ASSESMENT OF POULTRY PRODUCTIONCONSTRAINTS AND EVALUATION OF DIFFERENT CONCENTRATE ON PRODUCTION PERFORMANCE AND PARASITIC BURDEN OF EXOTIC CHICKENS IN KERSA DISTRICT OF JIMMA ZONE

MSc Thesis

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MAY 2017

JIMMA, ETHIOPIA

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A THESIS SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES OF JIMMA UNIVERSITY COLLEGE OF AGRICULTURE AND VETERINARY MEDICINE IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE MASTERES DEGREE IN VETERINARY EPIDEMIOLOGY

MAY 2017

JIMMA, ETHIOPIA

JIMMA UNIVERSITY

COLLEGE OF AGRICULTURE AND VETERINARY MEDICINE

MSc THESIS APPROVAL SHEET

We, the undersigned, member of the Board of Examiners of the final open defense by **Gezali Abafaji** have read and evaluated his/her thesis entitled **"Association and Evaluation of Different Concentrate on The Parasitic Burden and Production Performance of Exotic Chickens in Kersa Districts of Jimma Zone"** 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 **Veterinary Epidemiology .**

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Dedication

I dedicate this MSc Thesis work to my father Abafaji Abafita and my mother W/ro Lubaba Abanaem 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

First, I declare that this Thesis is my original work and all sources or materials used for this Thesis have fully acknowledged. This thesis having been submitted in partial fulfillment of the requirements for MSc degree in Veterinary Epidemiologyat Jimma University College of Agriculture and Veterinary Medicine and is deposited in the University Library to be made available under the rules of the library. I declare that this thesis not submitted to any other institutions anywhere for the award of any academic degree, diploma or certificate. Brief quotations from this Thesis are allowable without special permission if the source accurately acknowledged. Requests for permission for comprehensive citation from, duplicate of this manuscript in whole, or in part may grant by the School of Veterinary Medicine 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, Gezali Abafaji, was born on 6November 1989 in Kersa District, Jimma Zone of Oromia National Regional State. He attended his elementary education (grade 1-6) at Dibu Bujit Elementary School from 1995-2000, grade 7 and 8 at Serbo secondary school from 2001-2002, grade 9 and 10 at Serboo high school from 2003-2004. Preparatory at jimma preparatory school from 2005-2006. Dr. Gezali has received DVM from JUCAVM in June 2011.Dr. Gezali Abafaji had worked for Dedo District Animal Health and DevelopmentOffice in Jimma Zone, Southwestern Ethiopia as an expert for 2 years.

Acknowledgment

I give all glory and honour to the Almighty God whose guidance and provision made this work to succeed. I express my sincere gratitude to the University of Jimma and livestock and irrigation value chain for Ethiopian small holder (LIVES) project for their financial and material support. Special thanks go to my supervisors Dr. Hailu Degefu,Professor Solomon Demeke and Dr. Barbara Wieland for their guidance and continuous help. May the Almighty God richly reward them for the work; well done. My sincere gratitude goes to Dr. Gemeda of the LIVES project focal person for his generous support that immensely contributed to the success of this work. In addition, I am greatly indebted to staff working at animal nutrition laboratory and Parasitology laboratories, Department of animal Science and veterinary Parasitology, University of Jimma, for ever being available for me whenever I needed them during laboratory sample analysis. I extend appreciation to the field staff of the Ministry of Livestock Development in Jimma Zone for their cooperation during the entire study period. Special thanks go to our contact farmers in the district for their cooperation and availability whenever needed. Finally, I am grateful to my family for their moral support, understanding and prayers during the study period.

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LIST OF ABBREVIATION

ANOVA	Analysis of Variance
AOA	Association of Official Analytical Chemists
BB	Bovan Brown
CRD	Completely Randomized Design
CSA	Central statistical Agency
DM	Dry Matter
DMRT	Duncan's multiple range tests
FAO	Food and Agricultural Organization
FGD	Focus Group Discussion
IB	Isa Brown
IBD	Infectious Bursal Disease
IBDV	Infectious Bursal Disease Virus
ILRI	International Livestock Research Institute
LIVES	Livestock and Irrigation Value Chains for Ethiopian Smallholders
ME	Metabolizable Energy
NCD	Newcastle Disease
NDV	Newcastle Disease Virus
NGO	Non-Governmental Organizations
OIE	World Organization for Animal Health
OR	Odds Ratio
PA	Peasant Association
PE	Participatory Epidemiology
PK	Potchefstroom Koekoek
RIR	Rhode Island Red
RRA	Rapid Rural Appraisal
SEM	Standard Error of Mean
SPSS	Statistical Package for Social Sciences
VVIBDV	Very Virulent Strains of Infectious Bursal Disease Virus

ABSTRACT

The purpose of this study is to determine the constraints that limit exotic chicken productivity; assess and prioritize them determine the effect of supplementation on performance and parasitic burden and come up with appropriate measure that are sustainable in this livestock production system. The study was conducted in two phases in Kersa District of Jimma Zone. The first phase was a rapid rural appraisal study whereby identification and prioritization of exotic chicken constraints was carried out. Scarcity of feed and disease was found to be the most important constraint to exotic chicken's production (about 71.7% of the total chicken deaths which is about 89.4% from scavenging only chickens). Green diarhoea and coughing, yellowish diarrhoea and sudden death were the most observed sign of disease in order of importance. Parasites were also found to be important diseases in the chickens. Other constraints identified and ranked were poor animal health service delivery, predator, poor housing, theft and inadequate poultry management skills among farmers in order of importance. The second phase was experimental study to evaluate the effect of feeding on dry matter (DM intake), egg production, mortality, parasitic burdon and profitability of Bovans brown layers. A total of 60 chickens with uniform body weight (BW) and age were randomly divided in to two groups each with 30 pullets. Finally, the two treatment rations were randomly assigned to each of the group of the experimental pullets in completely randomized design with three replicates for an experimental period of 3 months. Treatments were ration made from locally available ingredients and purchased commercial layer feed. All diets contained crude protein (CP) and metabolizable energy (ME) within the recommended level for layers. The CP and ME content of treatment rations were 16.45, 17.8% and 3233.48, 3366.60 kcal/kg DM, respectively. The DM intake of layers was 92.78 and 104.28g/bird/day (SEM = 0.70) for homemade and commercial feed respectively. Hen-day egg production (65.3 and 74.8% (SEM = 1.32)) and total egg produced per hen (58.8 and 67.3 (SEM =1.31) for homemade and commercial supplemented respectively) were better for commercial supplemented. Body weight change and egg mass was greater for commercial supplemented chickens. Helminth parasite prevalence was lower for commercial supplemented chickens (25%) than homemade supplemented (30%). The economic return (profitability) was higher in homemade supplemented chickens. In conclusion, the exotic chicken production suffers from the scarcity of feed, diseases, unavailability of reliable veterinary and extension services, inadequate knowledge and skills in the management of exotic chickens amongst the farming community. Supplementation of commercial feed significantly improved egg production, body weight gain and total profit but when feed cost is taken in consideration lower profit than homemade feed. It is recommended that extension packages that would enhance the knowledge and skills of the exotic chicken farmers on integrated interventions, be initiated and sustained for the improvement of the productivity of the birds. until concluded with further research, I recommend the producers to use mixed vitamin if homemade feed is fed. In general, supplementation of exotic chickens led to improvement in performance but cheaper feed ingredients are needed in order to get high economic gains.

Key words: Poultry production constraints; Poultry feed; parasitic burden; feeding trial

1. INTRODUCTION

Poultry production has an important economic, social and cultural benefit and plays a significant role in family nutrition in the developing countries. It occupied an important position in the provision of animal protein for human consumption (Yoriyo *et al*., 2008). The contribution of poultry to the global animal protein production is estimated to reach 40% in the year 2020, the major increase being expected in the developing world (Delgado *et al.*, 1999). It has been estimated that 80% of the poultry population in Africa is found in the traditional backyard production system (Gueye, 2000), which makes substantial contributions to household food security (Muchadeyi *et al*., 2007), and Ethiopia is not exception to this situation.

The poultry sub-sector of Ethiopia could be characterized into three major production systems based on some selected parameters such as breed, flock size, housing, feeding, health, technology and bio-security. These are village or backyard poultry production system, small-scale commercial poultry production system and large scale commercial poultry production system (Bush, 2006).The village or backyard poultry production system is constrained by many extrinsic factors among which high prevalence of disease, insufficient nutrition; poor management and inadequate bio-security are outstanding. Disease is considered to be the major threat to village poultry production. Infectious diseases, such as Newcastle disease, fowl cholera, fowl typhoid and fowl pox are common all over Ethiopia. In addition to infectious diseases, parasites and nutritional deficiency disorders are serious problems in the case of village chickens. Poor genetic potential due to lack of selection and losses to predation are also potential threats to the productivity of the village poultry (Whitmarsh, 1997).

Different breeds of exotic chickens (Rhode Island Red, Australorp, New Hampshire and White Leghorns) were imported to Ethiopia since the 1950's to be used either by their own or for upgrading of the local flock through crossbreeding. 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). In the near past, there has been a substantial effort to introduce improved layer type chickens particularly Isa Brown (IB), Bovan Brown (BB) and dual-purpose hybrid Potchefstroom Koekoek (PK) to smallholder farmers to be kept under backyard management system, particularly in Kersa district of Jimma Zone. At present, it is believed that the exotic breeds of chickens comprise about 2.2% of the total Ethiopian poultry population (CSA, 2012/13).

Lack of recorded data on the production performance of exotic breeds of chicken makes it difficult to quantify the contributions of exotic breeds of chickens kept under rural objective condition (ILRI, 2015). Few of the available information tends to indicate that, most of the exotic breeds studied under village production system are not high yielding as the hybrids type used in the international poultry industry (FAO, 2010).

Some of the bottlenecks of the introduced exotic breeds of chickens under farmer management condition include poor feeding and extension, poor veterinary services, lack of water, high prevalence of disease and predators, high mortality and lack of understanding of the complex biological, cultural and socioeconomic relationships involved in the production processes Moges *et al.*, (2010), Getu and Birhan (2014) and Mengesha *et al.*, (2011).

Availability of commercial poultry ration is limited in and in the vicinity of Addis Ababa and is very expensive, especially for farmers in remote rural areas. The productivity of exotic breeds of chicken could be increased through improved feeding, the use of better adaptable breeds and adoption of better management and disease control system. On the contrary, it is believed that the local chickens are disease resistance and adaptable to the objective local conditions. However, it is difficult to improve the nutritional state of village poultry of local chickens, since the daily nutrient intake from scavenging is not exactly known (Smith, 2001), indicating that data on the nutritional status and supplementation requirement of chickens are lacking. Some of the available data tends to indicate that energy is critical during the rainy season in Ethiopia (Dessie, 1996), whereas protein supplementation, particularly that of essential amino acids are considered to be necessary for scavenging chickens during dry period (Rashid, 2003).

One possible means of tackling such a problem is to study into the existing nutritional status of village or backyard poultry production system of the district and formulate daily basic supplementary ration based on the result of the assessment with the use of locally available feed ingredients. This being the cases, the specific objectives of this research proposal are

- To collect baseline data on productivity and general constraints of village or backyard poultry of exotic chickens in Kersa District of Jimma Zone.
- Collect,identifyand determine the chemical composition of the locally available feed ingredients found in Kersa District of Jimma Zone including that of the commercial ration available on market
- To evaluate and develop daily basic supplementary ration based on the result of the laboratory chemical analytical data
- To study the effect of supplementary ration developed on productivity and the parasitic durden on the exotic layers
- To determine the comparative economic benefits of the basic daily ration developed as compared to commercial poultry ration available on the market

1. 1 Null hypothesis (Ho)

Identification of production constraints and putting in place appropriate measures will not improve productivity of the exotic chickens.

1.3. Research question

- What are external factor that influence the health and production performance of exotic chickens in Kersa District?
- What are internal factor of owner's perception affecting the health and production performance of exotic chickens in Kersa District?
- How are the health and production performance of exotic chicken's production in Kersa District improved?

