production increases (more chicks and growers survive and more eggs are laid). Hence, the SFRB available in a community determines the production potential of the poultry. If the SFRB is known, other factors affecting production can be identified and the benefits of providing additional inputs assessed. Nutritional status of scavenging chickens can vary with season, climatic conditions and locality (Goromela *et al.*, 2007, 2008; Mekonnen *et al.*, 2010).

Availability and quality of feed resource is the first step factor affecting the nutrient consumption for scavenging chickens. There is a variation on the availability and quality of feed resources with season. Cereal grains are abundant during the harvest time (Mwalusanya *et al*., 2002).Green materials and insects and worms are dominant in the rainy season (Mekonnen e*t al*., 2010). Insects and worms are mostly found in moist environments (Goromela *et al*., 2006). The nutritional quality of the CP content is high in the rainy season (Goromela *et al*., 2008;Mekonnen e*t al*., 2010). There is high DM and ME consumption in the harvesting season due to high energy-rich feed stuffs such as grains (Rashid *et al*., 2005). Calcium and phosphorus contents are usually higher in rainy season than during the dry season (Goromela *et al*., 2008), due to large consumption of green materials that contain high calcium and phosphorous (Mekonnen e*t al*., 2010). Information regarding vitamins availability for birds is scant. Minh *et al*. (2006) reported that the proportions of insects, worms and grains were significantly higher for the lowland compared to the highland villages, while the proportion of green materials was higher in the highland than in the lowland village.During the land preparation including burning of crop residues, bushes and shrubs in the field, it encourages the relocation of insects that were available for chickens.Cleaning the yard also has the potential to eradicate and deplete feed resources available for scavenging chickens (Goromela *et al*., 2007).

2.10 Nutrient requirements of Poultry

2.10.1 Water Requirement

Water is the most important, but most neglected nutrient in poultry nutrition. Water has an impact on virtually every physiological function of the bird. A constant supply of water is important to: i) the digestion of feed; ii) the absorption of nutrients; iii) the excretion of waste products; and iv) the regulation of body temperature. Water constitutes about 80 percent of the body. Unlike other animals, poultry eat and drink all the time. If they are deprived of water for even a short time, production and growth are irreversibly affected. Water must therefore be made available at all times. Both feed intake and growth rate are highly correlated with water intake(FAO ,2008) Therefore, it is necessary to provide adequate amounts of clean, fresh water daily during growth and egg production. Chickens will drink between two and three times as much water by weight as they eat in feed. Their consumption of water increases in warm weather. Amy Halls, (2008) reported that, depending on the age, a bird's body can contain between 60 and 85% water. Eggs contain about 65% water. A bird can survive for weeks without feed, but can only survive a few days without water. Water intake of birds is about twice the weight of feed intake. During periods of extreme heat stress, water requirements can easily quadruple. Therefore, a safe and adequate supply of water is essential for efficient poultry production (Merck & Dohme, 2016)**.**

2.10.2 Energy Requirements

In poultry, feed intake is determined by the amount of energy in the diet (Nahashon *et al*., 2006). The energy requirements of poultry are often expressed in terms of metabolizable energy per day (Smith, 1990). It has been shown that increasing the dietary energy concentration leads to a decrease in feed intake and vice versa and thus resulting in reduced growth (Veldkamp *et al*., 2005). In a study by Rashid *et al*. (2005) upon analysing crop contents of village chickens, calculated metabolisable energy (ME) was 11.49MJ/kg D.M. Chicken requirements for egg production are 11.3 to 11.5 MJ/kg ME (Daghir and Jones, 1995). Since village chickens mainly scavenge in order to obtain feed, the scavenging feed resources are not concentrated enough in terms of energy because they do not contain sufficient quantity of starch and they have high fibre content. Cereals have high amounts of crude fibre and cellulose (20-30%) (Kondombo, 2005). High crude fibre means more cellulose, lignin and hemi-cellulose that cannot be digested efficiently by monogastric endogenous enzymes; this progressively reduces the digestibility of the diet (Mekkonen *et al*., 2010). Scavenging birds consume additional energy for scavenging energy activities and stop feeding when the crop and gizzard are filled to capacity (Minh *et al*., 2006).

In most studies conducted in developing countries, the energy found in the crop contents was lower than that recommended by NRC (1994) for both layers and growers (2900kcal and 2850kcal, respectively). Payne (1990) recommended 2643kcal and 2595kcal, for layers and growers respectively. Metabolisable energy levels of 11.46MJ/kg D.M feed was recommended during the 1-6 weeks of growing period and 10.86MJ ME/kg D.M feed during the 6-12 weeks growing period (Payne, 1990). According to Kingori (2004), the daily energy requirement by indigenous chickens for maintenance is about 480KJ/d and more than 953KJ/d to support maximum egg laying and also energy is needed for scavenging activites.

The energy requirements of poultry and the energy content of feed stuffs are expressed in kilo calories (1 kcal equals 4.1868 kilo joules). Two different measures of the available energy in feed stuffs are in use, metabolizable energy (AME_n) and the true metabolizable energy (TME_n). Poultry can adjust their feed intake over a considerable range of feed energy levels to meet their daily energy needs. Energy needs and, consequently, feed intake also vary considerably with environmental temperature and amount of physical activity (Kir, 2016). Metabolizable energy of indigenous chicken from scavenged feed is sufficient to meet requirements for only low levels of egg production necessitating the need to add energy in rations of indigenous chicken. The nutrient requirement values are based on typical rates of intake of birds in a thermo neutral environment consuming a diet that contains specific energy content (eg, 3,200 kcal/kg for broilers). If a bird consumes a diet that has a higher energy content, it will decrease its feed intake; consequently, that diet must contain a proportionally higher amount of amino acids, vitamins, and minerals(Kirk ,2016).

2.10. 3 Protein Requirement

The dietary requirements for protein are actually requirements for the amino acids contained in the protein. Amino acids obtained from dietary protein are used by the chicken to fulfill a diversity of functions such as growth, meat or egg production . Protein is a key nutrient and its deficiency in a feed reduces growth, loss of appetite and deficiency of nutrient utilization. Protein requirements vary considerably according to the physiological state of the indigenous chicken, that is, the rate of growth or egg production.

Other factors contributing to variations in protein requirements of the chickens include age, body size, sex and breed. Matching the feed protein levels with animal protein requirements is crucial for maximizing animal performance (Khobondo *et al*., 2015). Many researchers reported that, a dietary protein level adequate for indigenous chicken used for growth and optimize feed intake aged between 14 and 21 weeks 13% Chemjor (1998), 16 % King'ori *et al.* (2007) , 17 to 23 % Ndegwa *et al*. (2001) and increase in protein requirement could be due to difference in production system and production improvement with time. King'ori *et al,*. (2003) compared the effect of varying crude protein levels of 100, 120, 140, 160 and 180 g/kg DM on the feed intake, feed conversion ratio and live weight of growing indigenous chickens raised intensively between 14 and 21 weeks of age. Khobondo. (2015) reported that feed intake per bird increased with increasing dietary protein levels. Similarly, live weight gain increased with increasing protein levels while feed conversion ratio decreased with increasing dietary protein levels. Tadele and Ogle (1996) reported that the protein requirement of village chickens varies between 16 and 18% during the growing phase for optimal performance.

Tadelle &Ogle (2000) reported with the study conducted in central highlands of Ethiopia, the concentrations of CP and calcium were below the recommended requirements for egg production, and the diets were even more unbalanced if energy to protein and calcium to phosphorus ratios are taken into account.

2.10.4 Minerals and Vitamin requirement

Minerals are needed for formation of the skeletal system , for general health ,as components of general metabolic activity ,and for maintenance of body acid- base balance .Calcium and Phosphorus are the most abundant mineral elements in the body,and are classified as macro-minerals, along with sodium,potassium,chloride, sulphur and magnesium.Macro-minerals are elements required in the diet at concentration of more than 100mg/kg. Calcium and phosphorus are necessary for the formation and maintenance of the skeletal structure and for good egg-shell quality (FAO, 2008). In general, 60 to 80 percent of total phosphorus present in plant-derived ingredients is in the form of phytate-phosphorus. Under normal dietary conditions, phytate phosphorus is poorly utilized by poultry owing to the lack of endogenous phytase in their digestive enzymes. According to FAO(2008), about one third of the phosphorus in plant feedstuffs is non-phytate and is biologically available to poultry, so the phosphorus requirement for poultry is expressed as non-phytate phosphorus, rather than total phosphorus. A ratio of 2:1 must be maintained between calcium and non-phytate phosphorus in growing birds' diets, to optimize the absorption of these two minerals. The ratio in laying birds' diets is 13:1, because of the very high requirement for calcium for good shell quality. For growing poultry, this ratio should not deviate substantially from 2:1. The calcium requirement of laying hens is very high and increases with the rate of egg production and age of the hen.

A deficiency of either calcium or phosphorus in the diet of young growing birds results in abnormal bone development, even when the diet contains adequate vitamin D_3 (see Vitamin D_3 Deficiency). A deficiency of either calcium or phosphorus results in lack of normal skeletal calcification. Rickets is seen mainly in growing birds, whereas calcium deficiency in laying hens results in reduced shell quality and subsequently osteoporosis. This depletion of bone structure causes a disorder commonly referred to as "cage layer fatigue." When calcium is mobilized from bone to overcome a dietary deficiency, the cortical bone erodes and is unable to support the weight of the hen (Leeson, 2016). Much of the phosphorus in feedstuffs of plant origin is complexed by phytate and is not absorbed efficiently by poultry. Consequently, it is critical that only the available phosphorus and not the total phosphorus levels be considered.

Appropriate calcium nutrition depends on both the level of calcium and its ratio to that of available phosphorus. Vitamins are classified as fat-soluble (vitamins A, D, E and K) and water-soluble (vitamin Bcomplex and vitamin C). All vitamins, except for vitamin C, must be provided in the diet. Vitamin C is not generally classified as a dietary essential as it can be synthesized by the bird. However, under adverse circumstances such as heat stress, dietary supplementation of vitamin C may be beneficial. The metabolic roles of the vitamins are more complex than those of other nutrients. Vitamins are not simple body building units or energy sources, but are mediators of or participants in all biochemical pathways in the body (FAO, 2008).

2.11 Challenges of Scavenging indigenous chicken production.

According to Tadelle and Ogle (2001), in Ethiopia the primary problem cited by the village poultry farmers was high mortality of chicks. The major causes of this problem as perceived by the community and in their order of importance were disease (63.8 %), predation (21.8 %), lack of feed (9.5 %) and lack of information (4.9%), as per the reports of (Tadelle,2003). Insufficient water was also one of the causes of mortality in chicks and older birds and a contributing factor to low productivity. The major constraints of village indigenous chicken production were partly due to poor management of the chicken (prevailing diseases and predators, lack of proper health care, poor feeding and poor marketing information). On the other hand attempt of replacing indigenous chickens by exotic chicken breeds was identified as a major threat in eroding and dilution of the indigenous chicken genetic resources (Hunduma *et al.,* 2010).

2.11.1 Disease and predation

The bio-security of the traditional poultry production system is very poor and risky, since scavenging birds live together with people and other species of livestock. Poultry movement and droppings are very difficult to control and chickens freely roam in the compounds used by households and children. There is no practices (even means) of isolating sick birds from the household flocks and dead birds could sometimes be offered or left for either domestic or wild predators. Branckaert *et al,.*(2000) reported that, Newcastle disease is the most serious epizootic poultry disease in the world, particularly in developing countries where in developing countries, occurs every year and kills on average 70 to 80% of unvaccinated village birds.Similarly, in Ethiopia Newcastle disease (ND) (locally known as "fengele") and it is the major causes of death of chickens were seasonal outbreaks diseases,), followed by predators and it is the most important cause of economic loss in poultry production in the country (Fisseha *et al.,* 2010; Habtamu *et al*; 2014 ; Meseret, 2010).