2. LITERATURE REVIEW

2.1. Poultry Production Systems in Ethiopia

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

2.1.1. Large Scale Commercial Poultry Production System

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

2.1.2. Small Scale Intensive Poultry Production System

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

2.1.3 Village or Backyard Poultry Production System

In Ethiopia, indigenous chickens are the most widespread and almost every rural family owns chickens, which provide a valuable source of family protein and income (Tadelle *et al.,* 2003). The country has diverse agro-climatic conditions favoring production of many different kinds ofcrops, providing a wide range of ingredients and alternative feedstuffs suitable for poultry feeding. Making use of these resources to complement the scavenging resource base promises a considerable potential for success (Dessie and Ogle, 2001). Unfortunately, however village or backyard poultry production system is largely dependent on local chickens with little or no inputs. It is characterized by poor health care with minimal level of bio-security, high off take rates and high level of mortality. The system does not involve investment beyond the cost of the foundation stock and handfuls of local grains. Mostly, indigenous chickens are kept although some hybrids and exotic breeds may be kept under this system (Dawit *et al*., 2008).

2.1.3.1. Poultry Housing under Village Condition

In traditional free range, there is no separate poultry house and the chickens live in family dwelling together with human beings (Solomon, 2007). The bio-security of the backyard poultry production system is very poor, as 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 household compound. There is no practice (or even viable means) of isolating sick birds from the household flocks and dead birds are left for either domestic or wild predators. Chickens and eggs are sold on open markets along with other food items. The current live bird marketing system represents a significant and potential hazard to both buyers and sellers, yet implementation of biosecurity and hygienic practices in such a system is generally difficult.

The Newcastle Disease experience and the attitude of communities to handling sick birds (which are often sold) shows that marketing systems play a considerable role in the dissemination of disease over wide geographical areas in a relatively short period of time (Gebreab, 1995). Housing systems in the backyard poultry production system is rudimentary and mostly built with locally available materials if there is any. In summary, it is very difficult to apply health and bio-security measures on full day scavenging birds in small flock. Oges *et al.,* (2010) reported that in Bure district, North West Ethiopia, 77.9% of the village chicken owners provide only night shelter and only 22.1% provided separate poultry house. Another study by Mengesha *et al.,* (2011) in Jamma district and South Wollo reported that 41.3% and 21.2% of chicken owners share the same room and provided separate poultry house, respectively.

2.1.3.2. Poultry Feeding Under Village Condition

Family chicken production is an appropriate system that makes the best use of locally available feed resources (Tadelle *et al.,* 2003). Village chicken also play a role of converting household leftovers, wastes and insects into valuable and high-quality protein (Doviet, 2005). There is no purposeful feeding of chickens and scavenging is almost the only source of diet. Different feeding materials are present for scavenging including seeds, plant materials, worms, insects and unidentified materials (Tadelle and Ogle, 2000). Feed supplementation has been reported in various countries as a common practice to promote chicken performance. In Ethiopia, 99%, 97.5% and 98% of feed supplementation by chicken owners were reported by Halima (2007); Moges *et al.*, (2010) and Mengesha *et al.,* (2011), respectively.

To make full use of the productive potential of hybrid layers adequate feed of high quality has to be provided. Ali (2002) reported that at least 60g/h/day of feed supplementation are needed for the scavenging cross birds. Scavenging laying hen could possibly obtain approximately 60 to 70% of their feed requirement from scavenging (Rahman *et al.,* 1997). It is also reported that free-range scavenging chickens fulfill their nutrient requirements for protein, vitamins, and minerals from scavenging feed resources (Payne and Wilson, 1999; Dessie and Ogle, 2001), depending on factors such as available scavenging area per bird, quality of scavenging feed resources; season and production stage (Abdelqader *et al.,* 2007). Maize is always the most preferred feed ingredient under every form of poultry production system (Benvenuti *et al*., 2012). Wilson (2010) suggested that provision of shelter, regular supplies of clean drinking water and some supplementary feeding would improve growth and reproductive rates and greatly increase survival at village level.

2.1.3.3 Disease and Health Status under Village Poultry Production System

Under village poultry production system, prevalence of diseases, predators, lack of proper health care, poor feeding and poor marketing information were reported to the major constraint of poultry production (Moges *et al.,* 2010; Dinka *et al.,* 2010 and Mengesha *et al.,* 2001). The high mortality of chicks under village chicken production system in the central highlands of Ethiopia is reported to be attributed to diseases, parasites, predation, lack of feed, poor housing and insufficient water supply (Tadelle, 2001). Among the infectious diseases, Newcastle disease, Salmonellosis, Coccidiosis, Fowl pox and predators are considered to be the most important causes of mortality in local chicken (Eshetu *et al.*, 2001).

Disease Condition is any condition that interferes with the normal functioning of the cells, tissues, organs and systems of diseased animal. In poultry, disease condition could be caused by many factors including disease causing organisms, nutritional deficiencies, consumption of toxic substances, physical damage and internal and external parasitic infestations (CIRAD, 2005). Disease condition resulting from nutrient deficiencies, consumption of toxic substances and physical damage are referred to as non-infectious diseases. These diseases cannot be passed from bird to bird. Infectious diseases are caused by microorganisms such as parasites, fungi, protozoa, bacteria, mycoplasmas, chlamydia and viruses. These diseases are often also called contagious diseases to indicate that they can be passed from one bird to another either directly or indirectly (Dereje, 2002).

2.1.3.3.1. Infectious Diseases

Newcastle disease is an infection of domestic poultry caused by virulent Newcastle disease virus (NDV). It is an acute respiratory disease, but depression, nervous manifestations, or diarrhea may be the predominant clinical form. Severity depends on the virulence of the infecting virus and host susceptibility. Occurrence of the disease may result in trade restrictions (petter and muller 2014). Newcastle disease viruses occur in three patho types: lentogenic, mesogenic, and velogenic, reflecting increasing levels of virulence (OIDE, 2000). The most virulent (velogenic) isolates are further subdivided into neurotropic and viscerotropic (Alexander, 1997). The disease can be present in healthy-appearing in cases of carrier exotic pets and birds and in a persistent carrier state, which has been demonstrated in the psittacine order (Erickson *et al*., 1977). Observations made by Nasser revealed that the velogenic strains of NCD virus are widely distributed throughout Ethiopia (Nasser, 1998). Transmission of Newcastle disease is via aerosols, birds, fomites, visitors and imported psittacines (often asymptomatic). It is not usually vertical (but chicks may become infected in hatcheries from contaminated shells). The virus survives for long periods at ambient temperature, especially in faeces and can persist in houses (in faeces, dust etc.) for up to 12 months. However, it is quite sensitive to disinfectants, fumigants and sunlight. It is inactivated by temperatures of 56°C for 3 hours or 60°C for 30 min, acid pH, formalin and phenol, and is ether sensitive (Hadipour2009).

Infectious bursal disease (also known as IBD, Gumboro Disease, Infectious Bursitis and Infectious Avian Nephrosis) is a highly contagious disease of young chickens caused by *infectious bursal disease virus* (IBDV). The disease is characterized by immuno suppression and high mortality generally at 3 to 6 weeks of age. The disease was first discovered in Gumboro, Delaware in 1962. It is economically important to the poultry industry worldwide due to increased susceptibility to other diseases and negative interference with effective vaccination. In recent years, very virulent strains of IBDV (vvIBDV), causing severe mortality in chicken, have emerged in Europe, Latin America, South-East Asia, Africa and the Middle East. Infection is via the oro-fecal route, with affected bird excreting high levels of the virus for approximately 2 weeks after infection (Caston *et al*., 2008).

Salmonella are Gram negative, short plump shaped rods, non-spore forming and non- capsulated, aerobic and facultative anaerobic organisms and classified under the family Enterobacteriaceae (OIE Manual, 2006). More than 2300 serotypes of Salmonella have been identified, only about10% of these has been isolated from poultry (Gast, 1997). Chickens are the natural hosts for both S. Pullorum and S. Gallinarum (Snoeyenbos, 1991). Pullorum disease is usually confined to the first 2-3 weeks of age and occasionally occurs in adults (Shivaprashad, 1997). Fowl typhoid is frequently referred to as a disease of adult birds and there are also reports of high mortality in young chicks (Christensen *et al*., 1992).

The epidemiology of fowl typhoid and pullorum disease in poultry, particularly with regard to transmission from one generation to the next are known to be closely associated with infected eggs (Wigley *et al.*, 2001). Contaminated eggs produced by infected laying hens are thought to be one of the main sources of human infection with Salmonella Enteritidis (Humphrey *et al*., 1989). Eggs may become contaminated with Salmonella in two main ways: (i) Salmonella may silently infect the ovaries of apparently healthy hens and contaminate the eggs before the shells are formed. (ii) Salmonella infected bird droppings contain Salmonella that can contaminate the outer egg shells and may penetrate when crack the shell (Deryck and Pattron, 2004).

Coccidiosis is caused by various species of Eimeria, an Apicomplexa protozoan parasite. It is one of the common diseases in poultry, which is responsible for major economic losses worldwide (Razmi and Kalideri, 2000). The disease occurs only after ingestion of sporulated oocysts in susceptible hosts. Both clinically infected and recovered birds shed oocysts in their droppings, which contaminate feed, dust, water, litter, and soil. Oocysts may be transmitted by mechanical carriers (e.g., equipment, clothing, insects, farm workers, and other animals) (Hadipour *et al*., 2011). Coccidiosis occurs in the epithelial cells of the intestine, despite the advances in nutrition, chemotherapy, management, and genetics. *E. tenella* and *E. necatrix* are the most pathogenic and cause bloody lesions, high morbidity, and mortality (Gyorke *et al*., 2013).

Most Eimeria spp. affect birds between 3 and 18 weeks of age and can cause high mortality in young chicks. Mixed infections are commonly found under field conditions. Coccidiosis in poultry is characterized by dysentery, enteritis, emaciation, drooping wings, and poor growth. Feed and water consumption are depressed. Weight loss, development of culls, decreased egg production, and increased morbidity and mortality may accompany outbreaks (Sharma *et al*., 2013). Bad management, such as wet litter that encourages oocyst sporulation, contaminated drinkers and feeders, bad ventilation, and high stocking density can exacerbate the clinical signs (Al-Natour *et al*., 2002). Knowledge regarding the farm conditions is necessary for developing the best prevention program, enabling the recognition of factors that influence the possibility of incidence of the disease (Shirzad *et al*., 2011)

2.1.3.3.2. None Infectious Diseases

Disease condition resulting from nutrient deficiencies, predation, consumption of toxic substances and physical damage are referred to as non-infectious diseases. Nutritional deficiencies are widespread in Ethiopia and common in poultry production. For maximum performance and good health, poultry need a steady supply of energy, protein, essential amino acids, minerals, vitamins and adequate clean water. Recent advances in poultry nutrition have focused on three main areas: developing an understanding of nutrient metabolism and nutrient requirements; determining the availability of nutrients in feed ingredients; and formulating least-cost diets that bring nutrient requirements and nutrient supply together (FAO, 2015).

Practical poultry diets are formulated from a mixture of feed ingredients, including cereal grains, cereal by-products, fats, plant protein sources, animal by-products, vitamin and mineral supplements, crystalline amino acids and feed additives. In developing countries, the increasing cost and decreasing supply of traditional feedstuffs are expected to constrain the future expansion of poultry production. This situation highlights the urgent need to improve utilization of the wide range of locally available alternative feedstuffs. In many circumstances, feed resources are either unused and wasted, or used inefficiently. The use of most alternative feedstuffs is currently negligible, owing to constraints imposed by nutritional, technical and socio-economic factors. However, unlike intensive commercial poultry production systems, family poultry units and semi-commercial systems are well-suited to the inclusion of these feedstuffs (FAO, 2015).

On the top of shortage and high cost of feed ingredients, one of the major nutritional problems in developing countries is the biological and chemical contamination of poultry feeds, which may have serious consequences on bird performance and the safety of poultry products in human nutrition. Of the potential contaminants, mycotoxins are the most widespread, particularly in hot, humid conditions (FAO, 2015). Clinical manifestation of nutrient deficiencies often occurs in conjunction with an alteration of normal biological processes that are unique for the nutrient. Some enzymes depend on particular vitamins and minerals for their functioning, and their activity diminishes when there are deficiency conditions. In other instances, a particular physiological response or change in metabolite concentration may occur. This information was primarily obtained from formal experiments in which the inadequacies were definitive. Under field conditions, nutrient inadequacies are usually marginal, occasionally multiple, and often confounded with management problems or disease (Lawrence *et al.*, 2004).