In Ethiopia, generally, the chicken rearing system is characterized by extensive scavenging management, no immunization programs, increased risk of exposure of birds to disease and predators, and reproduction entirely based on uncontrolled natural mating and hatching of eggs using broody hens, where there is no or minimum intervention to maximize their production and reproductive performance (Bushura, 2012).According to Matiwos*et al* .(2015) indigenous chickens were rated to have superior merits with regard to traits such as disease resistance, tolerance to cold and heat, ability to escape from predators, scavenging and brooding behaviors and hatchability of eggs which are important in adaptation to the village environment. Moges *et al*. (2010) and Mengesha *et al*. (2011) suggested that improvement in veterinary and advisory service could help to achieve control of diseases at village level. The same author reported 96.4% of village chicken owners had no culture of vaccination against poultry diseases in North West Ethiopia.

According to Meseret (2010)high prevalence of predators, fear of theft and lack of experience were frequently mentioned as the major reasons for not Constructing separate poultry houses and the risk of diseases, predators and thefts associated with day time scavenging poultry in Gomma Woreda. Similar studies conducted in the previous period in Ethiopia, showed that, lack of knowledge about poultry production, limitation of feed resources, prevalence of diseases (Newcastle, Coccidiosis, etc) as well as institutional and socio-economic constraints Ashenafi*et al.*(2004) remains to be the major challenges in village based chicken productions.According to Bushura (2012 and Halima (2007), Predators were listed alongside diseases as major cause of premature death. Similarly, Hunduma *et al*.(2010) also reported that, predation is strongly associated with the rainy season. Predators such as birds of prey (locally known as "Culullee") (34%), cats and dogs (16.3%) and wild animals (15%) were identified as the major causes of village poultry in rift valley of Oromia, Ethiopia and in northwest Ethiopia.

2.11.2 Nutritional constraint

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. The problem is mainly associated with lack of processing facilities, inconsistent availability and distribution, and sub-standard quality of processed feeds, when available (Tadelle *et al,.* 2001). Regular availability of good quality ingredients and a fully balanced complete feed are essential for efficient poultry production. Grains, cereal by-products, oil seed cakes and meat and bone meal are obtained locally. The shortage in the supply of grains especially corn is improving due to the increase in the production of corn in recent years. The most serious problems arise from the unavailability of suitable micro-nutrient sources: vitamins and minerals (Solomon, 2004; Dessie *et al*., 2013; Mazengia *et al*., 2012). Feed deficiency and malnutrition weakened the birds and made them more vulnerable to predators and also increased their susceptibility to disease. During poultry feed formulation it should contain the different nutrients like energy, protein, minerals, vitamins, etc. Otherwise the product will be reduced (Tekalegn *et al,.* 2017).

In Ethiopia the diet of scavenging poultry is usually adequate in protein but deficient in energy, especially in the rainy season due to the abundance of large numbers of invertebrates but protein supply may be critical in dry season (Tadelle and Ogle, 2001). However after the end of the short rainy season in April-May the amount of available grain decreases, so the birds then have to rely on scavenging only. Therefore scavenging alone does not provide enough food. The absence of the supplement in the diet of the birds in the rainy season results in a dramatic decline in the production of eggs, due primarily to a lack of energy (Tadelle and Ogle, 2001). Similarly, Hayat *et al*. (2016), reported that the energy and protein content seems to be critically deficient in the scavenging feed resource base during the beginning of dry season and this may be due to the macro requirement of the nutrients. In village chicken production systems, it is difficult to estimate the economic and/or physical value of feed resource input because there are no direct methods of estimating the scavenged feed input. According to Hunduma *et al*. (2010) feed shortage mostly occurs from June to August time of the year for village poultry as it is not harvesting season of cereal crops. Therefore, smallholder poultry farmers need to apply a means of feed scarcity coping mechanisms, by using the available surplus feed resources for wet seasons of the year (Tekalegn *et al,*. 2017). Under farmer management poultry production, prevailing disease, predators, market problem, lack of water, lack of proper health care, poor feeding and extension together with veterinary services were reported as the major constraint by (Moges *et al,*.2010; Getu and Birhan ,2014 ; Mengesha *et al,*.2011).

3. MATERIALS AND METHODS

3.1 Description of the Study Area

This study was conducted in Genji district (woreda) of Western Wellega Zone of Oromia Regional State, located at544 km west of Addis Ababa. Geographycally,Genji district is located at southwest of West Wollega Zone between 8^0 57, 30" and 9^0 7,30"North latitude and 35^0 30, 0" and $35^0$45,0"East longitude. The woreda was stratified in to two agro ecological zones (mid altitude and low altitude), ranging between 1420 and 2500 m.a.s.l.

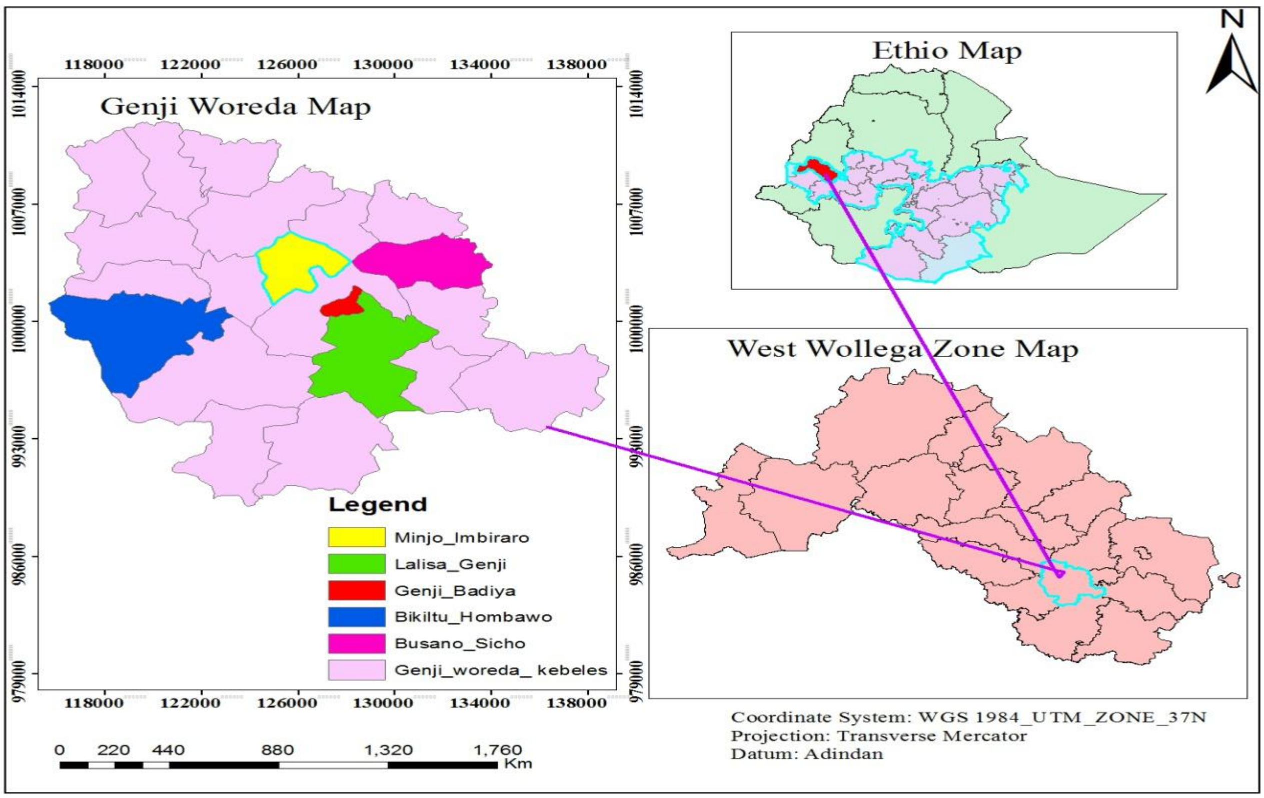

Figure 1: Map of the Genjiworeda

The minimum and maximum annual temperature of the woreda variesfrom 16to 25°C,respectively. The study area receives annual rainfall ranging between 1225 and 2000 millimeter. Genji district has high potential for livestock production and the livestock population of the woreda comprises of 66595 Chickens,52815 cattle, 17427 Sheep, 5598 Goat, 715 Horses, 820 Mule, 8715 Donkeys and 48792 Beehives (Genji Woreda Livestock and Fishery Resources Office,2017). The soil type found in the study area is clay (80%) and sandy soil (20%). The major food crops grown in the study area are maize, millet, sorghum, teff, barley,and wheat, while the major cash crop produced in the study area is coffee. The human population of the Woreda is about 72,368, the majority (95%) of which lives in rural areas (Genji Woreda Agricultural and Natural Resource Office, 2017).

3.2 Sample Size and Sampling Technique

Genji districts comprises of 21 Kebeles (Pesant Association).Agro-ecologically, Genji district is classified in to 14 (66%) kebelesfound in midlandand 7(34%) kebels found in lowland agroecology, respectively. Three representative kebeles from mid land and two kebeles from lowland were selected using purposive sampling technique based on the indigenous chicken production potential and accessibility.From representative kebelesof midlandagro-ecology (Busano Sicho, Genji Badiya,and Minjo Imbiraro)126 households were randomily selected and 42respondents were selected from each kebele based on the proportion of house hold population.From representative kebelesofLowland agro-ecology (Bikiltu Hombawo and Lelisa Genji)57 householdswere randomily selected and, 42 and 15 respondents were randomily selected from each kebeles, respectivelybased on proportion of households population.A total of 183 households were randomly selected using simple random sampling technique.Sample size was estimated using the following formula (Cochran,1977).

$$n = \frac{Z^2Pq}{e^2}$$

$$n = \frac{(1.96)^2 * (0.138)\,(1-0.138)}{(0.05)^2} = \frac{3.8416\,(0.138)\,(0.862)}{0.0025} = \mathbf{183}$$

Where

nis the sample size

z²is thethe normal standard deviation (1.96 for 95 % confidencelevel).

pis the estimated proportion of an attribute that is present in the population (P=0.138)

qis 1-p i,e (0.862).

e^{2}is margin of error(0.05).

The sample size of experimental endigenous chicken was also determined by the formula given by (Cochran's,1977).

$$n = \frac{Z^2Pq}{e^2}$$

$$n= \frac{(1.96)^2*(0.041)(1-0.041)}{(0.05)^2 0.0025} = (3.8416)*(0.041)(0.959) = \mathbf{60}$$

n is the sample size

$\mathbf{z^2}$is thethe normal standard deviation (1.96 for 95 % confidencelevel).

pis the estimated proportion of an attribute that is present in the population (P=0.138)

q is 1-p i,e (0.862).

$\mathbf{e}^2$is margin of error(0.05).

3.3Data Collection

Before the start of the survey, discussion was made with Woreda Livestock Office to identify the areas which predominantly produce indigenous chicken. Both primary and secondary data were collectedusing semi-sractured and pre-tested questionnairies. The primary data were collected from the selected households who raised indigenous chicken. Secondary data were collected through review of documents of Genji woreda livestock and fishery resource office, kebeles agricultural extension office and other related literature. The qualitative data collected included household socioeconomic characteristics, chicken husbandry practices (availability of poultry feed resource, traditional poultry feeding and management system). The quantitative data collected included (among others) flock size and flock structure,land size, and family size.

3.4 Study of Crop Contents

The group discussion was carried out with thehousehold respondents and all farmers were willing to participate in the study .Thirty households were selected based on ownership of scavenging chicken and willingness to further participate on crop content experiment.A contractual agreement was arranged with a total of 30 households (6 farmers from each

Kebelle) for the purpose of purchasing experimental chickens. A total of 60 grower chickens (30 pullets and 30 cockeres) between an age of 4-6 months (six from each kebelle) were purchased on the basis of physical appearance and information provided by the participating households.

. The chickens purchased were picked up from the households flock between 5.00 and 6.00 pm (local time) considered to be the last hours of scavenging. The chickens were directly transported tothe Genji town slaughter house in cages and slaughtered between 6:00 and 7:00 pm. The birds were individuallyweighed, slaughtered and allowed to bleed for five minutes.This was followed by socking in boiled water, feather plucking and evisceration. Crops was carefully removed from each of the slaughtered bird and weighed using sensitive electronic balance.Crop material was visually examined andseparated in to different categories. The number of samples analysed to determined crop content were (12 replecation). Finally the crop content was air dried for one day and transported to Addis Ababa'JIJE' Analytical Testing Service laboratory for chemical analysis.