Predation is not common in commercial poultry production. However, predation is a big concern for backyard poultry producers. The reason for this difference is in the way flocks are housed and managed (Aaron and Ison, 2004). Commercial poultry producers maintain flocks within buildings during the entire production cycle. In the commercial sector, poultry houses and buildings are usually constructed with concrete foundations, complete roof, and enclosed fenced run areas. Commercial flocks are at risk from small predators and birds of prey when the building structures are not maintained (Sara and Spiegle, 2004). Backyard flocks, maintained by small farmers are usually housed in the existing barns that may not be adequate for keeping predators out. In some cases, they may not be housed at all, allowing the birds to free-range and take cover under existing structures. Backyard poultry are also prone to predation if birds are raised on free-range, where they are allowed to scavenge freely. Flocks are at the highest risk, especially during the night, if they are not provided with any enclosed structure for protection (Teresa, 2004).

2.1.3.3.4. Poultry Health Management under Backyard Production System

Many factors influence the health of smallholder chicken population which makes it even more difficult to design improvement strategies to overcome health constraints (Mapiye *et al.,* 2008). High mortality is considered to be the major constraint to village chicken production systems (Muchadeyi *et al.,* 2007). The effective control of diseases is an essential first step towards improving village poultry production (Ahlers *et al*., 2009). Moges *et al.,* 2010) 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. Effective health coverage and vaccination programmes improved rural chicken performance in Pakistan (Javed *et al.,* 2003). In village production study in different parts of Ethiopia, no vaccination practice against poultry diseases was reported to exist (Moges *et al.,* (2010); Leta and Endalew (2010); Takele and Oli (2011).

The Ethiopian National Veterinary Institute (NVI) produces a range of ND vaccines and provides them on request to modern poultry subsector. There is no national ND control policy or coordinated prevention and control program in rural Ethiopia. Vaccination against ND occurs in rural areas only in response to an outbreak. According to CACC (2003), the estimated number of vaccinated and treated animals in the country in the agricultural year of 2003 was estimated at 11.5 and 2.8 million of which 1.39% and 10% was poultry respectively. On the other hand the great majority of afflicted (56%) and dead (67%) animals were poultry. At the beginning of the agricultural year of 2003, the total chicken population was estimated at 42 million of which 0.37, 0.68, 26.4 and 24.2% was vaccinated, treated, afflicted and died respectively. The number of poultry died over the year was estimated at 10.2 million (24% of the national poultry population) resulting in the poultry population of 32 million at the beginning of 2004.

2.2. Production Performance of the Ethiopian Poultry

2.2.1. Production Performance of Indigenous Chickens

In Ethiopia village poultry is rarely the sole means of livelihood for the household but is one of a number of integrated and complementary farming activities contributing to the overall well-being of the household. There is no reliable data indicating the annual contribution of village poultry for the national economic development in Ethiopia. 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).

The most dominant chicken reared in Ethiopia are local ecotypes, which show a large variation in body conformation, plumage color, comb type and productivity (Halima *et al*., 2007). Generally, Tadelle *et al*. (2003) and Halima (2007) reported that the names of the indigenous chicken groups were being called as chicken-ecotypes and native-chickens, respectively. The egg production potential of local chicken is 30-60 eggs/year/hen with an average weight of 38g, under village management conditions, as compared to exotic breeds' annual egg production of 250 eggs with mean egg weight of 60g (Alganesh *et al.*, 2003) under intensive production in Ethiopia. According to (Alganesh *et al.*, 2003) and (Negussie *et al.*, 2003), the low productivity of the local scavenging hens is not only because they are low producers of small sized eggs and slow growers but also attributed to high chick mortality before they reach around 8 weeks of age. Moreover, the local chickens are the results of uncontrolled breeding between various local chicken ecotypes, which have not been selected by systematic breeding methods.

The low production performance of the Ethiopian indigenous chickens' os also attributed to the long natural reproductive cycle. It is by natural incubation and brooding that chicks are hatched and raised all over rural Ethiopia. A broody hen hatching, rearing and protecting few number of chicks (6-8) ceases egg laying during the entire incubation and brooding periods of 81 days. Yet the successes of the hatching and brooding process depend on the maternal instinct of the broody hen and prevalence of predators in the area, such as birds of prey, pets and some wild animals, all of which are listed as the major causes of premature death of chicks (Solomon, 2007).

2.2.2. Production Performance of Improved Chickens

Production performance of exotic birds in Ethiopian condition needs to be monitored regularly to provide guidelines for policy makers. Lack of recorded data on the productive performance of chicken makes it difficult to assess the importance and contributions of the past attempts to improve the sector (Moges *et al*., 2010). All the available evidence indicates that all the imported breeds of chickens performed well under the intensive management system (Yami and Desie, 1997).

In Ethiopia, the idea of distributing exotic chickens particularly Rhode Island Red (RIR) was to improve the productivity of local birds by mating them with improved cocks. According to Permin (2008), this scheme usually failed to work due to the fact that the introduced breeds could not adapt to the hot climate, low feeding and extensive management. The egg production potential of local chicken is 30-60 eggs year–1 hen–1 with an average of 38 g egg weight under village management conditions, while exotic breeds produce around 250 eggs year–1 hen–1 with around 60 g egg weight (Alganesh *et al.,* 2003) in Ethiopia. With this potential of indigenous chicken, the demand of egg and chicken meat of Ethiopian populations cannot be satisfied (Geleta *et al.,* 2013).

The maximum number of eggs/year under Oromia Agricultural Research Institute for Fayoumi chicken (156 egg) was lower than 185 eggs year–1 hen–1 for Rhode Island Red and White Leghorn (176 eggs) but higher than Fayoumi (144 egg) as reported by Abraham and Yayneshet (2010) in North Ethiopia. Moreover, Alem (2014) reported average egg production per year per hen of exotic chicken (RIR) was 118.6 and 148.2 in lowland and highland agroecological zone of central Tigray, respectively. Most results showed that the overall performance of the crosses was better than either the native or the exotic parents under the existing management condition (Hailemariam, 1998; Aberra *et al.,* 2005).

From the report of CSA (2011), the average length egg-laying period/hen was also determined in breeds and environmental managements systems of which estimated numbers of days were 21, 36 and 105 days for local, hybrid and exotic breeds, respectively. Similarly, Alem (2014) reported average egg production per clutch per hen of exotic chicken (RIR) was 38.5 and 45.2 in lowland and highland agroecological zone of central Tigray, respectively. Sexual maturity of

White Leghorn under intensive and extensive management ranged from 149-169 days (Demeke, 2004, 2007). Geleta *et al.* (2013) indicated that egg weight of Fayoumi chicken under Adami Tulu Research center (44.3 g) was similar to Fayoumi (43 g) but lower than egg weight for Rhode Island Red (52.5 g) and White Leghorn (52.1 g) reported by Abraham and Yayneshet (2010) in North Ethiopia. From this we can conclude that exotic breed and cross breed chicken can produce large number of eggs in the presence of adequate amount of feed.

Poultry production is affected by factors such as breed and strain of chicken used, environmental conditions in poultry house, management practices and feed and feeding management (Bell and Weaver, 2002). The knowledge of performance of economic traits in chicken is important for the formulation of breeding plans for further improvement in production traits. Growth and production traits of a bird indicate its genetic constitution and adaptation with respect to the specific environment (Ahmed and Singh, 2007).

The laying cycle of a chicken flock usually covers a span of about 12 months. Egg production begins when the birds reach about 18-22 weeks of age, depending on the breed and season. Flock production rises sharply and reaches a peak of about 90%, 6-8 weeks later, production then gradually declines to about 65% after 12 months of lay. There are many factors that can adversely affect egg production. Unraveling the cause of a sudden drop in egg production requires a thorough investigation into the history of the flock. Egg production can be affected by feed consumption (quality and quantity), water intake, intensity and duration of light received, parasite infestation, diseases, management and environmental factors (Jacob *et al*., 1998 and Fesha *et al*., (2010).

3. MATERIALS AND METHODS

3.1. Description of Study Area

This study was conducted in Bulbul, Gello and Kitimbile Kebeles of Kersa district of Jimma Zone. Kersa district is located at 320 km South West of Addis Ababa. The altitude of the district ranges between 1740 and 2660 meters above sea level. About 58.6% of the total land of the district is arable of which 37.5% is under annual crops, 17.3% is pasture, 6.0% is forest, and the remaining 18.9% is considered swampy, degraded or otherwise unusable. The livestock resource of the study district comprises of 184,551 cattle, 12,364 sheep, 7,032 goats, 3,138 horses, 2,440 mules, 112 donkeys, 79,582 poultry, and 12,770 bee colonies. The total human population of the district is 165,391, of which 50% is reported to be male.

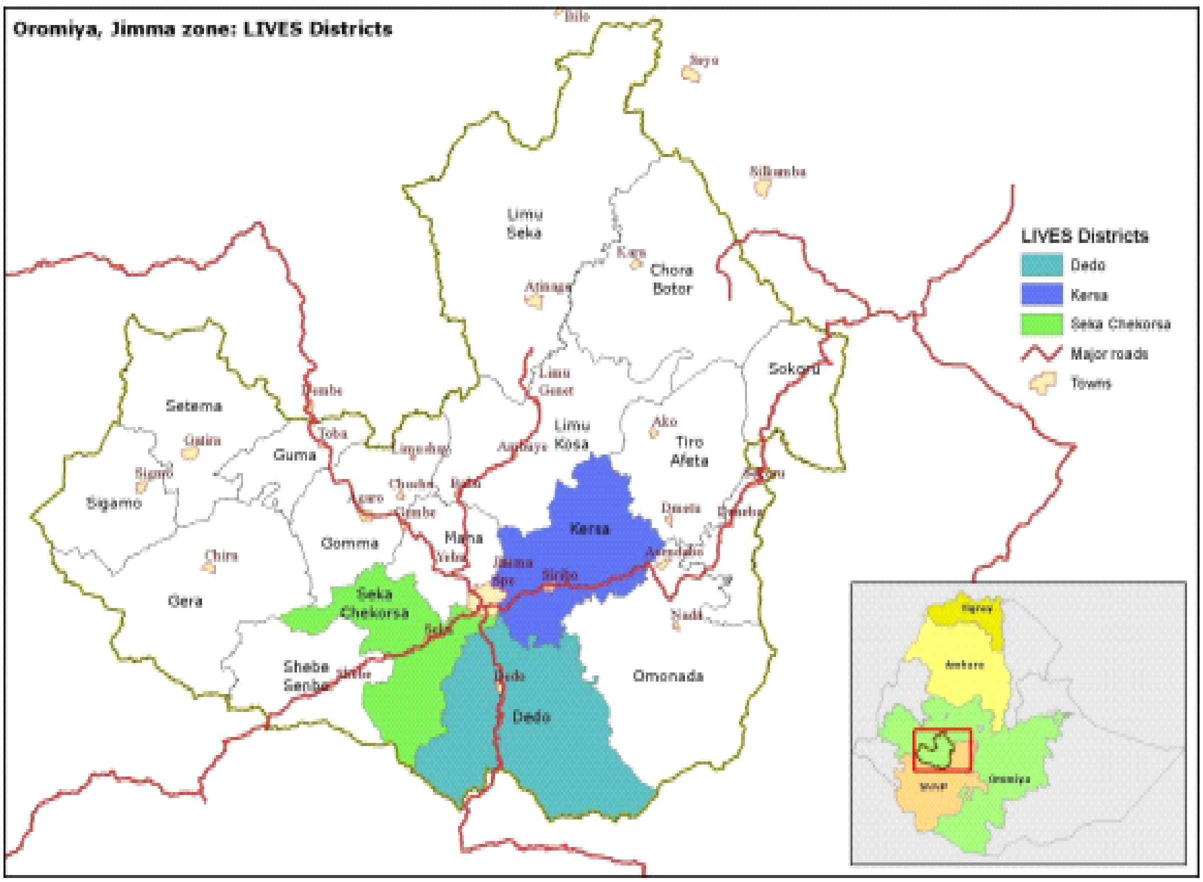

Figure 1: Map of the study area (ILRI, 2015)

3.2. Collection of Baseline Data for Problem Identification

3.2.1. Selection of Participating Households

Kersa district (Woreda) of Jimma Zone was purposively selected on the basis of poultry population, accessibility and the recommendation of Livestock and Irrigation Value Chains for Ethiopian Smallholders (LIVES) project. The three Kebeles (Peasant Association), namely Bulbul, Kitimbile and Gello were also purposively selected based on the accessibility and availability of exotic chicken either supplemented commercial feed or left as scavenging only. From the total of 360 exotic chicken owners, 180 owners were selected by using Krejcie & Morgan (1970) table for determining sample size of a known population. Then the 50% of the sample from each village was chosen to collect baseline data on productivity and general nutritional and health status of village or backyard poultry of exotic chickens in the district.

Table 1: Purposively Selected Peasant Associations and randomly selected Participating Exotic Chicken Owners

Peasant Association	Total Exotic chicken owners	Sampling fraction	Participating owners
Bulbul	176	0.5	88
Kitimbile	90	0.5	45
Gello	94	0.5	47
Total	360		180

3.2.2. Source of Data and Data Collection Instruments

The primary data were collected with the use of pretested and structured questioners and focus group discussion (FGD). The primary data collected included: socio-demography of chicken keepers, ownership, and type of housing, feeds and feeding practices, diseases and perceived flock mortalities and animal health service provision. On site observations on other aspects of production such as housing, feeding, feed and water availability and ectoparasite and endoparasite prevalence were made and data were recorded. Focus group discussions were held with 24 farmers starting with the introduction of the investigator and explanation of the purpose of the discussion. Each focus group comprised of 6-9 participants and included a both female and male and the discussions were held in Farmer Training Centers in each village. The discussions were conducted in *Afan Oromo* language, on the overall potential and challenges of exotic chickens with the use of checklist prepared in advance. Additional information's on secondary data were obtained from Livestock Development and Extension Office.

3.2.3. Identification and Prioritization of the Exotic Chicken Constraints

A Rapid Rural Appraisal (RRA) study with the use of Participatory Epidemiological (PE) tools was conducted to identify and prioritize the exotic chicken productivity constraints and capture the farmers' perception of the exotic chicken production. To understand the effect of supplementation the survey includes two categories of exotic chicken's owners keeping on scavenging with or without supplementary commercial ration. In the process of identification and prioritization, the specific item(s) identified by the respondents were written on cards. The cards were used for simple ranking of the item(s) in the desired order of importance (ILRI 2009), or for pair-wise ranking to compare individual with all the other items one-by-one to understand the relative importance of different constraint. The level of agreement between informants was assessed using Kendall's coefficient of concordance.

The participants were asked to identify poultry diseases found in the study area and the listed diseases were compared in terms of prevalence and mortality, using proportional pilling (Catley *et al.*, 2011). All the data (information) collected on exotic chicken production and the prevailing poultry disease rankings were tabulated and weighted by awarding scores from 1-6 and 1-3, respectively, to each respondent (Catley *et al.*, 2012). The cumulative sum of all the responses was considered as the weighted score for the particular constraint. Thus, the constraint with largest score was considered to be the most important. In the process of disease diagnosis and ranking, the clinical sign reported by the respondents were used to give tentative diagnosis and the respondents were asked to rank the diseases in order of prevalence and mortality rate. This was followed by the construction of seasonal calendar based on the information of the participating households.

3.2.4.Screening for Ectoparasites

Thrusfield,(1995)formula would be used for calculating the adequate sample size in prevalence of ectoparasite study: -

$$n = \frac{z^2 \mathrm{p}(1 - q)}{z^2}$$

Where **n** is the sample size, **Z** is the statistic corresponding to level of confidence, **P** is expected prevalence (that can be obtained from same studies or a pilot study conducted by the researchers), and **d** is precision (corresponding to effect size).

The expected prevalence was 80% and we would like to take enough samples to be 90% sure that our estimate is within 10% of the actual prevalence. So, 60 chickens were included in the sample. Screening for ectoparasites involved a thorough examination of the body of the birds including the head, cloacal, brachial, ventral, and femoral areas. Those with parasites were identified and recorded. Samples of the observed ectoparasites were removed with a thumb forceps or brush and transferred to a Petri dish containing 10% formal saline. The samples were cleared with lactophenol and fixed on a microscopic slide using a little quantity of polyvinyl alcohol and lactophenol solution before detailed morphological examination. The scrape was collected and preserved in 70% ethanol. The mites were isolated from scrape, cleaned and mounted directly with Hoyerûs medium (Hoyerûs medium method) (Krantz, 1970).The identification was done using a compound microscope Lapage (1962) and Soulsby (1982).

3.2.5.Faecal Collection and Analyses for Helminth Eggs

After thorough examination of each bird for ectoparasites, pooled sample were collected from the same birds examined for ectoparasites. The faecal sample were put into sample bottles and identified appropriately. The samples were later processed in the laboratory using the salt floatation technique with saturated sodium chlorideand sugar solution as the floating medium (Hansen 1990).Demonstration of the parasites was by microscopic examination of smears made after the concentration method. The identification keys of Soulsby (1982) and Khali *et al.*, (1994) were adopted.

3.3. Basic Daily Supplementary Ration Formulation and Feeding Trial

3.3.1. Preparation of Basic Supplementary Rations

The feed ingredients used for the formulation of experimental ration (homemade) used in this study were corn grain (CG), wheat (W), soybean meal (SBM), noug seed (NS), limestone, and salt. The CG, SBM, NS, and wheat were grounded before mixing and subjected to laboratory chemical analysis (DM, CP, EE, CF and ash) according to the proximate method of analysis (Table 2). The homemade, experimental ration was prepared to contain about 2800-2900 Kcal of metabolizable energy (ME) per Kg of dry matter (DM) and 16- 17% of crude protein (CP) to meet the energy and protein requirement of layers respectively.

Table 2: Proportion of feed ingredient used in formulating experimental rations

Experimental feed	T1
Ingredients	(%)
CG	44
WS	29
SBM	14
NS	7.5
LS	5.0
Salt	0.5
Total	100

CG= corn grain; WS= wheat short; SBM= soybean meal; NS = noug seed; LS= limestone; T1 =homemade feed

3.3.2. Management of the Experimental Chicken

Sixty (60), 3-month old pullets of Bovans Brown breed of chicken were purchased from Bishoftu Research Center. These were individually weighed, examined for general health status (Some points observed include behaviors (such as eating and drinking), attitude, gait, feathers (are they ruffled?) and personality of the bird in the group (fearful, aggressive, alert). The various body areas (eyes, nostrils, beak/oral cavity, ears, respiratory system, skeletal system, wings, feet, legs, weight/muscles) examined to determine if a problem exists. Feces also observed for their consistency)and divided in to two groups each with 30 pullets. Each of these groups was further sub-divided into 3 groups each with 10 pullets, making a total of 6 groups each with 10 pullets housed in an experimental cage. Prior to start of the trial the chickens were treated with broad-spectrum anthelmintic (Levamisole 30% IP; Smith Kline Pharmaceuticals Limited, India, at 30 mg per kg body weight through drinking water).

(Ox tetracycline 20% W.S.P.) Was chosen and administered as a broad-spectrum antibiotic. The dosage was at 0.5g per 1 liter of drinking water for 5 days. This was to ensure that no other bacterial disease would affect the chickens during the experiment. Finally, the two treatment rations shown in table 3 were randomly assigned to each of the group of the experimental pullets in completely randomized design with three replicates for an experimental period of 3 months.

Table 3: Completely Randomized Experimental Design Used in this Study

Dietary treatments	Types of treatments	Replication			
		1	2	3	Total
1	Homemade diet	10	10	10	30
2	commercial diet	10	10	10	30
Total		20	20	20	60

120g of supplementary feeds (homemade and commercial ration) were offered once per day and water is made available all the times. Body weight of the pullets was measured weekly and eggs were collected daily and recorded.

3.3.3. Measurement and Observation

3.3.3.1. Chemical Analysis of Feed Ingredients

Representative samples (3g) from each were taken from each of the feed ingredients and subjected to laboratory chemical analysis before formulating the homemade treatment ration (T_2). The results of the analysis were used to formulate the ration. The samples were analyzed for dry matter (DM), ether extract (EE), crude fiber (CF) and total ash according to AOAC (1990). Nitrogen (N) content was determined by Kjeldahl procedure and crude protein (CP) was calculated as Nx6.25. The total metabolizable energy content was estimated by using the formula of Wiseman (1987) as: ME (Kcal/kg DM) = 3951 + 54.4 EE – 88.7 CF – 40.8 Ash. Chemical analyses of feeds were done in Animal Nutrition Laboratories of JUCAVM.

3.3.3.2. Production Performance

Mean daily feed intake, body weight change, feed conversion ratio and rate of egg production were used to measure the production performance of the experimental pullets. Mean feed consumption was determined as the difference between the feed offered and refused. The experimental birds were weighed individually using analytical balance. Average bird weight was calculated as sum of individual weight of birds divided by number of birds. Average body weight gain or loss for each replicate was calculated by subtracting the initial weight from the final weight. Feed conversion efficiency was estimated as a ratio of the weight of feed consumed per unite body gain and per egg weight produced. Eggs were collected per day and rate of lay was expressed as the average percentage hen-day egg production based on the average values from each replicateHunton (1995).

3.3.3.3. Examining for Ectoparasites and Faecal Sample Collection for experimental chickens

After thorough examination of each bird, for ectoparasites, fresh faecal samples were collected in sterile polythene bags. The collected samples were placed into an airtight cool box and brought to JUCAVM Parasitology Laboratory and were refrigerated at 4ºC until analysis for the investigation of the parasites. The samples were screened using saturated sodium chloride floatation techniques (Mc Nabb *et al.*, 1985).

3.3.3.4. Partial Budget Analysis

Partial budget analysis was done according to Upton (1979) to determine the comparative economic benefit of the treatment rations. Total variable cost includes cost of feeds, cost of transportation and cost health during the experiment for each treatment group. Total return (TR) was considered as difference in sale and purchase price. The net income (NI) was expressed by subtracting total variable cost (TVC) from total return (TR).

- NI=TR-TVC

The change in net income (ΔNI) was expressed as the difference between the change in total return (Δ TR) and total variable cost (Δ TVC).

- $\Delta NI = \Delta TR - \Delta TVC$

The marginal ret of return (MRR) measures the increase in net income (ΔNI) related to each additional unit of expenditure (Δ TVC) and expressed in percentage. MRR= $\Delta NI / \Delta TVC$

3.4. Data Management and Analysis

Probing was used for description and clarification of the data at different stages of the process of information gathering and Kendall's coefficient of concordance was used to indicate the level of agreement. All the data obtained from the field were properly organized and prepared for codification. The collected data were coded and entered in to Microsoft Excel spread sheet and analyzed using Statistical software for Social Sciences (SPSS) version 20. Frequency was used to calculate the prevalence. Chi-square was used to test the statistical significance difference between the risk factor groups in prevalence of parasite infestation. Odd ratio was used to estimate risk in groups of risk factors at 90% confidence interval (CI). P-value less than 0.05 ($p<0.05$) was considered as statistical significance difference.

The data collected from experimental chickens were analyzed and ANOVA analysis was made to examine and understand relationship between the commercial and the homemade ration supplemented group and the observed score of Initial body weight, Final body weight, Egg production and the observed parasite score.

4. RESULT

4.1. Survey result

4.1.1. Demographic Background of the Respondents

Table 4 revealed that the proportion of female respondents were higher than males in three PAs. The analysis for educational status disclosed that 88.5% in Bulbul, 63.8% in Gello and 62.2% of the respondents in Kitimbille were illiterates. Others can write and read and involved in formal education such as elementary school and high school. About 93.3% of the respondents were fully involved in mixed farming activities as means of livelihood. Most of the respondents (62.8%) were between the ages of 23-33 years in all PAs.

Table 4: Demographic characteristics of the exotic chicken's owner's respondents in the study

		Frequency (N (%))			
Variables	Categories	Bulbul	Gello	Kitimbille	Total
Gender	male	18(20.5%)	16(34.0%)	8(17.8%)	42(23.3%)
	female	70(79.5%)	31(66.0%)	37(82.2%)	138(76.7%)
Educational status	illiterate	78(88.5%)	30(63.8%)	28(62.2%)	136(75.6%)
	literate	10(11.4%)	17(36.2%)	17(37.8%)	44(24.4%)
Source of income	mixed farm	82(93.2%)	44(93.6%)	42(93.3%)	168(93.3%)
	poultry production	4(4.5%)	2(4.3%)	0(0%)	6(3.3%)
	other	2(2.3%)	1(2.1%)	3(6.7%)	6(3.3%)
Age	23-33	50(56.8%)	30(63.8%)	33(75.3%)	113(62.8%)
	34-46	38(43.2)	17(36.2%)	12(26.7%)	67(37.2%)

4.1.2. Constraints ranking

Table 5; presents lists of exotic chicken constraints ranked in order of importance in the three PAs. The ranking of constraints by the stakeholders was almost similar in the three study villages.