3.4LaboratoryChemical Analysis

The crop contents was oven dried at65^{0}c to aconstant weight and was grinded to pass through 1 mm screen. The grinded materials were stored in tight plastic bags until required for laboratory chemical analysis .The materials were analyzed for proximate components i.e the Dry Matter (DM) content was determined according to the standards of the Association of Official Analytical Chemists (AOAC, 2000) official methods the crop content per sample was heated in anOven dry at 130^{o}c for 3 hours. Crude protein was determined using nitrogen to protein conversion factor of 6.25to convert total nitrogen to CP. The crude fibre (CF) was determined accordingto AOAC(2000) using Ceramic Fiber Filter method.Ether Extracts was determined accordingto AOAC(2000) Official method using Sohxlet apparatus.

Ash content was determined According to AOAC(2000) Official direct methodusing incinerating the sample at 550 ^{0}C for 16 hours.Calcium was determined according to AOAC(2000) with the use of EDTA Titration. Phosphorus was determined according to

AOAC (2000) with the use of Vanadomolybdo phosphoric acid. Nitrogen Free Extract (NFE) was calculated by difference as : 100 – (CP +CF +EE +Ash). The Metabolizable Energy content of the materials was estimated using the formula adopted by Wiseman, (1987), with the assumption that TME is 8% higher than ME (Rashid *et al*., 2005).

TME (Kcal/ kg^{-1} DM) = (3951 + 54.4EE - 88.7CF - 40.8Ash)

Where: EE % composition of ether extract on DM basis

CF % composition of crude fiber on DM basis

Ash **%** composition oftotal ash on DM basis.

The conversion factor of 238.85 kilo calorie (Kcal) equivalents to 1 Mega joule (MJ) was used to convert Kcal to MJ.

3.5 Estimation of Household Leftover

The amount of household leftover (HHL) in the study area was estimated directly using the formula developed by Roberts and Gunaratne (1992).The following formula was used for the estimation after the measurement & identification of different components of the house hold waste and crop content with the use of structured questionnaires and crop content laboratory analytical data.

$$SFRB = \frac{H}{P} \times \frac{N}{N-X}$$

Where ***H***is the household leftover (kg dry weight), ***P***is the proportion of crop content, which is household leftover, ***N***is the number of households in the settlement , ***X***is the number of households in the settlement that are not keeping chickens.

3.6 Statistical Data Analysis

Descriptive statistics was used to analyze the data captured during the survey as percentage and mean using statistical package for social science (SPSS) Version 20. Data collected fromcrop content of experimental chicken and laboratory chemical analysiswere analyzed using the General Linear Models (GLM) procedure using SAS , 2009 (Version 9.3) (Littell *et al,*.2011).The 5% significant level should be considered based on the following model.

$Y = \mu + si + aj + (sa)ij + Eij$

Yij= an observation for a given variable

μ = overall mean.

si = effect of the ith sex of the bird (i= 1 cockerel , 2 pullets)

aj=effect of the jth altitude of the study area (j = 1 low altitude , 2 Mid altitude)

(as) ij = effect of interaction between sex and altitude of the study area..

Eij = residual random error.

4. RESULTS AND DISCUSSION

4.1 Socio economic Characteristics of the Respondents

4.1.1 Respondent's Profile

The sex, marital status, religion, occupation and educational status of the respondents are shown in Table 2.About 65% of the respondents were male household heads, while the remaining 35% of therespondents were female household heads. The majority of the respondents (94%) reported to be dependent on farming activities for their livelihood, where as 6% of the respondents reported to be merchant. About 98.4 and 1.6% ofthe household respondents were married and widowedrespectively. About 94% of thehousehold respondents were protestant where as the remaining 3.8 and 2.2% were orthodox and Muslim respectively. The results of this study showed that about 13.1, 9.8, 59 and 18.0% of the household respondents were Illetrate, read and write , completed elementary school and high school repectively.The age category of the respondents are shown in Table.2. About 39.3 and 15.8% of the respondents were between 51 and 65 years and above 66 years of age repectively. About 37.2 and 7.7% of the respondents reported to be between 36 and 50 and between 20 and 35 years in age respectively.

Table 2.Respondent'sProfile in the study area(N=183).

Descriptions		Frequency	Percentage (%)
Gender	Male	119	65.0
	Female	64	35.0
Major Occupation	Farming	172	94.0
	Merchant	11	6.0
Age Category(years)	20-35	14	7.7
	36-50	68	37.2
	51-65	72	39.3
	>65	29	15.8
Educational level	Illiterate	24	13.1
	Read and write	18	9.8
	Elementary school	108	59.0
	High school	33	18.0
Religion status	Protestant	172	94.0
	Orthodox	4	2.2
	Muslim	7	3.8
Marital status	Married	180	98.4
	Widowed	3	1.6

4.1.2Family Size,Land holding and Flock Structureof the respondents.

The mean family size, flock size and land holding of the respondents are shown in Table3. The mean family size of the respondents in the study area was reported to be 5.81 persons/hh. This result was in agreement with that of CSA(2013) and comparable to that of Western Wollega Zone (5.6 persons/hh) and Oromia Regional State (5.5 persons /hh). The results of the mean family size of the current study was higher, when compared to the national average (5.1 person/ households). The mean family size recorded from the current study (5.81 persons/hh) was also found to be greater than that of Tigray region (4.8 persons/hh), Amhara (4.6 persons/hh) and, SNNP (5.3 persons/hh).

The result of this study tends to indicate that the study area has the highest family size as compared to all the others Ethiopian Regional States. The mean land holding recorded from the current study was about 1.26 ha/hh. According tothe result of the current study, there was no statistically significant difference (P>0.05) between the agroecologies in mean land holding perhousehold. The results of the current study was in agreement with that of Fisseha *et al.* (2010) and Halima (2007) who reported land holding of 1.23 and 1.28 ha/hh from Bure district and North West Amhara Region, respectively, but lower than that of Oromia regional(1.7 ha/hh) and Ethiopian National (1.4 ha/hh) average land holding /household (CSA, 2013).

The results of the mean chicken holding of the respondents is shown in Table 3. The mean total chicken holding of the study area was reported to be 9.39 chickens/hh. Of which 2, 1, 1.16, 0.98 and 4.17 were hens, cocks, pullets, cockerels and young chicks repectively. The results of this study indicated that the large segment (44.4%) of the chicken population of the study area was chicks to an age of 8 weeks. About 21.41, 12.35,11.4 and 10.44% of the chicken population of the study area was hens of more than 20 weeks, pullets aged between 9 and 20weeks, cocks aged more than 20 weeks and cockerels aged between 9 and 20 weeks of age respectively(Table 3).

The current resultis in line with that of Adem and Teshome (2016) , who reported average flock size of 9.13chickens/hh, from the Yaki Woreda of Southwestern Ethiopia. This result is comparable to that of CSA (2003) which reported that about 41.7%, 18.5%, and 39.7% of the national poultry population are chicks to an age of 8 weeks, growers aged from 9 to 20 weeks and adult birds of more than 20 weeks of age respectively.In agreement with the results of the current study CSA(2017) reported that the Ethiopian indegenous chicks to an age of 8 week accounts for the largest segment of the countrys chicken population.

Table 3. The mean Family Size, Land holding and flock structure of the respondents in the study area(N=183).

Descriptions	**Agro ecology**			
	Mid altitude (Mean ±SD)	**Low altitude (Mean ±SD)**	**Total mean (Mean ±SD)**	**P-value**
Family size	5.76±2.31	6.47± 2.5	5.81±2.33	0.258
Land holding(ha/hh)	1.27± 0.92	1.02± 0.58	1.26±0.86	0.317
Chicken Cathegory				
Hens	2.03±1.13	1.75 ± 0.45	2.01±1.08	0.313
Cocks	1.08±0.79	1.00 ± 00	1.07±0.75	0.705
Pullets	1.17 ± 0.92	1.06 ± 0.85	1.16 ± 0.92	0.669
Cockerels	0.98 ± 0.88	1.06 ± 0.85	0.98 ± 0.87	0.722
Chicks	4.31 ± 2.84^{a}	2.81 ± 1.05^{b}	4.17 ± 2.76	0.044
Total Flock size/hh	9.56 ± 5.25^{a}	7.68 ± 1.92^{b}	9.39 ± 5.07	0.026

a, b Least square means with different superscript within the same raw are significantly different (P<0.05).SD= Standard deviation, hh= house hold, ha = hectare.

4.2 Feed Resource and feeding practices

The results of the feed resource and feeding practice of the study area are shown in Table 4. The major poultry feed resources of the study area was reported to be scavenging. About (37.5%) of the respondents practiced full day scavenging, while 62.5% of the respondents reported to have practiced insufficient and infrequent supplementary feeding with locally available feed materials. About 60.1,15.3,9.3, 11.5 and 3.7 % of the respondents reported to use maize,sorghum,millet, barley and wheat as supplementary feeding respectively.

About 44.9, 42.5, and 12.6% of the respondents offer supplementary feeding to their chickens at any time of the day, in the morning before they go out for scavenging, and in the afternoon while scavenging respectively. Bangu,(2016) reported that, 94.6% of the respondents use maize grain assupplementary feed and about 58.1% of the respondents use household scraps as supplementary feeding in the morning in Shebedino and Dale districts.

All of the respondents(100%) feed their chicken in flock or in group. About 50.8,19.7, 25.1 and 4.3% of the respondents direct supplementation towards egg yield, meat yield, egg and meat yield and broodiness (during incubation) respectively (Table 4). The majority of the respondents (90%) in the study district provide water purposively to their chicken. About 41.5, 30.1 and 28.4% of the respondents reported to provide water two times per day, all the times and once per day respectively. About 71.6, 15.8 and 12.6% of the respondents reported to have used tap water, river water and other sources of water for their chickens respectively.

The results of this study was in agreement with that of Samson and Endalew,(2010) who reported 66, 15, 6 and 13% of the respondents use tap water, river water, and other source of water for their chickens in the mid rift valley of Oromia Region respectively. On the other side, the result of this study was contrary to that of Kibreab *et al*,.(2015) who reported that 41.33, 21.33, 14, 9.33, 2.67 and 8.67% of the respondents use spring water, river water, rain water, tap water, pipe water, underground water, and different combinations of the aboves for their chickens respectively.

Table 4. Feed resources andfeeding practice of chicken in study area(N=183).

Description	**Parameter**	**Agro ecology** **Lowland (%)**	 **midland (%)**	 **Total (%)**
Source of chicken feed	Scavenging only	36.421.737.5		
	Scavenging with supplement	63.678.3	62.5	
Type of grain supplements	Maize	54.4	62.760.1	
	Sorghum	14.0	15.915.3	
	Millet	8.8	9.59.3	
	Burley	17.5	8.711.5	
	Wheat	5.3	3.23.7	
Non conventional feedsuppliments	Leftover(injera and processed meal, Ceareal debris)	100	100	100
Reasons of supplemention	Egg yield	50.0	50.9	50.8
	Meat yield	18.8	19.8	19.7
	Egg and meat yield	25.0	25.1	25.1
	Broodiness(during incubation)	6.2	4.2	4.4
Method of supplemention	Collective group feeding	100	100	100
Frequency of daily supplementation	Once	37.5	43.7	43.2
	Twice	50.5	34.7	37.2
	Three times	12.0	21.6	19.6
Ways of feeding	On a feeder material	3.5	7.8	6.7
	On the bare ground	96.5	92.2	93.3
Frequency of watering/day	Adlib	57.0	24.9	30.1
	Once	25.0	28.7	28.4
	Twice	18.0	43.7	41.5
Material of watering	Plastic	75.0	91.0	88.6
	Metal	1.0	3.0	2.7
	Other material	24	6.0	8.7
Sources of water	Tap water	18.8	76.6	71.6
	River water	75.0	10.2	15.8
	Other	6.2	13.2	12.6

4. 3 Crop composition of the experimental Birds

4.3.1 Weights of live bird

The results of the quantity and crop content of the experimental birds are given in Table 5. The results showed that the mean live weight of the cockerels and pullets slaughtered for the determination of crop content was 1.4 and 1.23 kg/ bird respectively. The result showed that the mean live weight of the experimental sampled pullet were significantly lower (P<0.05)than the mean live weight of the cockerels. The result of the current study was in line with that of Hayat *et al*.(2016*)* who reported that the mean live weight of indegenous pullets and cockerels in SekaChokorsa was 1.12 and 1.4 kg/head/,respectively. There was significant difference(P<0.05)between cockerels and pullets in mean body weight at slaughtering while there was no significant difference (P>0.05)between either the experimental cockerels or pullets obtained from low land and midland agro ecology in mean body weight at slaughter.

4.3.2 Physical characteristics of crop content

The scavenging feed resources of the study area as measured by the physical visual appraisal of the crop content of slaughtered chicken comprised of householdscraps, animal protein sources (worms,smallsnails,grasshoppers,ants & termites), grains (maize, sorghum,millet,teff, barley), green materials (leafs and grass) and other ineduiblematerials. The results of the visual appraisal indicated that (in order of importance), the major components of the crop contents were cereal grains, household scraps, insects and worms, plants and inedible materials as shown in Fig 2. Significant interactions between altitude and sex of birds were observed with regard to the crop weight,grain, insects/worms, plant material and other content.

Table 5. Effect of altitude and sex of birds on the crop content of experimental chickens(Mean ± SE)

Altitude/Sex Of birds	Altitude/sex of bird physical composition (% fresh bases)						
	Body wt(kg)	Crop wt(gm)	Cereal grains(%)	Household refused(%)	Insect/worm (%)	Plants (%)	Others (%)
Altitude							
Lowland(30)	1.34±0.02	28±0.3	48.1±1.18^{b}	23.43±0.89	9.88±0.38^{b}	7.37±0.28^{b}	5.86±0.38^{a}
Midland(30)	1.35±0.02	31±0.3	52.97±1.18^{a}	24.33±0.89	11.22±0.38^{a}	8.83±0.28^{a}	4.28±0.38^{b}
P-Value	**0.654**	**0.701**	**0.005**	**0.476**	**0.017**	**0.001**	**0.006**
Sex of birds							
Cockerels(30)	1.41±0.02^{a}	25±0.3^{b}	48.1±1.18^{b}	23.1±0.89	10.98±0.38	7.93±0.28	4.94±0.38
Pullets(30)	1.23±0.02^{b}	34±0.3^{a}	53.3±1.18^{a}	24.7±0.89	10.11±38	8.26±0.28	5.2±0.38
P-Value	**0.001**	**0.001**	**0.001**	**0.203**	**0.1097**	**0.411**	**0.642**
Altitude*sex of birds							
L x C	1.42±0.02^{a}	22±0.4^{b}	48.52±1.67^{ab}	22.67±1.26	10.24±0.54^{ab}	6.87±0.4^{b}	5.89±0.55^{a}
L x P	1.39±0.02^{a}	33±0.4^{b}	47.67±1.67^{b}	23.47±1.26	9.51±0.54^{b}	7.87±0.4^{ab}	4.00±0.55^{b}
M x C	1.28±0.02^{b}	27±0.4^{a}	53.37±1.67^{a}	24.19±1.26	11.73±0.54^{a}	9.00±0.4^{a}	5.83±0.55^{a}
M x P	1.28±0.02^{b}	34±0.4^{a}	52.57±1.67^{ab}	25.2±1.26	10.7±0.54^{ab}	8.67±0.4^{a}	4.57±0.55^{ab}
P-Value	**0.001**	**0.001**	**0.001**	**0.530**	**0.001**	**0.001**	**0.001**

a,b Least square means with different superscript with in the same column are significantly different(P<0.05),SE=Standard Error ,

*Alt*Sex = interaction between Altitude and Sex of bird, Kg=kilogram,gm=gram, %= percent, (30)= number of slaughtered chickens. LxC=lowland with Cockerel, LxP=Lowland with Pullet,MxC=Midland with Cockerel, M xP=Midland with Pullet, %=percentage.*

Figure 2. Fresh crop content and physical examination

The fresh crop contents obtained from the slaughter chickens considerably varied based on altitude and sex of the slaughtered chickensTable 5.However, there was significant difference (P <0.05) between altitudes in the cereal grain proportion of the crop content of the experimental chickens. Cereal grains represent the largest proportion of the scavengable feed resources of bothlowland and mid altitude agro-ecologies studied. The scavenging feed resource ofboth the lowland and midaltitude ecologies of the study area, as measured by crop content ofthe slaughtered chickens comprisedof cerial grains,refused household, green materials, insects/wormsand other materials, all of which showed some sort of variation between individual birds.

As shown in Table 5, there was no significant difference between the pullets and cockerels in mean daily insect and worm andgreen materials ($P>0.05$) proportion of the crop contents. Cerial grains comprisedof about 53.3 and 48.1% of the total crop content of the slaughtered pullets and cockerels respectively. Maize, sorghum and millets were the cereal grains frequentely encountered during the crop content analysis both in lowland and midland. The relatively higher proportion of cereal grains recorded from the crop content of the slaughtered chickens could be attributed to the harvest time of grains which takes place at early dry period (October– December) in the study area.

The proportion of cereal grains obtained from crop content of pullets (53.3%) was significantly higher ($P<0.05$) than the proportion of cereal grains obtained from the crop content ofcockerels (48.1%). The resultsobtained showed that, the mean total crop content obtained from pullets and cockerels was 34 and 25g, respectively. Thus the results obtained indicated that the mean daily cereal grain and total feed material intake of the pullets was significantly ($P<0.05$) higher than that of the cockerels. The relatively higher mean daily grain and total feed material intake of the pullets seems to bedue to the fact that females require more nutrients than males to meet their production and reproduction performance.

The results of the current study was in agreement with that of Mekonnen et al . (2010) who reportedthat hens have better scavenging capacity on protein rich feed resources probably to meet the nutrient requirnment for egg production. According to McBride *et al.* (1999), the male would be most of the time on guard and show an alert position while females keep on scavenging.The males call to the hens when they find edible items to share through the performance of “tidbitting” displays by picking up and dropping the food repeatedly and offering it to the hen. During the breeding season, males become very territorial and guard fixed areas and dominant males patrol the boundaries of their territory.

The results of this study was in agreement with that of Hayat *et al*.(2016) who reported that cereal grains comprised the highest proportion of the crop content of the experimental chickens, in Seka Chokorsa district of South Western Ethiopia.Further more this result was similar with that of Tadelle and Ogle (2000) who reportedthat seeds comprised the largest proportion of thefeed materials present in the crop, followed by plant material , worms , insects and unidentified materials , respectively from study conducted in central high lands of Ethiopia.

As shown in Table 5. there was no significant difference between lowland and midaltitude in mean total crop content and in the proportion of household refusal obtained from the slaughtered chickens(P>0.05). The household refusal obtained from both altitudes mainly consisted of kitchen leftovers (porridge and its waste products, refused injera, bread, potatoes and onion pills), maize, and other grain by-products generated during the traditional household food preparation. The results obtained showed that the mean daily grain intake recorded in the lowland (48.1 %) was significantely lower (P<0.05) than that recorded in the midaltitude(52.97 %). Similarly, the proportion of insect and worms and green plant materials obtained from crop content of slaughtered chicken of midland was significantely higher (P<0.05) than that of the crop content of slaughtered chickens of the lowaltitude, attributed to the difference in the availability of protein source feed and green forages in the area.

In contrary to the result of this study,Tadelle.(1996) reported that there is no difference in the availability of insects/worms with the midland and low land altitude, from crop contents of experimental chickenstudied in central highland of Ethiopia.The proportion of animal protein source in the crop content of the slaughtered chickens was lower for the lowland.The inedibleorganic materials found in the crop of the slaughtered chickens comprised of soil, sand (grits), charcoals and others. The proportion of these materials was significantly higher (P<0.05) in the crop content of lowland chickens. But there was no significant difference (P>0.05) in the proportion of inedible organic materials between pullets and cockerels.

4.3.3 Chemical composition of crop contents

The chemical composition of crop contents of the experimental chickens is shown in Table 6. There was no significant difference (P>0.05) between the crop content of slaughtered chickens of the lowland and midaltitude in percent composition of dry matter, total ash, crude fiber ,metabolizable energy, calcium and phosphorus. The percentage composition of ether extract and nitrogen free extract of the crop content of the slaughtered chickens of the lowland was significantely higher (P<0.05) than that of the crop content of the slaughtered chickens of the midaltitude. On the contrary, the percentage composition of crude protein of the crop content of slaughtered chickens of the midaltitude was significantely higher (P<0.05) than that of the crop content of slaughtered chickens of the lowland altitude. Significant interactions between altitude and sex of bird were observed with regard to the DM, EE, CP, CF and NFE level of composition(Table 6).The relatively higher percentage of the crude protein content of the crop content of slaughtered chicken of the midaltitude could be attributed tothe better availability of protein rich scavenging feed resources.

The dry matter contents of experimental pullets and cockerels were 89.86% and 89.38% , respectively and shows no significant difference between each others(P>0.05). With the exception of the percentage composition of dry matter, there was no significant difference in the percentage composition of all the other nutrients between the crop content of the slaughtered pullets and cockerels. The mean percentage composition of dry matter and total ash of the crop contents of slaughtered pullets was higher than that of slaughtered cockerels. The relatively higher percentage of dry matter and total ash recorded from the crop content of pullets could be attributed tothe high proportion of grains in their crop contents.It was also reported that the higher proportion of grains in the crop content of pullets might be a reflection of the preferential treatment given to the adult birds in grain supplementation by the local people.

Table 6. Effect of altitudeand sex of birds on chemical composition of crop contents(Mean ±SE)

Altitude/Sex of bird	Chemical Composition (% of dry weight)								
	DM	Ash	EE	CP	CF	NFE	ME(Kcal)	Ca	P
Altitude									
Lowland	89.15±0.14	14.5±0.3	2.92±0.16^{a}	9.47±0.37^{b}	9.38±0.24	63.69±0.65^{a}	2584.7±23.2	1.15±0.06	0.83±0.12
Midland	89.1±0.14	15.1±0.3	2.05±0.16^{b}	12.17±0.37^{a}	9.32±0.24	61.54±0.65^{b}	2519.9±23.2	1.01±0.06	0.65±0.12
P-Value	**0.803**	**0.222**	**0.006**	**0.001**	**0.852**	**0.048**	**0.084**	**0.136**	**0.334**
Sex of birds									
Cockerel	88.86±0.14^{b}	15.02±0.3	2.61±0.16	11.05±0.37	9.14±0.24	62.35±0.65	2569.1±23.2	0.92±0.06^{b}	0.68±0.12
Pullet	89.38±0.14^{a}	14.62±0.3	2.36±0.16	10.59±0.37	9.56±0.24	62.87±0.65	2535.6±23.2	1.24±0.06^{a}	0.79±0.12
P-Value	**0.031**	**0.372**	**0.321**	**0.404**	**0.261**	**0.584**	**0.337**	**0.005**	**0.532**
Altitude*sex	**of birds**								
Lx C	89.15±0.2^{ab}	14.71±0.42	3.22±0.23^{a}	9.5±0.53^{b}	9.6±0.34^{ab}	62.9±0.92^{ab}	2574.8±32.8	0.94±0.15	1.08±0.17
L x P	89.15±0.2^{ab}	14.38±0.42	2.62±0.23^{ab}	9.44±0.53^{b}	9.17±0.34^{ab}	64.4±0.92^{a}	2594.6±32.8	1.26±0.15	1.24±0.17
M x C	88.57±0.2^{b}	15.34±0.42	1.99±0.23^{b}	12.6±0.53^{a}	8.68±0.34^{b}	61.72±0.92^{ab}	2578.9±32.8	0.85±0.15	1.29±0.17
M x P	89.62±0.2^{a}	14.87±0.42	2.11±0.23^{b}	11.73±0.53^{a}	9.95±0.34^{a}	61.35±0.92^{b}	2476.5±32.8	1.3±0.15	1.36±0.17
P-Value	**0.031**	**0.873**	**0.016**	**0.001**	**0.001**	**0.036**	**0.143**	**0.79**	**0.759**

a, b Least square means with different superscript within the same column are significantly different (P<0.05)SEM = Standard Error of Mean ,Alt X birds= interaction effect between altitude and sex of bird, LxC=lowland with Cockerel, LxP=Lowland with Pullet,MxC=Midland with Cockerel, M xP=Midland with Pullet, %=percentage

They believe that since the layers lay eggs or rear the chicks, they should have more feed. This result is lower than that of Mekonnen *et al*. (2010) who reportedthat the higher dry matter (91.1- 92.5%) composition of the crop content might be due to conducting the study in harvesting season. On the other side the result of the current study was contrary to that of Ncobela (2014) who reported that the dry matter concentration of crop content was higher in the hot dry season in cocks than in hens from the experimental chickenconducted in South Africa.