Table 5: Simple ranking constraints by exotic chicken farmers in the three PAs

Constraints	Focus group discussions					
	Bulbul	Kitimbille	Gello	R (sum of the rank)	R-A	$D^2\sum(R-A)$
Scarcity of Feed	5	6	6	17	10.5	110.25
Disease	6	5	5	16	9.5	90.25
Poor animal health service	2	4	4	10	3.5	12.25
Predator	4	3	3	10	3.5	12.25
poor housing	1	1	2	4	-2.5	6.25
Theft	-	-	1	1	-5.5	30.25
Conflict	-	-	1	1	-5.5	30.25
Inadequate skills	-	-	-	-	-6.5	42.25
	-	-	-	-	-6.5	42.25
					A=59/9=6.5	S= 376.25

- $W=12S/m^2 (N) (N^2-1)$

- Where
- S= sum of the square of the R- from the A
- m= number of respondents ranking the constraints
- n= number of constraints that is evaluated by respondents
- From the data
- s= 376.25
- m=3
- n=9

W= 4515/9(9) (80) = 4515/6480 = 0.69

Table 6: Pair wise ranking on importance of exotic chicken constraints

Principal symptoms observed by farmers, prior to the death of their chickens

	Disease	Poor animal health service	Conflict	feed	Low attitude	Predator	Theft	Inadequate skills	Poor housing
Disease		disease	Disease	feed	disease	disease	disease	disease	disease
Poor animal health service			Poor animal health service	feed	Poor animal health service	Poor animal health service	Poor animal health service	Poor animal health service	Poor animal health service
Conflict				feed	conflict	predator	conflict	conflict	conflict
Feed scarcity					feed	feed	feed	feed	feed
Low attitude						predator	theft	Inadequate skill	Poor housing
Predator							predator	predator	predator
Theft								theft	theft
Inadequate skills									Poor housing
Poor housing									

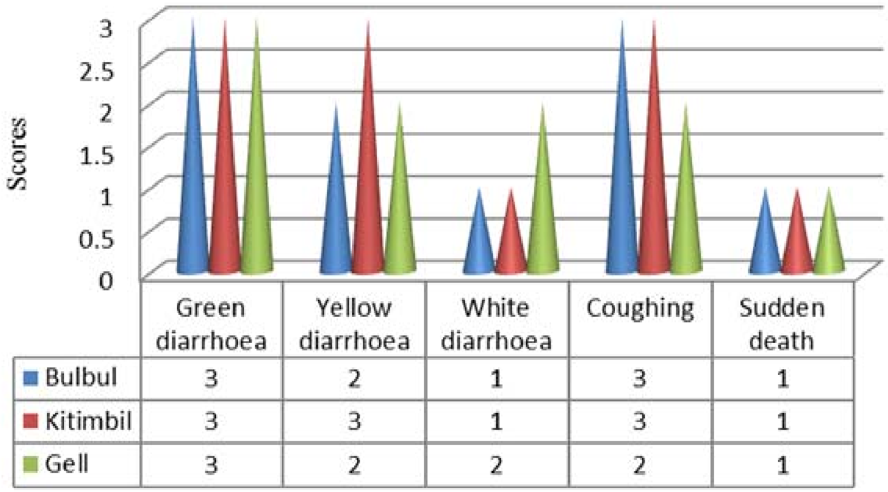

Figure 2: Principal symptom observed by farmers

4.1.3. Seasonal changes and occurrence of exotic chicken death and diseases

Seasonal patterns of the diseases were similar in the three villages. Participants identified a number of seasonal risk factors, and believed that early morning dew (obsessrved throughout the wet season) was the most important risk factor for disease occurrence. Another seasonal factor included the early onset of the wet season (referred to as *early rain* or *early grass growth*). Alternatively, some farmers simply identified the wet season as increasing risk. Farmers confirmed that they experienced losses in their chickens as illustrated in table 12. Basically, losses were due to diseases, nutrition and parasites. The extent and severity of losses were reported to be seasonal (Table 12) with the greatest magnitude of losses (57.8%) occurring during the rainy season.

Table 7: Mortality and season of disease outbreak of chickens as reported by owners during

	villages			
Parameters	Bulbul N =88	Gello N=47	Kitimbille N=45	Overall N=180
Mortality				
Dry Season	11(12.5%)	5(10.6%)	10(22.2%)	26(14.4%)
Rainy Season	49(55.7%)	30(63.8%)	24(53.3%)	103(57.2%)
Total	60(68.2%)	35(74.5%)	34 (75.5%)	129(71.7%)
Season of Disease Outbreak				
Rainy Season	67(76.1%)	33(70.2%)	29(64.4%)	129(71.7%)
Dry Season	15(17%)	11(23.4%)	10(22.2%)	36(20%)

4.1.4. Disease control

Table 8 presents the proportions of indigenous chicken farmers who used various disease control methods and animal health service provision in Bulbul, Gello and Kitimbille villages. Small percentage of households used to isolate sick birds in Bulbul (3.4%) and Gello (2%) but none of households isolate sick birds in Kitimbille. According to the majority (94.4%) of the respondents, there is no control of the free movement of birds, except (11.4%) of households in Bulbul. All of the respondents reported to throw away dead birds. About 17.2% of the respondents vaccinate their chickens whereas about (82.8%) of respondents reported to have no history of vaccination. Animal health service delivery was poor in the three villages, with less than 10% of the farmers receiving services from Government in the three villages. About 6% of the farmers in the three villages used human antibiotics, particularly tetracycline capsules for treating their chickens.

Table 8: Summary of farmer's responses on the various dimensions of handling chickens during survey

Variables	Categories	Frequency (N (%)) Bulbul	Gello	Kitimbille	Total
Isolate sick bird	Yes	3(3.4%)	1(2%)	0(0%)	4(2.2%)
	No	85(96.6%)	46(97.8%)	45(100%)	176(97.2%)
Extension package	Good	21(23.8%)	5(10.6%)	6(13.3%)	32(17.8%)
	Poor	67(76.1%)	42(89.4%)	39(86.7%)	148(82.2%)
Control free movement	Yes	10(11.4%)	0(0%)	0(0%)	10(5.6%)
	No	78(88.6%)	47(100%)	45(100%)	170(94.4%)
Throwing dead bird on field	Yes	88(100%)	47(100%)	45(100%)	180(100%)
	No	0(0%)	0(0%)	0(0%)	0(0%)
Vaccination	Yes	21(23.9%)	4(8.5%)	6(13.3%)	31(17.2%)
	No	67(76.1%)	4.3(91.5%)	39(86.7%)	149(82.8%)
Access to vet. service	Yes	11(12.5%)	2(4.3%)	2(4.4%)	15(8.3%)
	No	77(47.5%)	45(95.7%)	43(95.6%)	165(91.7%)
Human drug	Yes	5(5.7%)	3(6%)	2(4.4%)	10(5.6%)
	No	73(82.9%)	44(93.6%)	43(95.5%)	160(88.8%)

4.1.5. Management

4.1.5.1. Poultry housing system

The results of poultry housing and facilities assessment are presented in Table 9.

Table 9: Housing management of exotic chickens reported in Kersa District during survey

	villages			
Parameters	Bulbul N=88	Gello N=47	Kitimbille N=45	Cumulative N=180
Housing				
Share main house	23(26.1%)	3(6.4%)	9(20%)	35(19.4%)
Separated shelter	65(73.9%)	44(93.6%)	36(80%)	145(80.6%)
Perch inside	17(73.9%)	0(0%)	8(88.9%)	25(73.5%)
On ceilings of the house	6(26.1%)	3(100%)	1(11.1%)	10(28.6%)
Constructed based on recommended package	9(10.2%)	7(14.9%)	5(11.1%)	22(12.2%)
Frequency of cleaning				
Once per day	66(75%)	40(85%)	34(75.5%)	138(76.6%)
Every two days	4(4.5%)	5 (10.6%)	7(15.6%)	16(8.5%)
Every 3 to 6 days	0(0%)	2(4.2%)	1(2.2%)	3(1.7%)
Per week	9(10.2%)	2(4.3%)	8(17.7%)	19(10.6%)
Never	3(3.4%)	0(0%)	3(6.7%)	6(3.2%)

4.1.5.2. Feeds and feeding practices

In all the PAs studied, 61.7% of the respondents reported to use only scavenging with no additional feed supplements for chicken except a few households (12.2%) supplemented kitchen left over and some grain very rarely. About 26.1% of the respondents wereusing purchased commercial feeds (Table 10).

Table 10: Feeding management and season of feeding of exotic chickens reported in Kersa

Parameters	villages			
	Bulbul N=88	Gello N=47	Kitimbille N=45	overall N=180
Feed system				
purchased feed supplemented	16(18.2%)	10(21.3%)	11(24.4%)	47(26.1%)
Scavenging only	62(70.5%)	32(68.1%)	27(60%)	111(61.7%)
Kitchen left over and some grain	10(11.4%)	5(10.6%)	7(15.6%)	22(12.2%)
Feed availability				
Harvesting season	54(61.4%)	32(68.1%)	38(84.5%)	124(68.9%)
Wet season only	14(15.9%)	8(17%)	4(8.9%)	226(14.4%)
Dry season	3(3.4%)	2(4.2%)	0	5(2.8%)
Feeding troughs				
Regular feeding troughs	0	0	0	0
Flat plastic	12(13.6%)	7(14.8%)	5(11.1%)	24(13.3%)
locally made wood	2(2.3%)	1(2.1%)	0	3(1.7%)
any broken material	4(4.5%)	3(6.3%)	6(13.3%)	13(7.2%)

4.1.5.3. Watering

Information recorded for frequency of watering (Table 11) revealed that about 63.9% of respondents provide water with free access in the three PAs. Only 11.1% of the respondents provide water in the afternoon only. A few respondents 19.4% were provide water both in morning and evening. Regarding source of water, river water was the major source (55.6%), whereas pond water accounts for about 31.1% of the total water supply. Borehole accounts for the rest of the proportion (13.3%) as water source. The majority of the respondents (57.7%) used any broken material as watering trough while 40.6% used plastic materials. But none of respondent used regular watering troughs.More than half (69.4%) of the respondents never cleaned watering trough, which indicates poor sanitation.

Table 11: Source and frequency of watering and watering equipment reported during survey

Source and frequency of watering	villages			
	Bulbul N=88	Gello N=47	Kitimbille N=45	overall N=180
Frequency of watering				
Free access	48(54.5%)	32(68.1%)	35(77.8%)	115(63.9%)
Afternoon only	12(13.6%)	5(10.6%)	3(6.7%)	20(11.1%)
Morning and evening	18(20.5%)	10(21.3%)	7(15.6%)	35(19.4%)
Water sources				
River water	33(37.5%)	28(59.6%)	39(86.7%)	100(55.6%)
Borehole water	16(18.2%)	8(17%)	0(0%)	24(13.3%)
Pond water	39(21.7%)	11(23.4%)	6(13.3%)	56(31.1%)
watering troughs				
Regular watering troughs	0(0%)	0(0%)	0(0%)	0(0%)
Plastic tray	35(39.7%)	17(36.2%)	21(46.7%)	73(40.6%)
locally made wood	2(2.3%)	1(2.1%)	0(0%)	3(1.7%)
any broken material	51(57.9%)	29(61.7%)	24(53.3%)	104(57.7%)
Frequency of cleaning				
daily	6(6.8%)	0(0%)	0(0%)	6(3.3%)
twice per week	9(10.2%)	2(4.3%)	0(0%)	11(6.1%)
once per week	27(30.7%)	7(14.9%)	4(8.9%)	38(21.1%)
never	46(52.3%)	38(80.6%)	41(91.1%)	125(69.4%)

4.1.6. Ectoparasites

Two species of mites of the genus *Acari*, three species of lice of the genus *Mallophaga*, one species of tick of the genus *Argasidae* and one species of flees of the genus *Echidnophaga* were identified in the study areaduring survey (Table 12).