The crude protein level of crop content of the experimental birds significantly ($P< 0.05$) varied with altitude butthere was no significant difference ($P > 0.05$) in crude protein between the crop content of males and females (Table 6).The meancrude protein level of the crop contents of experimental birds of the mid altitude and low altitude was 12.17 and 9.47 % of the dry matter respectively. The mean CP contents of the crop content of the study area was 10.88%,indicating that the result of the current study was lower than that of Mohmoh *et al*.(2010), who reported crude protein of 12.77% from crop content during early dry season , but was in agreement with that of 10.94% the value of which was recorded from the crop content studied during late dry season in Nigeria. The percent composition of CP obtained from the current study was higher than that of Hayat *et al.* (2016) who reported CP of 9.76% from crop contents of indegenous scavenging chicken of Seka Chokorsa. The resultsof this study showed that growing chicken tended to consume feed with a higher crude protein content. According to the results of this study, the crude protein content of the crop content of the experimental birdswas below the requirement (160 g Kg $DM^{-}1$) of local laying hens.

Kinghori *et al*. (2003) reported that the CP requirements of indigenous chickens at 14 - 21 weeks of age is 160 g kg^{-1}. Based on the results of the current study, the total CP content of the crop content of laying hen was calculated to be 108.2 g $kg^{-1}$the value of which was lower than the requirement of laying hen. According to NRC (1994),the recommended levels ofCP in diets of egg type growers range between 150 and 200 g/kg of DM. The crude protein level of the crop content obtained from the current study was lower in low altitude than in mid altitude. The low CP content of the crop contents of experimental birds from the low altitude could be attributed to the poor vegetation cover and soil fertility and relatively low proportion of seeds in the crops of the slaughtered birds.

There was no significant difference (P>0.05) between altitudes and sex of birds in the percent composition of crude fiber of the crop contents of experimental birds. Where as there was significant difference (P<0.05) on the interaction effect of altitude with sex of birds. On the contray, the percentage composition of CF obtained from the crop content of pullets (9.56%) was higher than that of the cockerels (9.14 %). The overall mean percent composition of CF of the crop content obtained in this study was 9.35% . This result was inline with that of Momoh *et al* .(2010), who reported CF content of 9.95 and 8.91% from crop contents of the Nigerian indigenous chickens during early and late dry season respectively.

The CF content of crop obtained in the current study was lower than that of Hayat *et al* .(2016), who reported CF of 11.92 and 11.07% from crop contents of pullets and cockerels from the study conducted in Seka Chokorsa. On the other side , the CF values recorded from the current study was higher than that of Mokonnen *et al*.(2010) and Raphulu *et al*. (2015),who reported CF content of 3.65 and 3.3% from crop content of egg type adult and grower chicken of Ada'a district of Oromia Region and South Africa, respectively. The CF content obtained in this study was higher than the CF level recommended with in commercial layers rations of around 5% (Feltwell and Fox, 1978). Excessive Crude Fiber composed of cellulose, lignin and hemi-cellulose is likely to be poorly digested by mono-gastric animals (Mekonnen *et al*., 2010). The consumption of undesirable materials such as feathers may contribute to high levels of CF in crop contents and results in poor availability of nutrients (Sonaiya *et al*., 1999).

Carbohydrate is the major source of energy for poultry and most of the carbohydrate in poultry diets is provided by cereal grains.The NFE represents soluble carbohydrates and other digestible and easily utilizable non-nitrogenous substances in chicken feeding . According to the results of the current study, there was significant difference in NFE levels of crop content (P< 0.05) between altitude and interaction effect of sex with altitude.

Mean percent composition of 62.61% of NFE value was obtained from the crop content of the experimental birds of the current study. The result of the current study was higher than that of Hayat et al .(2016), who reported NFE value of 46.2% from crop contents of the experimental chickens in Seka Chokorsa Woreda . The result of the current study was also higher than that of Momoh *et al*.(2010), who indicated 53.62 and 56.26% of NFE from crop content of the experimental birds during early and late dry seasons of North Central Nigeria respectively. Ncobela (2014) reported 33.9 and 30.02% of NFE from crop contents of experimental chicken in South Africa. Rashid *et al* .(2005) and Raphulu *et al*. (2015) reported about 68.7 and 61.03% of NFE from crop contents of the experimental chicken in Bangladesh and Venda region of South Africa, respectively. The higher NFE value indicatehigherproportion of grains in the crops during late and early dry seasons. Higher NFE content is associated with higher metabolizable energy.

The mean calculated metabolizable energy level of thecrop contents of the experimental chicken of the current study was 2552.3 Kcal/kg. Tadelle and Ogle (2000) reported comparable metabolizable energy content of 2245.1– 3528.1 Kcal/kg DM-1 from crop contents of the experimental chickens of cenral highland of Ethiopia. Higher energy content was reported during early dry season compared to the other seasons, attributed to the better availability of cereal grains which had just been harvested and given to the birds in larger amounts. The result of the current study was higher than that of Hayat *et al*. (2016) who reported 2023 and 2082 Kcal/kg-1 for pullets and cockerels respectively .

Momoh *et al*. (2010) reported metabolizable energy value of 2352 and 2598 Kcal/kg-1 from crop content of layers and grower during the early dry period in Nigeria. There is no an efficient utilization of the metabolizable energy by scavenging chickens since some energy could be lost due to their movement over a long distance to find feed. According to NRC (1994) the relative amounts of energy available vary with the amount and composition of the feedstuffs in the scavenging feed resource.

Other factors, such as species, genetic makeup and age of poultry, as well as the environmental conditions also influence the utilization of dietary energy. Deficiency of energy negatively affects the production performance of poultry. If the available energy concentration of the diet is changed, birds maintain constant energy intakes by changing their feed intakes. Therefore, energy is required for chickens for supporting movment activities during scavenging.

The Ash level of the crop content of the experimental chickens was not significantely influenced (P> 0.05) by altitude and sex of the birds. The meanash content of the crop content observed in this study was 14.82%. This result was in agreement with that of Tadelle and Ogle (2000), who reported ash content of 1.6 – 15.7%from the crop content of indigenous chickens during dry season in Central Highland of Ethiopia . The result of current study was lower than that of Hayat *et al* .(2016), who reported ash content of 22.86and 22.15% for crop content of pullets and cockerels in Seka Chokorsa.

Calcium levels of the crop contents of the experimental chicken was significantly (P<0.05) higher (1.24%) in pullets than in (0.92%) in the cockerels. The over all mean calcium content of experimental chicken was 1.1%. The result of the current study was lower than1.32% reported by Rashid *et al* .(2004) from Pakistan. The higher calcium content in the crop content of pullets compared to that of cockerelsmight be attributed to a selective feeding habit of the pullets which in turn depends upon the nutritional requirement during the early phase of laying period. Calcium requirement(18 g kg DM^{-1} of laying hens is comparatively high and increases with the rate of egg production and age of the hen.

The phosphorus content of the crop content obtained in the current study was 0.68 and 0.79 % for cockerels and pullets ,respectively. The mean phosphorus content of the crop content of the experimental chicken in the study area was 0.74%. This result is higher than that of Tadelle and Ogle (2000), who reported 0.9 and 0.6% of Calcium and Phosphorus from crop content of indigenous chickens in the Central Highland of Ethiopia. The result of this study was in line with that of Hayat *et al* .(2016) who reported calcium content of 1.26 and 0.73% for pullets and cockerels, and phosphorus content of 0.66 and 0.68%

from a study conducted in Seka Chokorsa Woreda. The results of the current study was higher than that of Mekonnen *et al*.(2010) who reported 0.43 - 0.9%Calicium and 0.24 – 0.38%Phosphorus from the crop content in Ada'a district. Rashid *et al* .(2005) reported 0.46 and 0.34% of Phosphorus from crop content of scavenging layers and growers in Bangladesh. Poultry needPhosphorus and Calcium to build and maintain their skeletons. Phosphorus is also necessary for energy utilization at the cellular level (NRC, 1994). However, Phosphorus is unavailable to the birds because it is found in the phytate form which is being excreted in to the environment (Tahir *et al.,* 2012). The low Calcium content obtained from the current study indicate low availability of green forage during dry season in the study area. It is indicated that lower proportion of green forages was found in crop content of most village chickens during the harvesting season.

4.4. Estimating Adequacy of Scavenging Feed Resource

The amount of scavenging feed material available /chicken/day is important in smallholder chicken production. The Scavenging Feed Resource Base (SFRB) of the study area was calculated to be about 254.77 kg of dry matter /annum./hh/flock. It has been shown that the result obtained from the current study is higher than that obtained from Sri Lanka by Gunaratne *et al.* (1993), who reported 195 kg of dry matter/year/hh/, but lower than that reported from , Indonesia by Kingston and Creswell (1982), who reported 475 kgdry matter /year/hh.

The results of this study (254.77 kg of dry matter /annum/hh) was also lower than that reported from Thailand by Janviriyasopak *et al*,.(1989), who reported 390 kg of dry matter /year/hh, but higher than that reported from four villages of Nigeria by (Sonaiya *et al*, 2003), who reported 110kgof dry matter/year/hh. In contrast to the above circumstances, the estimated SFRB of 254.77 kg of dry matter/year/hh might not be efficiently utilized by poultry since only chickens are involved under the condition of the current study area. More over SFRB depends on the number of households, types of food crop grown, crop cultivation and processing methods and climatic conditions that determine the rate of decomposition of the food products.

Seasonal fluctuations in the SFRB occurs due to periods of fallow or flooding,cultivation, harvesting and product processing (Gunaratne *et al,*.1993; Roberts and Gunaratne, 1992).

The results of this study showed that the mean SFRB availablein the study area was about 698 g of dry matter/day/hh. It is indicated that the indigenous chickens spent 8-10 hours of scavenging close to the residential area with in a radius of 100-150 meters (Gunaratne *et al*,. 1993). At the SFRB utilization efficiency of 60 and 70% , about 419 and 489 g of dry matter/day is available/hh in the study area respectively. This result is comparable to that of Gunaratne (1993) who reported availability of 550 g of dry matter /hh/day in Sri Lanka.

The results of the currentstudy showed that the mean flock size /household in the study area was about 9.39 chickens, the value of which was greater than the average of both the National (4.1 chickens) and Oromia Regional state (3.6 chickens) . The flock size obtained from the current study (9.39 chickens) was also found to be greater than that of Tigray (7.2 chickens) and Beneshangule- Gumuze (7.6 chickens), both of which were reported to be the highest chicken flock size as compared to all the other parts of Ethiopian. At the daily dry matter intake of 70-90 g/day/ chicken, the available SFRB of 419- 489 g of dry matter /hh/day in the study area seems to support flock size of 5.7 chickens /household. Based on the chemical composition of the crop content of the experimental chicken, the metabolisable energy and protein intake from scavenging could be calculated at about 10.4 - 11.4 MJ/ day/ bird and 9.13 - 13.81 % /day/bird of proteins respectively, both of which are less than the requirement of growers of 9 weeks of age as recommended by NRC (1994).

The results of this study tend to indicate that the total biomass of the scavenging population was not proportional to the available SFRB. As reported by Gunaratne *et al*; (1993), the factor determining the size of available SFRB include flock size and season of the year. If the biomass of the flock is exceeding carrying capacity of SFRB, production of chicken falls, indicating that the SFRB available in the community determines the production performance of scavenging chickens. Thus the result of this study tend to indicate that the shortage of the 258gm DM /day/hh of SFRB (both in quantity and quality) seems to have negatively affected productivity.

This study was conducted in the early phase of dry period in Ethiopia,which belongs to the season of ripening and harvesting of almost all food crops including cerial grains. which comprised of thehighest proportion (50.7 %) of the crop content of the experimental chickens in the study area. More over , household left over accounts for about 23.85 % of SFRB, followed by animal protein (Insects, worms, ants and small snails) which was found to be accountable for about 12 %of the crop content of the experimental chickens. Thus it seems that the availability of SFRB in the study district was maximum at the time of conducting the the current study.

The results of this study was in agreement with the results obtained else where in Ethiopia. The scavenging feed resource base for local birds was reported to be inadequate and variable depending on season (Hoyle, 1992 ;Alemu and Tadelle,1996). According to Tadelle and Ogle (2000), the materials present in the crop, as visually observed, are seeds, plant materials, worms, insects and inedible materials. The nutritional status of local laying hens (from the chemical analysis of crop contents) indicated that crude protein was below the requirements for optimum egg production. Protein supply may be critical , particularly during the drier months, (Alemu and Tadelle,1996).

There may be deliberate supplementary grain feeding during the ripening and harvesting period of October – March. The quantities of supplementation gradually decrease until June – August, during which scavenging is the only source of feed. Scavenging chickens are vurnerable to predation as they need to leave the family dwelling to scavenge for feed. Scavenging for food away from the family dwelling also results in birds coming in to contact with larger numbers of birds from other flocks, facilitating the spread of infection. New castle disease is usually cited as the most widespread, particularly during the rainy season (Tadelle and Ogle, 2000).

4.5. Supplementary Feed Resources of Genji District.

The results of this study clearly showed that the available SFRB of the study area is characterized by low protein, metabolizable energy,Ca and P contents indicating that, SFRB alone cannot support optimal growth and egg production of scavenging poultry (Table 7). Thus the nutrients that are deficient or cannot optimally supplied by SFRB should be provided as supplementary feeds.

Table 7. Comparative nutrient requirement of poultry and nutrient content of SFRB of Genji district.

Critical Nutrients	Recommended level by NRC (1994)	Estimated in take from SFRB	Nutrient balance	Nutrient balance(%)
ME (MJ kg DM^{-1})	11.9	10.1	(1.8)	(15.1)
CP (g kg DM^{-1})	160	108.2	(51.8)	(32.4)
Ca (g kg DM^{-1})	18	10.8	(7.2)	(40.0)
P (g kg DM^{-1}	3.5	7.4	(3.9)	(111.4)

The SFRB of the study area is deficient in the critical nutrients with the exception of Phosphorus Table7. The metabolizable energy , protein and calcium intake from SFRB was calculated to be about 15.1, 32.4 and 40 % of the requirement of growing flock as recommended by NRC (1994). Thus, the SFRB of Genji district seems to be critically deficient in calcium,protein,and metabolizable energy. However , in poultry feed intake is determined by the amount of energy in the diet (Nahashon *et al*.,2006). It has been shown that increasing the dietary energy concentration leads to decrease in feed intake , resulting in reduced growth (veldkamp *et al*.,2005). Thus in poultry nutrition, dietary energy level is the main factor influencing feed intake, as birds eat to satisfy their energy requirnment. The energy necessary for maintenance and production is provided by the energy-yielding dietary components, primarily carbohydrates and fats (NRC, 1994). A wide range of alternative feed stuffs are available in Genji district to be used as supplementary source of energy in village poultry production system. This energy sources include cerial grains(maize,sorghum, millet, and barley), of which maizeis widely grown in Genji district.

Optimum growth and reproductive performance is possible only if the SFRB is supplemented with feed materials containing the proper amount of essential amino acids. Feed ingredients such as oil seed cakes and by- products of slaughter houses (meat, blood and fish meals) could be used as supplementary protein. How ever, the gap between local supply and demand for these conventional protein concentrates is expected to wider over the coming decades, providing a compelling reason for exploring the usefulness of locally available alternating feedstuffs in correcting the protein deficiency of SFRB of the study area. According to FAO (2008) much focus is not given to using insects as afeed and nutrient source to meet the protein requirement of scavenging chickens. Ethiopia in general and Genji woreda in particular is not exception to this situation. Maggots and termites are excellent and cheap sources of protein in free ranging systems, when offered as supplement to other feeds . Maggots may be grown by simple technique and used to supplement the diet of the young chicks. There is also a simple method for growing termites to be used as source of protein for chicken feeding as source of protein. Insects and worms (maggots and termites)have high nutritive value , not only in proteins, but also in fats, minerals and vitamins, which makes them best energy and protein source for scavenging chickens.

5. CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The present studyindicated that the quantity of scavengeable feed resources scavenged by local chickens and their chemical composition varied with altitudeandsex of birds. The variation occurred between birds may be attributed to the selective feeding habit of birds, which are related to their nutritional requirements. During the study period of the early dry season in the Genji district the availability of cerial grains and house holdrefusal/kitchenwastewere highercompared with green plants and insects/wormsobserved in the crop contents of scavenging local chickens.This may be attributed to the availability of the cerial grains during harvesting and ripening season of different seed crops harvested in the district.

The major nutrients calcium, crude proten and Metabolizable energy in crop contents appeared to be low to support satisfactory production potential.It can also be concluded that the nutritional status of scavenging local chickensunder small holder management condition was below the requirement except for Phosphorus. And also the total biomass of the scavenging chicken population per house holds were not proportional to the available scavengeable feed resources base in the Genji district.

Generally the results of the current study indicated that the nutrient content of scavengeable feed resources base of Genji district is below the requirements of scavenging local chickens. This may be attributed to the lack of knowledge about the importance of supplementary feeding and very little attention given for poultry management. A wide range cereal grains available in the district to be used as supplementary source of energy. However, scavengeable feed resources alone cannot support optimal growth and egg production of local chickens.

5.2 Recommendation

- Training, development agencies must focus more on the needs of smallholder poultry producers, who for the most part are women.
- Developing the awareness of people and a basic daily supplementary ration with the use of locally available feed ingredients. Poultry keepers must provide sufficient supplementation to their birds rather than simply throwing leftovers "away to the birds".
- For poultry producers, resources available in the backyard must be supplemented with sources of appropriate nutrients as necessary.
- Adequate feed supplementation based on composition of the available SFR in the early dry season is necessary for improved productivity of the local scavenging chickens.
- Further studies are needed to identify and characterize potential scavengeable resources in different farming systems at different periods of the year.
- As alternative feed resources for local chickens which are not used in competition with human use, insects (termite)could be used as source of supplementary protein, fats and minerals through the use of simple harvesting techniques to overcome the deficiencies of the SFRB in this nutrients.

6. REFERENCES

Aberra,M;2000. Comparative studies on performanceand physiological responsesofEthiopiaindigenous(‘Angete-melata) chicken and their F1 crosses tolong term heat stress. PhD thesis.MartinLutherUniversity, HalleWittenberg, Berlin, Germany. 182.

Abdulqadir, Wolnnyc, B.A. and Gauly, M., 2007. Characterization of local chicken production system and their potential under different level of management practices in Jordana. Animal breeding and husbandry in tropics and sub tropics, George Augest University, Gottingen, Germany.

Addis, G. and Malede, B., 2014.Chicken Production Systems, Performance and Associated Constraints in North Gondar Zone, Ethiopia.Journal of Fisheries and Livestock Production.

Addisu H, Hailu M, Zewdu, W; 2013. Indigenous Chicken Production System and Breeding Practice in North Wollo, Amhara Region, Ethiopia. Poult Fish Wildl Sci 1: 108. doi: 10.4172/ 2375-446X .1000108.

Adem, A.and Teshome, G.,2016. Indigenous chicken production system and their productive performance in Yeki Woreda, Southwestern Ethiopia.Agriculture and journal of North America.ISSN Print: 2151-7517, ISSN Online: 2151-7525, doi:10.5251/abjna.2016. 7.5.266.274 .

Aklilu, H.A., Almekinders, C.J., Udo, H.M., Van der Zijpp, A.J., 2007. Village poultry consumption and marketing in relation to gender, religious festivals and market access. Trop. Anim. Health. Prod., **39(3)**, 165-177.

Alders, R., 2004. Poultry for profit and pleasure.FAO Diversification Booklet 3.FAO (Food andAgriculture Organization of the United Nations), Rome, Italy.

Alemu, Y., Tadelle, D., 1997. The status of poultry research and development in Ethiopia.Research bulletin No. 4, Debre Zeit, Ethiopia.

Amy E. Halls,.2008. Water Quality For Poultry. Monogastric Nutritionist Shur-Gain, Nutreco Canada Inc.

AOAC, 2000.Official Methods of Analysis. 17th ed. The Association of Official Analytical Chemists.Alington, V.A., USA.

Asefa, T., 2007. Poultry management practices and on farm performance evaluation of Rhode Island Red (RIR), Fayoumi and local chicken in Umbullo Wachu water shed.M.Sc.thesis. Department of animal and range sciences, Hawassa College of agriculture Awassa, Ethiopia.

Asmelash, B., Dawit, M, Kebede, E., 2018. Characterization of Village Chicken Production and Breeding Practices of Smallholders inEastern Ethiopia. J Vet Sci Technol 9: 507. doi:10.4172/2157-7579.1000507.

Atsbaha Hailemariam & Negassi Amaha,. 2017.A Review on Current Characteristics of Chicken ProductionSystem dynamics and Bio-security implications in Ethiopia. Advances in Life Science and Technology www.iiste.org.ISSN 2224-7181 (Paper) ISSN 2225-062X (Online)(Vol).55,

Ashenafi, H, Tadesse, S, Medhin, G, Tibbo, M., 2004 . Study on Coccidoiosis of scavenging chickens in central Ethioipia.Trop. Anim.Hlth.Prod., 693-701.

Bangu Bekele,2016.Locally Available Poultry Feeds, Feeding Practices and Health in Sidama Zone and Halaba Special Woreda in SNNPRsouth Agricultural Research Institute, Hawassa Agricultural Research CenterP.O Box -06.

Besbes, B., 2009. Genotype evaluation and breeding of poultry for performance under sub-optimal village conditions. World's Poultry Science Journal, **65 (2)**: 260-271.

Bogale, K., 2008. *In situ* characterization of local chicken eco-type for functional traits and production system in Fogera Wereda, Amhara Regional state. Haramaya University, Ethiopia. Pp. 123.

Bushra, B.,2012. The Status of Indigenous Village Chicken Production and Marketing System in Ethiopia; International Journal of PoultryScience , **6**: 128-136

Branckaert, R.D.S. and Gueye, E.F.,2000. FAO's Programme for support to family poultry production.http://www.husdry.kvl.dk/htm/tune99/24.branckaert.thm.

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

Charles.,T and Hanyani.,2012.Effect of full and semi scavenging Rearing systems on crop contents and the quality of meat from village chickens during the spring season.Deparment of livestock and pasture science.Eastern Cape south Africa.

Chemjor, W., 1998. Energy and Protein Requirements of the Growing Indigenous Chickens of Kenya. M.Sc. Thesis. Egerton University Njoro Kenya.

CSA (Central Statistical Agency).,2003. Ethiopian Agricultural Sample Enumeration, 2001/2002.Statistical report on farm management practices, livestock and farm implements part II, Addis Ababa, Ethiopia.

CSA (Central Statistical Authority).,2013. Central Statistical Authority and World bank health sample survey.May 7th ,2013.Addis Ababa ,Ethiopia.

CSA (Central Statistical Authority).,2017.Agricultural Sample Survey 2016/17 (2009 E.C).Volume II. Report on Livestock and livestock characteristics. Statistical Bulletin, 505. November, Addis Ababa, Ethiopia

Daghir, N.J. and Jones, R., 1995: Breeder and hatchery management in hot climates. pp. 255-291. In: Poultry Production in Hot Climates. N.J. Daghir (Ed). CAB International, Wallingford, UK.

Dana, N., Dessie, T., van der Waaij, L.H., van Arendonk, J.A., 2010a. Morphological features of indigenous chicken populations of Ethiopia. Animal Genetic Resources Information,**46**: 11-23.

Dana, N, Vander Waaij, E. H. and Van Arendok, J. A., 2011. Genetic and phenotypic parameter estimates for body weights and egg production in Horro chicken of Ethiopia. Tropical Animal Health and Production,**43**: 21–28

Debre Zeit Agricultural Research Centre (DZARC),1991. Annual Research Report. DebreZeit, Ethiopia.

Debre Zeit Agricultural Research Centre (DZARC), 2007. Annual Research Report. DebreZeit, Ethiopia.