Table 12: Types of ectoparasites observed during survey inthe study area

Ectoparasites	No. Examined	No. Infested	Prevalence (%)	95% CI
Mites	60	30	50	1.08-9.95
Lice	60	44	73.3	0.32-32.9
Ticks	60	16	26.7	0-12.25
Fleas	60	20	33.3	0.41-6.47

The species of ectoparasites registered in present survey includes, *M. gallinae* which had the highest prevalence 46.7% followed by, *C.mutans, Echidenophaga gallinacean, M. stramineus,, A. persicus, D.gallinae and C. heterographus,* with a respective prevalence of 40%, 33.3%, 30%, 26.7%, 23.3% and 16.7%, respectively. These ectoparasites have commonly been identified in free range chickens (Ekpo *et al.*,2010).

Table 13: Species of ectoparasites and their sites of attachment

Species of Ectoparasites	**No. infested**	**Prevalence (%)**	**95%CI**	**Sites of attachments**
Mites	**30**	50		
Cnemidocoptes mutans	24	40	1.06-9.3	Lower limb (non-feather part)
Dermanyssus gallinae	14	23.3	0.62-7.4	
mixed	8			
Lice	**44**	73.3		
Cuclotogaster heterographus	10	16.7	0.41-6.5	Comb, head, neck
Menopon gallinae	28	46.7	0.8-6.4	Thigh, wing, leg,chest, theshoulders and the back of birds
Menacanthus stramineus	18	30	0.62-5.9	Vent,head, fluffy feather
mixed	12			
Ticks	**25**	47.1		
Argas persicus	25	47.1	2.46-60.9	Ventral abdominal area and below wings
Fleas	**20**	33.3		
*Echidnophaga gallinac*ean	20	33.3	1.5-16.56	Comb, wattles, eyes and around the ears

4.1.6.1. Feed wise prevalence of ectoparasites

Out of the 60 chickens examined for ectoparasites 46 chickens were infested with an overall prevalence of 76.7%.In this study, higher infestation rate was observed in scavenging with no supplemented chickens 96.7% than scavenging with supplemented birds (56.7%) and the difference was statistically significant ($p<0.05$).

Table 14: Prevalence, risk factor, presence or absence of statistical significance difference in prevalence for each species of identified ectoparasites

Species of Ectoparasites	Scavenge only	Scavenge plus supplement	OR	95%CI	X^2	P-value
Cnemidocoptes mutans	16(53.3%)	8(26.7%)	3.14	1.06-9.3	4.4	0.032
Dermanyssus gallinae	15(50%)	11(36.7%)	1.7	0.6-4.8	1.06	0.217
Cuclotogaster heterographus	5(16.7%)	4(13.3%)	1.3	0.3-5.4	0.13	0.5
Menopon gallinae	17(56.7%)	11(36.7%)	2.25	0.8-6.4	2.44	0.098
Menacanthus stramineus	11(36.7%)	7(23.3%)	1.9	0.6-5.8	1.27	0.19
Argas persicus	17(56%)	8(26.7%)	3.6	1.2-10.6	5.5	0.18
*Echidnophaga gallinac*ean	15(50%)	5(16.7%)	5	1.5-16.5	7.5	0.006
Overall	29(96.7%)	17(56.7%)	22.17	2.66-184.7	13.4	0.000

As we can observe from the result of the above Table 15, scavenging with no supplemented group (OR=22.17 $p<0.05$), thus the result indicates that there is statistical significance relationship between the scavenging plus supplemented and scavenging without supplemented group on the prevalence of ectoparasites. The odds of ecto-parasitic prevalence for scavenging chickens with no supplementations are 22.2 times the odds of parasitic ecto-prevalence of scavenging with commercial feed supplemented

There was a significant association between feeding and parasitic prevalence ($X^2(1)>=13.4$, $P<0.001$).

4.1.7. Prevalence of gastrointestinal parasites

From a total of 60 examined chickens 28 (62.2%) were found positive for gastrointestinal parasite eggs. About 53.3% and 26.7% of the chickens were positive for nematodes and cestodes species, respectively. The association of prevalence of gastrointestinal nematodes and cestodes species with the considered risk factors were shown in Table 15. There is statistically a significant difference in the overall prevalence of GIT helminth parasites between commercial supplemented and Scavenging only chickens ($P <0.05$). During the survey, the commonly recorded ova were of *A. galli* (26.7%), *H. gallinarum* (40%), *Capillaria spp*. (13.3%), *Raillietina, spp*, (26.7%).

Table 15: Prevalence, risk factor, presence or absence of statistical significance difference in prevalence for each species of identified gastrointestinal parasites

Species of Ectoparasites	Scavenge only	Scavenge plus supplement	OR	95%CI	X^2	P-value
Capillaria species	5(16.7%)	3(10%)	1.8	0.39-8.3	0.57	0.353
Heterakis gallinarum	16(53%)	6(20%)	4.57	1.45-14.39	7.17	0.007
Ascaridia galli	12(40%)	5(16%)	3.3	0.99-11.12	4.02	0.042
Raillietina tetragona	7(23%)	6(20%)	1.22	0.35-4.17	0.098	0.500
Raillietina echinobothrida	2(6.7%)	0	-	0.848-1.03	2.069	0.246
Raillietina cesticillus	4(13%)	7(23%)	0.50	1.31-1.95	1.002	0.253
Total	23(76%)	14(46.7%)	3.75	1.24-11.34	5.71	0.016

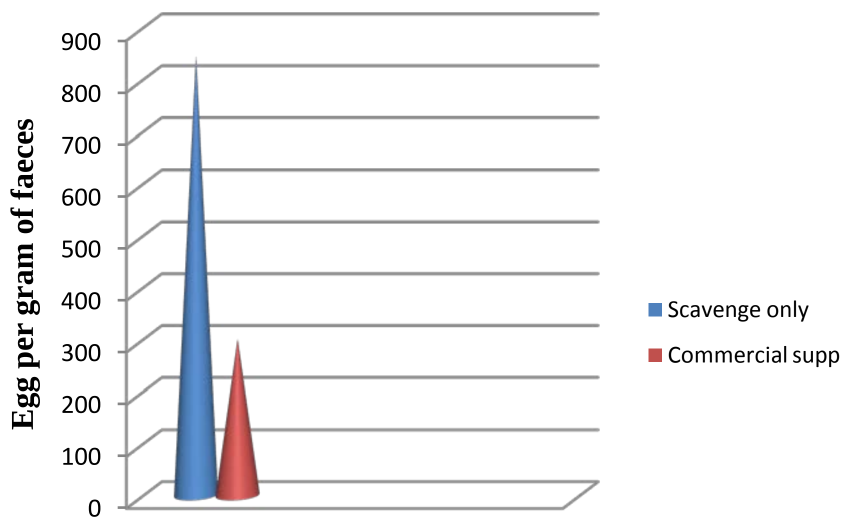

figure 3: Faecal egg count in scavenging with and without commercial feed

The lower Mean faecal egg counts (FECs) were recorded in the scavenging with supplemented chickens as compared to the scavenging without supplementation (Figure 2).

4.2. Measurements and Observations during experiment

4.2.1. Chemical composition and nutritive values of rations

The results of the chemical analysis of ingredients used and nutritional composition of the ration for the treatment are given in Tables 19.

Table 16: Chemical composition of treatment diets and feed ingredients used for experimental

	Chemical composition (%)					
Ingredients	DM	CP	EE	CF	Ash	ME Kcal/kg
CG	89.5	8.7	5.9	5.2	4.21	3638.95
WS	90.3	14.3	5.1	7.4	4.8	3376.22
SBM	93.2	38	7.8	6.1	6.4	3384.15
NS	92.5	28.5	9.2	17.2	8.2	2694.53
Treatments						
Homemade	89.175	16.45	6.2	7.2	10.2	3233.48
Commercial	91.56	17.8	4.32	6.8	5.3	3366.60

DM= dry matter; CP= crude protein; EE = ether extract; CF= crude fiber; CG=Corn grain; WS=Wheat short; SBM=Soybean meal; NS=Noug seed; ME=methabolizable energy

4.2.2. Feed Intake

The effect of using locally available ingredients and commercial feed in layers ration on dry matter (DM) intake and performance of layers is shown in Table 18. Intake of DM was higher in commercial feed supplemented birds.

Table 17: Performance Characteristics of Layer Pullets Fed Experimental Diets

Parameters %	Dietary Treatments	
	Homemade	Commercial
DMI (g/bird/day)	92.78	104.28
Initial body Weight (g)/bird)	962.5	967.75
Final Body Weight (g/bird)	1492.7	1553.25
Body Weight Gain (g/bird)	530.2	585.5
Total Feed Consumed (kg)	250	281
Eggs produced (per bird/wk)	4.9	5.61
Total Eggs produced	1764	2019
Hen Day production (%)	65.3	74.8
Mortality	-	-
Egg mass (g/hen/d)	24.8	29.3
FCR	3.7	3.5

4.2.3. Live weight change and animal performance

Initial BW (g) in experimental chickens did not differ significantly ($P<0.05$) among dietary treatments; however, final BW and total BW gain (g) for the period of 90 days were significantly ($P<0.05$) higher in commercial feed supplemented groups relative to homemade supplemented group. Feed conversion ratio (FCR) by chickens (g DMI g^{-1} gain) was also significantly ($P<0.05$) better in commercial supplemented groups as compared to homemade supplemented group. Egg production during the experimental period was significantly ($P<0.05$) better in commercial supplemented birds as compared to homemade supplemented birds.

Table 18: T-test-Comparing Initial body weight, Final body weight, Egg production and Dry matter intake by feeding group

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
Initial body weight	Homemade	30	966.67	4.381	0.800
	commercial	30	967.7	3.816	0.697
Final body weight	Homemade	30	1444.37	9.478	1.730
	commercial	30	1490.33	8.976	1.639
Egg production	Homemade	30	58.13	4.04	0.74
	commercial	30	67. 2	4.5	0.80
Dry matter intake	Homemade	30	92.70	3.56	0.65
	commercial	30	104.23	5.26	0.96

Table 19: ANOVA- Comparing Initial and Final body weight, Egg production and Dry matter intake by feeding group

ANOVA

	Group	Sum of Squares	Df	Mean Square	F	Sig.
Initial body weight	Between Groups	16.017	1	16.017	0.949	0.334
	Within Groups	978.967	58	16.879		
	Total	994.983	59			
Final body weight	Between Groups	31694.017	1	31694.017	371.993	0.000
	Within Groups	4941.633	58	85.201		
	Total	36636.65	59			
Egg production	Between Groups	1233.07	1	1233.07	67. 20	0.000
	Within Groups	1064.27	58	18.35		
	Total	2297.33	59			
Dry matter intake	Between Groups	1995.27	1	1995.27	98.94	0.000
	Within Groups	1169.66	58	20.16		
	Total	3164.90	59			

4.2.4.Effect of dietary treatments on faecal egg counts

From a total of 60 experimental chickens examined 14 (23.3%) were found positive for gastrointestinal parasite eggs prior to treatment with anthelminthic (Table 19).

Prevalence and species of gastrointestinal parasite identified prior to treatment

Species of parasites	No.of chicken examined	No.of positive chickens
Nematodes		
Ascaridia galli	60	9(15%)
Heterakis gallinarum	60	5(8%)
Eimmiria species	60	7(11.6%)
Cestodes		
Raillietina tetragona	60	4(6.7%)
Total	60	14(23%)

The mean faecal egg counts (FECs) (per gram) were slightly the same in both treatments when assigned to this different treatment and started decrease in both treatments. No appreciable difference in FECs was noticed up to 3rd period of experimentation in the two groups of chickens. A significant increment in the EPG was recorded in the homemade feed supplemented chickens after 3rd period whereas, in commercial feed supplemented groups the FECs remained unchanged throughout the 90 days experimental period (Figure 5).