Dessie,T., Esatu,W., Waaij,L.V., Zegeye,F., Gizaw,S., Mwai,O. and van Arendonk,J., 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, Chala, R, Dawo, F, Leta, S. and Bekana, E., 2010**.** Socio-economic importance and management of village chicken production in rift valley of Oromia, Ethiopia. *Livestock* ResearchforRuralDevelopment..RetrievedSeptember22,2017,fromhttp://www.lrrd.org/lrrd22/11/dink22203.htm

Emebet, 2015.Phenotypic and genetic characterization of indigenous chicken in south west Showa and Gurage zones of Ethiopia.College of Veterinary Medicine and Agriculture of Addis Ababa University

FAO., 2004. Small-Scale Poultry Production. Rome, Italy: Fao.

FAO., 2008. An analysis of the poultry sector in Ethiopia. Poultry sector country review. Food and Agriculture Organization (FAO), Rome, Italy, 1-48.

FAO.,2009. The state of food and agriculture: Livestock in the balance. Food and Agriculture OrganizationoftheUnitedNations(FAO),Rome,Italy.http://www.fao.org/docrep/012/i0680e/i0680e.pdf.

FAO**.,**2010. Smallholder poultry production – livelihoods, food security and sociocultural significance, by K. N. Kryger, K. A. Thomsen, M. A. Whyte and M. Dissing. FAO Smallholder Poultry Production Paper No. 4. Rome

FAO.,2014. The state of food and agriculture: Livestock in the balance. Food and Agriculture Organization of the United Nations (FAO), Rome, Italy. http://www.fao.org/docrep/012/i0680e/i0680e.pdf

Fisseha, M., Azage, T. and Tadelle, D., 2010. Indigenous chicken production and marketing systems in Ethiopia: Characteristics and opportunities for market-oriented development. IPMS (Improving Productivity and Market Success) of Ethiopian Farmers Project Working Paper 24. ILRI, Nairobi, Kenya

Faruque, S., Siddiquee, N.U., Afroz, M.A. and. Islam, M.S., 2010. Phenotypic characterization of native chicken reared under intensive management system. Journal of Bangladesh Agricultural University, ***8***: 79-82.

Getu A, Birhan M (2014) Chicken Production Systems, Performance and Associated Constraints in North Gondar Zone, Ethiopia. J Fisheries Livest Prod 2:115. doi: 10.4172/2332-2608.1000115

Goromela, E.H., Kwakkel, R.P., Vestergen, M.W.A., Katule, A.M., 2006. Strategies to optimize the use of scavengeable feed resource base by smallholders in traditional poultry production systems in Africa: A review. *African Journal of Agricultural Research* ,**1 (3):** 091-100.

Goromela, E. H., Kwakkel, R. P., Verstegen, M.W. A.& Katule, A. M.,2007. Identification, characterization and composition of scavengeable feed resources for rural poultry production in Central Tanzania. AfricanJournal of Agricultural Research, **2 (8)**: 380–393.

Goromela, E. H., Kwakkel, R. P., Verstegen, M. W. A. & Katule, A. M., 2008.Effect of season and farming system on the quantity and nutritional quality of scavengeable feed resources and performance of village poultry in central Tanzania.*Journal of Cell and Animal Biology*, **2 (3)**: 63–71.

Gunaratne, S.P., Chandrasiri, A.D.N., Hemalatha, W.A.P., and Roberts, J.A.,1992. Productivity and nutrition of village chickens in Sri Lanka. In: *Newcastle Disease in Village Chickens*, n (Spradbrow, P.B., Ed), Australian Centre for International Agricultural Research, Canberra, Proceedings No**39**:144-148.

Gunaratne, S.P., Chandrasiri, A.D.N., Hemalatha, W.A.P., and Roberts, J.A.,1993. Feedresource base for scavenging village chickens in Sri Lanka.*Tropical Animal Health and Production*, **25**:249-257.

Haftu, K .,2016. Exotic Chicken Status, Production Performance and Constraints in Ethiopia: A Review. *Asian Journal of Poultry Science,* **10 (1)**: 30-39.

Halima Hassen, 2007. Phenotypic and genetic characterization of indigenous chicken populations in northwest Ethiopia.PhD Thesis. University of the Free State, Bloemfontein, South Africa.

Haruna, M. and Massango,F.A.,2001.Village Poultry Production in Mozambique: Farming Systems andEthnoveterinary Knowledge in Angonia and Tsangano Districts, Tete Province [online]. In: SADC Planning Workshop on Newcastle Disease Control in Village Chickens. Workshop on Newcastle disease in village chickens, Maputo, Mozambique, March 6-9, 2000.ACIAR Books Online. Available from: http://www.aciar.gov.au/publication/PR103. Pr103chapter17.pdf. ISBN 0 642 45687..

Jeff Mattocks., 2002 .Poultry and Livestock Nutritionist.The Fertrell Company P.O. Box 265 Bainbridge, PA **17502** 800-347-1566 jeff@fertrell.com.

Kennea, Y., Legesse, D. And Alemu, Y.,2003. Poultry marketing structure, spatial variation and determinants of prices in Eastern Shewa Zone, Ethiopia. Challenges and Opportunities of Livestock Marketing in Ethiopia, Proceedings of the 10th annual conference of the Ethiopian Society of Animal Production (ESAP) held in Addis Ababa, Ethiopia, 21-23 August 2002. Ethiopian Society of Animal Production: Addis Ababa. 115-120 Poultry production and performance in the... (PDF Download Available).

Khobondo, J. O., Muasya, T. K., Miyumo, S., Okeno, T. O., Wasike, C. B., Mwakubambanya R, Kingori,A.M.and Kahi,A.K.,2015.Genetic and nutrition development of indigenous chicken in Africa. *Livestock Research for Rural Development.Volume 27,Article#122.*Retrieved October 5, 2017, from http://www.lrrd.org/lrrd27/7/khob27122.html.

Kibreab et al, 2015.Feed and Feeding Practice of Village Chicken at Kafa and Bench Maji Zone, South West Ethiopia.Southern Agricultural Research Institute, Bonga Research Center, Ethiopia, P.O. Box 309, Bonga, Ethiopia.

King'ori, A.M., 2004. The protein and energy requirements of indigenous chickens (Gallus domesticus) of Kenya (Ph.D. thesis. Egerton University, Kenya: 93).

Kingori, A .M., Tuitoek, J. K.,Muiruri,H.K.,Wachira,A.M. and Birech, E.K., 2007.Protein intake of growing indigenous chicken on free-range and their response to supplementation. International Journal of Poultry Science 6: 617-621.

Kingori, A. M.,Wachira,A.M. and Tuitoek, J. K., 2010.Indigenous Chicken Production in Kenya: A Review. International Journal of Poultry Science. **9**: 309-316.

Kirk, C.Klasing., 2016.Nutritional Requirements of Poultry. Department of Animal Science, University of California.*Merck Veterinary Manual in the US and Canada and the MSD Manual outside of North America.*

Kock, A., Halima, H., Neser, F.W.C. and Marle-Koster, E., 2007. Village-based indigenous chicken production system in north-west Ethiopia. Tropical animal health and production, **39 (3)**: 189-197.

Kondombo, S.R., 2005. Improvement of village chicken production in a mixed (chicken-ram) farming system in Burikina Faso. PhD thesis submitted to Wageningen University, The Netherlands 208.

Kumar, P.,2016. Importance of Indigenous Breeds of Chicken for Rural Economy and Their Improvements for Higher Production Performance. *Regional Centre, ICAR-Central Avian Research Institute, Baramunda, Bhubaneswar 751003, India. Review Article.*

Littell ,R.C.,Stroup,W.W.and Freund,R.J. 2002. SAS for Linear Models, SAS institude.

Makkar, H.P.S., Tran,G., Heuzé,V., Ankers,P., 2014. State-of-the-art on use of in sects as animal feed. Animal Feed Science and Technology,**197**: 1–33.

Matiwos, H., Negassi, A.and Solomon, D.,2013.Production performance of local and exotic breeds of chicken at rural household level in Nole Kabba Woreda, Western Wollega, Ethiopia.Vol. **8(11)**: 1014-1021.

Matiwos habte, Selamawit Debele.,Birhanu Admassu and Asmamaw Yinnessu , 2015**.** Village chicken production performances assessment under scavenging management system in Amaro district, SNNPRS of Ethiopia. Wudpecker Journal of Agricultural Research,**4(3)**: 021 – 034.

Mazengia, H., Siraw,G.,and Nega,M., 2012. Challenges and prospects of village-based exotic chicken development strategy in Amhara regional state, Northwest Ethiopia.Global J. Sci.Front. Res. Agric. Vet. Sci.

McBride, G., Parer, I. P. & Foenander, F.,1969. The social organization and behaviour of the feralDomesticfowl.Animal Behaviour Monographs,2:125–181.

Mehari, K., 2016. Poultry production systems and its feed resources in Ethiopia: A research review. Sci. J. Ani. Sci., **5(2)**: 220-227.

Mekonnen G/gziabher, 2007. Characterization of the small holder poultry production and marketing system of dale, wonsho and loka abaya weredas of snnprs. MSc Thesis. Hawassa University.

Mekonnen,H., Kelay,B. & Berhan, T.,2010.Assessment of the nutritional status of indigenous scavengingchickens in Ada'a district, Ethiopia.*Tropical Animal Health and Production*, **42**: 123–130.

Mengesha,M.,Tamir,B.,and Dessie,T.,2011.Village chicken constraints and traditional management practices in Jamma District, South Wollo, Ethiopia. J. Livest. Res. Rural Dev.

Merck Sharp & Dohme Corp.,2016 a subsidiary of Merck & Co., Inc., Kenilworth, *Veterinary Manual in the US and Canada and the MSD Manual outside of North America.*

Meseret, M., 2010.Characterization of village poultry production and marketing system in Gomma wereda of Jimma Zone. M.Sc. Thesis, Thesis presented at the school of graduate studies, Jimma University, Jimma Ethiopia. P 143.

Minh, D. V., Lindberg, J. E., and Ogle, B., 2006. Effect of season and location on the crop contents of local and improved scavenging hens in northern Vietnam. Tropical Animal Health and Production, **38**: 121-129.

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, North West Ethiopia. Afr. J. Agric. Res., **5**: 1739-1748.

Momoh,O.M.,Egahi,J.O.,Ogwuche,P.O.and Etim,V.E.,2010.Variation in nutrient composition of crop contents of scavenging local chickens in North Central Nigeria. Agric. Bio. J. North Am., **1**: 912-915.

Muchadeyi, F., Sibanda,S. Kusina,N. Kusina,J.and Makuza,S., 2007. The village chicken production system in Rushinga District of Zimbabwe. Livestock Research for Rural Development.

Mutayoba, S.K ; Katule, A. K; Minga, U. Mtambo, M .M. and Olsen, J .E.,2011.Seasonal variation in nutritive value of scavenged feed and effect of supplementation on performance of rural birds in Sokoine University of Agriculture, Morogoro, Tanzania.

Mwalusanya, N.A., Katule,A.M., Mutayoba,S.K., Minga,U.M., Mtambo,M.A. and Olsen, J.E.,2002. Nutrient status of crop contents of rural scavenging local chickens in Tanzania.Br. Poult. Sci., **42**: 64-69.

Mwalusanya,N., Katule,A., Mutayoba,S.,Mtambo,M.,Olsen,J. and Minga,U., 2004.Productivity of Local Chickens under VillageManagement Conditions. Tropical Animal Health and Production, **34**: 405-416.

Ncobela, C. N., Chimonyo, M., 2015. Potential of using non-conventional animal protein sources for sustainable intensification of scavenging village chickens: A review. Animal Feed Science and Technology,**208**: 1-10.

Nahashon, S.N.,Adefope, N.,Amenyenu, A., Wright, D.,2006. Effect of varying metabolisable energy and crude protein concentrations in diets of pearl gray guinea fowl pullets Growth performance.*Poultry Science Journal*, **85**: 1847-1854.

Ndegwa, J.M., Kimani, C.W., Siamba, D.N., Ngugiand,C.N.,Mburu, B.M.,2001. On farm evaluation ofimproved management practices on productionperformance of indigenous chicken.Oct-Dec.quarterly report, Nahrc Kari Naivasha, Kenya.

NRC., 1994. Nutrient Requirements of Poultry. 9th Edn., National Academy Press, Washington, DC., USA., ISBN-13: 9780309048927,: 155.

Nzietchueng, S., 2008. Characterization of poultry production systems and potential pathways for the introduction of highly pathogenic avian influenza in Ethiopia. Draft Report. Int. Livest. Res. Institu.

Nyaga, P., 2007. The structure and importance of the commercial and village based poultry systems in Kenya. Food and Agricultural Organization of the United Nations.

Hayat,N.,Solomon,D. and Meseret,M.,2016. Chemical composition of scavenging feed resource of indigenous chickens. Asian J. Anim. Sci., **10**: 182-188.

Payne, W.J.A., 1990. An Introduction to Animal Husbandry in the tropics, 4th edn. 684-744 (Essex and New York, Longman scientific and technical).

Raphulu,T., Jansenvan Rensburg,C., and van Ryssen ,J.B.J., 2015.Assessing nutrient adequacy from the crop contents of free-ranging indigenous chickens. South African Journal of Animal Science, **45 (2)**.

Rashid, M.M., Roy, B.C., Asaduzzaman, C. 2004. Chemical Composition of Crop Contents of Local Scavenging Chickens.*Pakistan Journal of Nutrition*, **3 (1)**: 26-28.

Rashid, M. M., Islam, M. N., Roy, B. C., Jakobsen, K., and Lauridsen, C., 2005. Nutrient concentrations of crop and gizzard contents of indigenous scavenging chickens under rural conditions of Bangladesh.Livestock Research for Rural Development, 17,www.lrrd.org/lrrd17/2/rash17016.htm.

Reta,D.,2006. Phenotypic characterization of someindigenous chicken ecotypes of Ethiopia.Livestock Research for Rural Development,**18**: Article # 131RetrievedSeptember 13, 2006,from http://www.lrrd.org/lrrd18/9/dugu18131.htm.

Reta,D., 2009**.**Understanding the role of indigenous chickens during the long walk to food security in Ethiopia. *Livestock Research for Rural Development,Volume 21, Article #116.*Retrieved October 2, 2017, from http://www.lrrd.org/lrrd21/8/dugu21116.htm.

Roberts, J.A., Gunaratne, S.P.,1992. The scavenging feed resource base for village chickens in a developing country. *Proceedings of the XIX World.s Poultry Congress*, Amsterdam, **1**:20-24.

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.

Samson Leta and Endalew Bekana, 2010. Survey on Village Based Chicken Production and Utilization System in Mid Rift Valley of Oromia, Ethiopia. Global Veterinaria, **5(4)**: 19203.

SAS (Statistical Analytical Systems SAS / STAT user's guide).Version 9.3, SAS.,2011 Institute Inc., Cary, North Carolina.

Smith, A. J., 1990. Poultry-Tropical Agriculturist series. CTA, Macmillan Publishers, London,. 179–184.

Snedecor,G. W. and Cochran, W. G., 1977. Statistical Methods. Iowa State University Press, Ames.

Solomon,D,. 2004. Egg production performance of local and White Leghorn hens under intensive and rural household conditions in Ethiopia. Livestock Res. Rural Dev., Vol. **16.**

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

Solomon,D., 2008. Poultry Sector Country Review. FAO, Rome, Italy.

Sonaiya, E.B., Branckaert, R.D.S., and Guèye, E.F**.,**1999.Research and development options for familypoultry.Introductory paper to the First INFPD/FAO electronic conference onfamilypoultry,December1998toJuly1999(alsoavailableathttp://www.fao.org/ag/aga/AGAP/LPA/fampo1/fampo/Intropap.htm).

Sonaiya, E.B., 2003.Village poultry and its role in rural Africa, pp. 16–30. Paper presented at the 1st National Workshop on IndigenousPoultry Development, Nature and Development Group of Africa(NGO Registration No. 026-851-NPO).

SPSS.,2002. Statistical Package for social Sciences. SPSS user's guide 20.0. SAS Institute Inc.,Cary NC.

Steven Leeson, 2016.Mineral Deficiencies in Poultry.,Merck Veterinary Manual in the US and Canada and the MSD Manual outside of North America.University of Guelph.

Tadelle, D., 2003. Phenotypic and genetic characterization of chicken ecotypes in Ethiopia. Ph.D. Thesis, Humboldt University of Berlin, Germany, 144-152.

Tadele, D. 1996. Studies on village poultry production systems in the Central Highlands of Ethiopia MSc. Thesis.Swedish University of Agricultural Sciences. Uppsala, Sweden.

Tadelle, D. 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**: 47-57.

Tadelle, D. and Ogle, B. 2001. Village poultry production system in the central high lands of Ethiopia. Tropical Animal health and production, **33**:521-537.

Tadelle, D., Million, T., Alemu, Y. and Peters, K.J.,2003. Village chicken production system in Ethiopia: use patterns and performance valuation and chicken products and socio-economic functions of chicken. Livest.Res. Rural. Dev.,**15(1).**

Tadelle, D., and Peters, K. J.,2003. Indigenous chicken in Ethiopia: their genetic potential, attempts made in the past for improvement and future areas of research. Humboldt University of Berlin, Animal Breeding for Tropics and sub-tropics.

Tekalegn Yirgu, Etalem Tesfaye and Getinet Assefa., 2017.Poultry Feed Resources and Coping Mechanisms of Challenges in Sidama Zone, Southern Ethiopia.Food Science and Quality Management.ISSN 2224-6088 (Paper) ISSN 2225-0557 (Online) Vol.**60**, 2017

Teklewold, H., Dadi,L., Yami,A. and Dana,N., 2006. Determinants of adoption of poultry technology: A double-hurdle approach. Livestock Res. Rural Dev., Vol. **18**

Tahir, M., Shim, M. Y., Ward,N. E., Smith,C., Foster, E., Guney,A. C. and Pesti,G. M., 2012. Phytate andother nutrient components of feed ingredients for poultry. Poultry Science **91**:928-935..

Tamir, S., Moges,F., Tilahun,Y., and Hile,M., 2015.Determinants of adoption of exotic poultry breeds among smallholder poultry producers in North Western Amhara Region, Ethiopia.Global Sci. Res. J., **3**: 162-16.

Veldkamp, T., Kwakkel, R.P., Ferket, P.R., Verstegen, M.W.A., 2005.Growth response to dietary energy and lysine at high and low ambient temperature in male turkeys.*Poultry Science Journal*, **84**: 273-282.

Wisemam, J.,1987. Feeding of Non-ruminant livestock.Butterworths. London, United Kingdom913.

APPENDEXES

Appendix 1: Mean square of ANOVA for Physical Component of Crop content of experimental chicken

Source	DF	Mean Square						
		Bodyweight (gm)	Crop weight(gm)	cereal grain(%)	Household refused(%)	Insect/ worms(%)	Plant/ leaves(%)	others(%)
Altitude	1	0.002ns	0.00042ns	356.48**	12.294ns	26.894*	32.267**	37.337**
Sexof bird	1	0.234**	0.0079**	10.209**	39.723ns	11.695ns	1.667ns	0.980ns
Altitude * sex of birds	1	0.002**	0.00104**	0.0094**	0.168ns	0.339**	6.667**	1.451**
Error	56	0.0089	0.00028	41.81	23.926	4.247	2.426	4.479
Total	59							

=significance(p<0.05),= highly significance(p<0.01),ns=non significance(p > 0.05), %= percent. Altitude * sex of bird=interaction effect of Altitude with sex of birds.*

Appendix 2: Mean square of ANOVA for Chemical Composition of Crop content of experimental chicken.

Source	DF	Mean Square								
		%DM	%Ash	%CP	%EE	%CF	%NFE	ME(kcal)	%Ca	%P
Altitude	1	0.008ns	0.941ns	2.179**	2.279**	0.013ns	13.867*	12607.490ns	0.208ns	0.090ns
Sexof bird	1	0.816*	0.480ns	0.649ns	0.180ns	0.521ns	0.832ns	3365.410ns	0.244**	0.036ns
Altitude * sex of birds	1	0.816*	0.015ns	0.492**	0.392*	2.167**	2.448*	8534.400ns	0.005ns	0.0085ns
Error	8	0.12	0.537	0.836	0.161	0.357	2.560	3229.649	0.068	0.085
Total	11									

=significance(p<0.05),= highly significance(p<0.01),ns=non significance(p > 0.05),%Ash= percent of tatal Ash, %CP=percent of Crude protein, %DM=Percent of Dry Matter,% CF=Percent of Crude Fiber, %NFE=Percent of Nitrogen Free Extract,ME=Metabolizable energy,% Ca=Percent of Calcium,%P=percent of phosphorus.*

Appendix 3. Survey Questionnaires.

Farmer'sName_________________,Region____________,District___________,

Kebelle______

Enumerator's Name _______________, Date of interview___________________

Agro ecology: a, lowland b, mid altitude c, high land

I. Socio-economic characteristics

1, Sex and Age of the respondent .1.1 Male ________1.2 Female________

1.3 Age_________

2. Major occupation

3. Educational level of the respondent

1). Illetrature, 2).Read & write, 3) 1^{st} __$4^{th,}$ 4) 5^{th}__8^{th} 5)9^{th}_12^{th}

4. Religion_____________, 5. Marital status _____________

6, Economic status of the family (low, medium or high income).

7. Land size (ha) ____________

8. Family size ______________.

<u>Male Female Total.</u>

A) Ages under 14'years ________ ________ ______

b) Ages between 15 to 30 years._______ ________ ______

c) Ages between 31 to 60 years _______ ________ ______

d)Ages above 60 years _______ ________ _______

e) Total number _______ ________ _______

9. Animal ownership, sale and consumption by the household

Type	Number per family	Purpose		
		Consumed	Sold	For other purpose
Cattle				
Small ruminant				
Equines				
Poultry/Chickens				

II, Feed Resources and feeding strategy

1. Do you practice purposeful feeding of your chicken in confinement?

    a) Yes b) No

2. Do you practice supplementary feeding of your chicken?

    a) Yes b) No

3. Indicate the ingredients you use for poultry feeding using the following table

Feed	Specific name of feed	State briefly form of consumption at d/t age level				
Grains		chicks	grower	Layer	cockerel	Broiler
Vegetables						
Oil seeds						
Minerals						
Vitamins						
Other by products						

4. If you provide concentrates or industrial by products where do you buy these feeds?

    a) Factories b) Retailers c) Commercial farms d) Feed mills e) Other /specify

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

    a) In the morning before they go out for scavenging

    b) In the evening after scavenging

    c) In the afternoon while scavenging.

    d) Any time during day time

    e) Morning and evening

    f)Morning and afternoon

    g) Morning, evening and afternoon

6. If your answer to question 1 is Yes, how frequent do you feed your birds daily?

7. If your answer to question 1 & 5 are yes, how do you feed your birds?

    a) In a feeder b) On the bare ground c) Others specify

8. How gives the extra feeds?

    a) Separate to different classes b) Together for the whole groups (for group feeding).

9. Amount of house hold waste you give per day /kg?

a) I don't give them b) ¼ kg c) ½ kg d) 1 kg e) more than 1 kg

10. What is the basis of your giving supplements?

a) Egg yield b) meat yield c)Egg and meat yield d) Broodiness (during incubation) e) Age f) other,/specify

11. Indicate seasonal extra feeding of your chicken using the following table, (At which season(s) do you offer more extra feed to your birds?) (Use asterisks).

Class	Short rainy (Feb_ March)	Short dry (April _ May)	Long rainy (Jun_ Sept)	Long dry (Oct _ Jan)
Layer				
Pullets				
Cocks				
Chicks				

12. If your answer to question 2 is No 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 f) Others, Specify ______________________

13. Do your bird scavenge? a) Yes b) No

14. Do your give water to your birds? a) Yes b) No

15. If you give water for the chickens, where do you get water from?
a) Rain water b) River c) Tap water d) Other specify

16. If you give water for the chickens what type of container do you use to supply water?

a) Plastic b) on metal c) other

17. If you give water for the chickens, how frequent do you wash the container (per week).

a) Once a week b) Twice a week c) More than three times d) Never.

18. If you give water for your chickens, how frequent do you provide?

A(Every other day b) Once/ day c) Twice /day d) Adlib

Appendix 4: Figures during Data Collection and Experiment