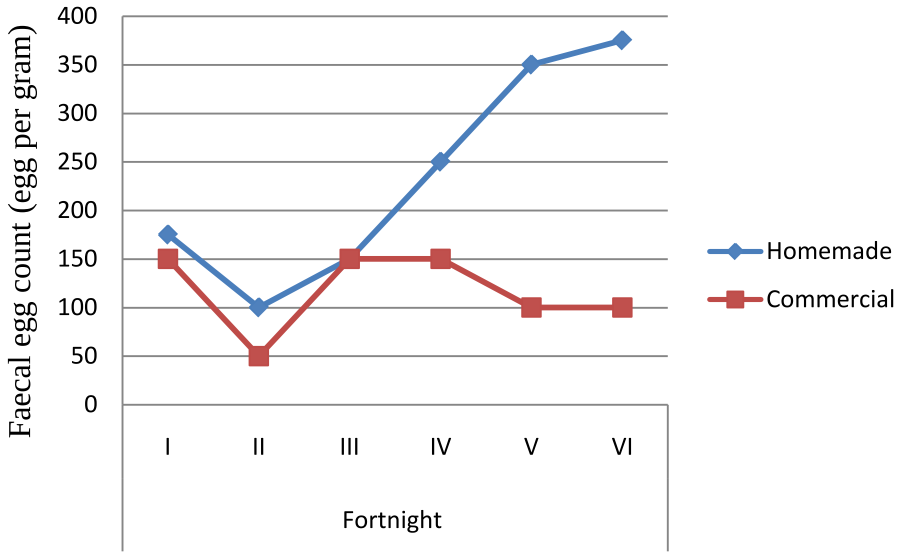

Figure 4: Effect of feed on faecal egg count

4.2.5. Economics analysis

Table 26 shows the economics of raising exotic chickens under homemade and improved feed management. Higher gross margin, net profit and return per birr invested were obtained from homemade feed supplemented chickens, compared to commercial feed supplemented chickens. The MRR implied that each additional unit of 1 birr per hen egg cost increment resulted in 1 birr and additional 1.326 ETB profit for T1. Even though, layers in T2 showed higher percentage of egg production, it was not found economically feasible as compared to layers in T1. On the other hand, T1 was found to be profitable and economically feasible due to relatively lower cost. Assuming that capital is not a constraint, the technology with the highest change in net return is chosen.However, if cost of feed change, recommendation could be change based on the existing conditions for egg production.

Table 20: Economic Analysis of Egg Production

Parameters %	Dietary Treatments	
	T1	T2
Total Feed Consumed (g/bird)	250	281
Cost of total Feed Consumed/treatment	2275	3186.5
Feed Cost per Kg (wt)	9.1	11.34
Total egg produced	1764	2019
Gross income (Birr)	5292	6057
Net return (Birr)	3017	2870.5
Change in net return	146.5	-
Change in total variable cost	-911.5	
MRR (%)	132.6	90

MRR = marginal rate of return; Birr is Ethiopian currency; the price of the egg during the experiment at local market was 3 Birr/egg; T1= homemade ration; T2 = commercial ration

5. DISCUSSION

This study investigated the views of people involved in exotic chicken production in kersa district, with respect to the economic importance of chickens, constraints to production, perceptions of disease risk factors and biosecurity measures. For many of the participants in this study, chicken production was not their primary source of income. Although detailed data on participants' income or assets were not collected we believe that it is likely that almost all exotic chicken producers had very low incomes based on our discussions with the participants, our observations during visits to households and our knowledge of the local area. The RRA approach managed to provide quick over view of exotic chicken production. The RRA method was found to be introductive and boosted the morale of the farmers who were very active and generously offered information that enriched the outcome of the survey. This agrees with the finding by Olwande, (2014) that farmers feel appreciated and become positive, when their ideas are respected.

In this study, scarcities of feed were ranked as the most important constraint to exotic chicken production. Poor quality and cost of feed was an important production constraint to farmers in this study area. There are few established feed processing companies in Ethiopia and the majority of them are located near Bishoftu (FAO, 2008). Given that local farmers rank feed constraints so highly; this is a concern for producers in other parts of the country, where the additional transportation costs could be expected to impose further limitations. The result is comparing well with Emmanuel (2015) who reported feed as highly constraints for local farmer. Poor feeding of the indigenous chicken flocks had been reported by several studies including Okeno *et al.*, (2011), Wachira *et al.*, (2010) and Olwande *et al.*, (2010) in Kenya and Yakubu (2010) in Nigeria.

Poorly fed chickens always take longer time to reach maturity and produce fewer eggs (Wachira *et al.*, 2010). This partially explains why indigenous chickens take longer time to start laying (6-10 months) compared to the well fed commercial chickens that start producing eggs at 5 months of age. It also partially explains why the indigenous chickens lay fewer eggs (36- 60 eggs a year) compared to the commercial birds (over 250 eggs a year (Okuthe, 1999)). Well-fed chickens always develop adequate immunity to disease infections (Njagi *et al.*, 2012).

Diseases were ranked as the second most important constraint to indigenous chicken production. Emmanuel (2015) in Ethiopia, Wachira *et al.*, (2010) in Kenya and Yakubu, (2010) in Nigeria reported disease as the most important constraint to indigenous chicken production. The other constraints identified in this study were poor animal health services reported by the producers. Poor animal health care associated with indigenous chicken production was the reason for high prevalence of the diseases. Predominantly, this issue identified by informal discussions that followed the ranking exercise about veterinary services. The issues that were identified included difficulty accessing veterinarians, the perception that the treatment was not effective, afraid the cost of their services, Lack of attention to village birds and carelessness of the producers. There was evidence that producers had limited knowledge of the potential benefits of veterinary services, and this may be symptomatic of the previously reported lack of understanding that buyers and sellers of veterinary services in many African countries have of one another (Leonard, 2000). Other important constraints identified such as poor housing, Conflict with neighbor, Inadequate skills, Farmers low attitude theft and predation were also reported by others including Wachira *et al.*, (2010) and Ondwasy *et al.*, (2006) in Kenya and Gondwe and Wollny, (2005) in Malawi and Mohammed *et al.*, (2005) in Sudan.

The participants could name and provide accurate clinical signs for some diseases. This is contrary to previous reports (Pagani and Wossene, 2008), where individually and collectively chicken farmers was unable to identify more than a small number of diseases. This difference may be due to the relatively greater importance of chicken production (FAO, 2008; USAID, 2010) and the concentration of animal health expertise in the study area. Many previous studies have focused on Newcastle disease as an important cause of mortality among chickens in Ethiopia (Dessie and Jobre, 2004; Tadesse *et al.*, 2005; Halima *et al.*, 2007) and this is consistent with the opinions of the participants of this study. Coughing and greenish diarrhoea was the most frequently identified disease problem causing bird mortality, and was usually the highest ranked sign of disease. However, our results highlight that a number of other disease were impacting chicken productivity and mortality, including diarrhoea, chronic respiratory diseases, sudden death and reduction in egg production.

This study was the first to construct a comprehensive seasonal pattern of major exotic chicken diseases for the district, with a view of providing basis for mitigations for improved productivity.

The pattern showed that most exotic chicken diseases occurred during feed scarcity and wet and cold months of the year. All these months are usually associated with stressful conditions that compromise the immunity of the birds. When birds are starved during feed scarcity, their immunity to most diseases is lowered (Wachira *et al.*, 2010). Several studies including Njagi *et al.,* (2012), Njue *et al.,* (2001) and others have shown that stressed birds have poor immune response to infections to the extent that, even less virulent pathogens can cause severe clinical disease in the stressed birds.

The producers identified a number of seasonal risk factors, and believed that early morning dew (observed throughout the wet season) was the most important risk factor for disease occurrence. Another seasonal factor included the early onset of the wet season (referred to as *early rain* or *early grass growth*). Alternatively, some farmers simply identified the wet season as increasing risk with the greatest magnitude of losses (57.2%) occurring during the rainy season. The result is in contrary with that of (Kusina *et al*., 2004) that reported the extent and severity of losses were seasonal with the greatest magnitude of losses (47%) occurring during the hot, dry season.

In the study area, about 91.7% of the total respondents have encountered most disease outbreak. In Bulbul, Gello and Kitimbille, about 76.1%, 70.2% and 64.4% of households reported that, they have experience of disease outbreak in rainy season in their flock, respectively. The disease affected all classes of chicken and killed all birds. Fast transmitting fatal disease locally named as 'koksa' (it means coughing) that may kill all birds in the flock occurs in rainy season. The symptom of the disease was mentioned to be greenish diarrhea and in coordination of movement, which are symptoms of Newcastle disease at different stages. Tadelle (2003) reported that, in five agro ecological zones of Ethiopia, one of the disease commonly reported as 'Fengle' that is believed to be Newcastle disease.

The farmers identified limited access of veterinary services and resorted to the use of human medicine, which they confessed never worked. Few farmers who vaccinated their birds never followed the recommended vaccination regime making it difficult to control the disease. About 17.2% of the respondents vaccinate their chickens after disease outbreak; this case increases disease severity instead of curing it. This result in line with the finding of (Samson and Endalew

2010) and Fisseha *et al.,* (2010) who reported the level of awareness about availability of vaccines for chicken is low and the farmers do not have any experience of getting their chicken vaccinated against diseases. This is due to the fact that the farmers have no information about disease control and vaccination because of poor extension package of poultry production. The veterinary assistant reported that the farmers were not responsible bringing their chickens on assigned day for vaccination and the problem of dose formation.

Housing structures currently used by most households were not appropriate. The housing structures most of which were tiny and sketchy in make (made of pieces of old iron sheets) and some grass house made from locally available material were only used to shelter few birds from hot sun during the day. From the total of 180 chicken owners interviewed, only 145 farmers (80.6%) prepared separate overnight houses for village birds (Table 9). However, the minority (19.4%) of village chicken owners share the same house with their chickens. kept birds on various night sheltering places including; on ceilings of the house (28.6%) and perch inside the hose (73.5%). Lack of attention to village birds, lack of construction materials, lack of knowledge and awareness and shortage of labor and time were some of the major reasons mentioned by village chicken owners for not preparing a separate house for their chickens.

Most of the respondents clean their chicken house/shelter daily (76.6%). This result agrees with the survey undertaken by Halima (2007) in northern Ethiopia who reported 74.02 % of the households cleaned their chickens' house once per day. About 8.5% of the owners cleaned it every two days while (10.6%) of the households clean the chicken's house once per week. The remaining (1.7%) and (3.2%) clean every 3 to 6 days and never clean respectively. The situation in the other study areas is similar. Lack of frequent cleaning of poultry shelter can easily cause diseases and increase morbidity and mortality rates of chicken. Thus, raising awareness of farmers on the need for cleaning shelters is important that all development practitioners should take seriously. Housing is essential to protect the bird against incremental weather (rain, sun, very cold winds, dropping night temperatures), predators, and theft, and also to provide shelter for hens laying eggs and broody hens. And most important: housing is necessary in order to maintain a high level of biosecurity in the flock. Furthermore, a suitable or comfortable poultry house is extremely important to maintain an efficient production and for the convenience of the poultry farmer.

The major feed resource base for rural poultry in this study area is scavenging and it consists of anything edible found within the environment. The chickens got most feed requirements from scavenging; around the home stead, where they could eat plant leaves and seeds, insects and any other edible within range. This scavenging feed resource base (SFRB) can include household waste, grains, worms and insects, grasses and many more. The birds got plenty of food during harvesting seasons; in October, November and December each year. The birds lived mainly on scavenged food during the other months of the year, except in some few households where they received little quantities of grains and kitchen left over as supplements, but inconsistently.

The SFRB is not constant but changes with season and household farming activities, for example, sowing and harvesting. According to Tadelle (1996), protein supply may be critical, particularly during the drier months of the year, whereas energy may be critical during the rainy season. To improve the nutrition of village chickens, and hence productivity, supplementary feeding may be necessary as this will reduce pressure on the available SFRB. This will increase the biomass that can be supported by the system, reduce survival pressure and selection against the weakest members of the flock and hence reduce mortality of chicken's due lack of adequate nutrition. Lack of adequate nutrition predisposes chickens to the effects of diseases. Farmers interviewed in the survey realized the benefits of supplementary feeding to their poultry.

The most commonly used supplementary feeds in the study area include maize, Dura and kitchen leftovers. Frequency of feeding and amounts were variable and depended on seasonal supply and fluctuation in local feed resources such as cereal grains. In addition, poultry feed is expensive for the rural resource-poor farmers to purchase (ARC 1999). Improved feeding will also improve productivity, well fed birds are resistant to most infections and hence deaths from diseases will go down. This was demonstrated by the seasonal patterns of diseases constructed in this study. Low or no major disease prevalence was shown to be occurring in the harvesting months with plenty of food for the chickens. That being the case, it is important to develop feeds based on locally available ingredients to supplement the SFRB of rural chickens. A very high level of mortality reported in non-supplemented birds.

Despite variations in source of water and frequency of watering, almost all of the respondents provided water for their chickens. This is a promising and good experience and could be considered as one aspects of their concern to their chickens. Households reported use of different sources of water for chicken and river is the major source of water followed by pond water and borehole water. In the Kitimbille and Gello villages, the majority of chicken owners used river water sources 86.7% and 59.6% respectively. This result was in agreement with that of Mekonen (2007) who reported that water for chickens in Southern Nations, Nationalities and Peoples Regional State of Ethiopia was drawn from river (37%), pond (35%) and bore hole (28%).

The most widely used types of watering troughs in the study area were broken home utensils, plastic material and locally made watering trough from wood. Regarding the frequency of cleaning watering trough, 69.4% of chicken owners never clean watering trough, 6.1% clean twice per week, 21.1% once per week and 3.3% daily (Table 11). However, more than half of chicken owners having watering trough responded that they never cleaned watering trough, which indicates poor sanitation. The result is in line with the finding of Abdurehman (2014) that reported the frequency of cleaning watering trough, 47.8% of chicken owners never clean watering trough, and 23.3% clean twice per week, 16.7% once per week and 12.2% daily. This finding disagrees with the report of Tesfau (2007) who reported the container was not washed at all in 15.3 percent of the households; simply poured extra water so as to remove the dirt seen in the container around the village of Dire dawa town.

The overall prevalence of ectoparasites in the study area during the survey was 76.7%. The observed overall prevalence of 76.7% of ectoaparasite infestation in the current study is slightly comparable to 70.73% report from Meerut Kansal and Singh (2014). However, higher prevalence rate of 91.5% Belihu *et al.,* (2010), 86.67% Shanta *et al.,* (2006) and 100% Bala *et al.,* (2011) were recorded in East Shoa zone (Ethiopia), Bangladesh and Nigeria, respectively. This discrepancy might have occurred due to agro-ecology, management, climatic factors in the study area and sample size and differences in sampling time.

In the present survey, a significantly ($p<0.05$) higher overall prevalence of ectoparasite was found in scavenging only chickens (96%) slightly comparable finding of 93.68% was reported in central Ethiopia (Hagos Ashenafi and Eshetu Yimer 2005) and Hossein *et al.,* (2012) Sistan region, east of Iran who reported prevalence of (93.22 %). In supplemented birds the prevalence was 56.7% slightly comparable finding of 48.21% was reported in and Around Ambo Town, Ethiopia Firaol *et al.,* (2014) (Table 16). Ectoparasite infestation in feed type showed significant difference (p<0.001) with odds ratio (OR) of 22; where scavenging only chickens were 22 times more likely infested than scavenge with supplemented chickens. The likely explanation is that it might be associated with long period exposure to the infested environment than the supplemented chickens, hence a higher prevalence rates. In addition, scavenging only chickens scavenge through a wider area of the farmers' homesteads and beyond that make them more exposed to the source of infestation.

The species of ectoparasites registered in present survey includes, *M. gallinae* which had the highest prevalence 46.7% followed by, *C.mutans, Echidenophaga gallinacean, M. stramineus, A. persicus D.gallinae, and C. heterographus* with a respective prevalence of 40%, 33.3%, 30%, 26.7%, 23.3% and 16.7%, respectively. These ectoparasites have commonly been identified in free range chickens (Ekpo *et al.,* 2010).

Lices were more prevalent comprising 73.3% of the total infestations. Lawal *et al.,* (2016) reported lices as the most prevalent ectoparasite in village chickens. Other studies reported lower prevalence of lice, ranging from 8.1%-19.5% (Hagos Ashenafi and Eshetu Yimer, 2005; Solomon Mekuria and Elsabet Gezahegn, 2010). The higher prevalence of lices in the current study areas might be associated with poor hygiene of chicken houses as well as lack of control measures towards such parasites or may be related to favourable climatic condition for the successful breeding and development of the parasites in the study areas (Hopla *et al*., 1994). Their fecundity is high and they lay relatively large number of eggs in clusters (Urquhart *et al.,* 1996). Besides, after introduction into a flock the lice can spread from bird to bird very rapidly by contact. Perhaps these factors contributed towards a higher prevalence of lices in backyard poultry.

Out of the three lice species, *M. gallinae* had the highest prevalence 46.7% followed by, *M. stramineus,* in scavenging only chickens. Similar finding has reported by (Solomon Mekuria and Elsabet Gezahegn (2010) and Lawal *et al.,* (2016). *Menacanthus stramineus* (30%) was the second most prevalent species of lices encountered in this study. The result was slightly compareable to the finidng of Eslami *et al.,* (2009).

Lower prevalence of (1.28%) *M. stramineus* was reported by (Firaol Tamiru *et al.,* 2014). However, highest prevalence of 70% and 65.33% *M. stramineus*was reported from Bangladesh Shanta *et al.,* (2006) and Ethiopia Belihu *et al.,* (2010), respectively. *M. stramineus* is the most pathogenic species of poultry lice as it causes severe anaemia by puncturing small feathers and feed on blood that oozes out. It is known to cause inflammation of the skin and extensive scab formation (Urquart *et al*., 1987). *Cuclotogaster heterographus* 16.7% the third lice species identified in this study. The prevalence was lower than the report of (40%) Solomon Mekuria and Elsabet Gezahegn 2010 Wolayta Soddo town, Southern Ethiopia.

Mite infestation was registered as the second most in this survey in contrary to *Tesfaheywet Zeryehun and Yonas Yohannes* (2015) who reported mites as the first most prevalent (26%). *Cnemidocoptes mutans* (40%) is slightly comparable to the finding of Firao *et al*., (2014) but lower prevalence of *C.mutans* 9.4% Bala *et al.,* (2011) and 0.89% Biu *et al.,* (2012) reported in Nigeria. The difference might be due to management, climatic and geographic (altitudinal) difference among these studies. *C. mutans* is one of the dozen related species of scaly leg mites occurring on various chickens (Swai *et al*., 2010).

The second species of mite observed in the current survey was *D. gallinae* (23.3%). *Dermanyssus gallinae* (23.3%) encountered in this study was lower than 71.2% and 57% reported by Zumani (2011) and Shanta *et al*., (2006). *Dermanyssus gallinae* is a common mite of poultry houses and the most important haematophagus ectoparasite of birds (Eslami *et al.,* (2009). *Dermanyssus gallinae* (northern fowl mites), apart from causing intense pruritis and pain act as vectors of *Borrelia anserine* (Urquart *et al*., 1987). Chicken mites may cause severe problems for producers, through potential direct effects on weight gain, egg production and sperm production in rooster and importance nuisance pest for human beings including poultry workers and particularly who handle hens and eggs (Bellanger *et al*., (2008).

Echidnophaga gallinacean is the only flease encountered in the current survey with a prevalence of 33.3%. This finding is in line with the finding of Lawal *et al*., (2016) in Gombe, Northeastern Nigeria. The Prevalence of (33.3%) encountered in this study is lower than 50.7%; 71.9%; 44.4% and 51.16% reported by Moyo *et al.,* (2015), Mukaratirwa and Hove (2009), Firaol *et al.,* (2014) and Belihu *et al.* (2010) respectively, but higher than 9.4% and 0.89% reported by Bala *et* *al*., (2011) and Biu *et al.,* (2012). Fleas have been reported as the dominant ectoparasites by Nnadozie (1996) while Saidu *et al*., (1994) showed that they were the least occurring of the ectoparasites. Moreover, Adene (1975) encountered no flea in their survey of blood and ectoparasites of domestic fowls in Ibadan, Western Nigeria. We speculate that these variations in result could be attributed to the season, time of the day, and the study location with respect to urban, periurban or village setting. Moreover, it is expected that the prevalence may have been higher as other flea types may have left the host after feeding and during overnight caging of the chicks.

A. persicus was the only tick species identified with prevalence of (26.7%). This finding was higher than the findings of Bala *et al.* (2011), Mulugeta *et al*., (2013), Mukaratirwa and Hove (2009), Kelay Belihu *et al*., (2010) and Tesfaheywet and Yonas, 2015 who recorded 8.8%, 4.97%, 5.2%, 5.2% and 1.3% respectively. However, Bunza *et al.,* (2008) reported 62.2% prevalence of *Argas persicus* in village chickens in a survey to study the ticks in domesticated birds which was higher than the current finding. Considering the respective findings reported in the various works, the difference might be due to the numbers of birds examined during various study, type of management system practice, climatic and geographic (altitudinal) difference among the various study areas. However, this does not reflect the true figure, due to the feeding habit of the parasite where it briefly visits the host usually at night; hence it may not be found abundantly at sampling during the day time.

The result of this survey also showed a wide range of gastrointestinal parasitic infections among backyard village chickens. The overall prevalence of gastrointestinal parasites was 62.2%. This finding is comparable with some reports 63.6% by Ogbaje *et al*., (2012) in Makurdi and 59.64% by Yehualashet (2011) in Ethiopia. In scavenging, African chicken's even higher prevalence (99-100%) of helminth infections reported Mwale and Masika, (2011). The observed higher prevalence of helminth infection in scavenging chickens could be due to a constant contact with the infective stage and/or intermediate host. Or it could be the absence of chickens deworming practice by the owners Mekibib *et al.,* (2014).

The prevalence was higher in scavenging only chickens (76%). This finding is in a general agreement with the report of various investigators from Ethiopia and other areas. Such frequent multiple species infestations could be explained by the free roaming nature of the scavenging chickens, which increase the access to different types of embryonated parasite eggs or infective larvae. Moreover, in the absence or scarcity of feed these chickens could be forced to eat different insects, snails, slugs, dung beetles and earth worms, which are believed to be the intermediate hosts of some nematode and cestodes.

The most prevalent nematode species encountered in the present survey were *Heterakis gallinarum* (40%) and *Ascaridia galli* (26.7%), *Raillietina* spp. (26.7) while *Capillaria* spp. (13.3%) was the least frequently recorded. Previous studies indicated high prevalence rates of *Ascaridia galli* (45-67%) and *Heterakis gallinarum* (11-43%) in backyard chicken from different parts of Ethiopia Abebe *et al.,* (1997), Bersabeh (1999), and Teshome (1991) and Alam *et al.*, (2014) from Bangladesh. Higher prevalence of *Heteraki sgallinarum* 93.3% reported by (Rahman *et al.,* 2009) among nematode spp. in Malaysia. (Baboolal *et al.,* 2012**)** reported lower prevalence of (0.9%) *Heterakis gallinarum.* This discrepancy could be related to the differences in the management systems, control practices in the farms and seasonal differences. It has been reported that these factors exacerbates the infection of domestic birds in the tropics (Opara *et al*., 2014).The presence of *Heterakis gallinarum* poses the danger of enhanced transmission of *Histomonas meleagridis* to both susceptible turkeys and other poultry through shedding of the eggs in the environment.

Ascarida galli (26.7%) was the second prevalent nematode parasite encountered in this study. this species had been reported in several studies as the commonest and most important helminth infection of poultry (Ahmed *et al*., 2011). The result was in line with the report of Yacob and Hagos (2013). In previously conducted studies higher prevalence of Ascarida galli ranging between 47 to 67% (Asfaw, 1992; Teshome, 1993; Abebe *et al*., 1997; Bersabeh, 1999; Hagos, 2000) were reported in different parts of Ethiopia. But lower prevalence (5.8%) with (Vandana *et al.,* 2012) was reported in commercial broiler chickens. The rate of infection by *A.galli* was higher in the lowland and midland areas compared to the highlands. These variations could be due to differences in local environmental conditions, which support larval development and facilitate transmission.

About the cestodes *Raillietina spp*. were the most prevalent one which found in (26.7 %) in the current survey (Table 18). Similar to this finding in Bangladesh, Alam (2014) reported prevalence of *Raillietina spp*. (21.05%) during winter season. Higher prevalence of *Raillietina spp* were reported by (Ahmed *et al.*, 2011) in Eritrea and (Eslami *et al.,* 2009) in Iran with the prevalence rate of (82.35%) and (60%) respectively. The relatively higher prevalence of *Raillietina* spp. can be attributed to the wide spread and eases accessibility of intermediate hosts (dung beetles, ants) to the scavenging chickens. The habit of free range chickens of scratching any material including cow dung to look for among other things maggots accounted for the high prevalence of *Raillietina* whose intermediate hosts are maggots of Musca domestica (Dube *et al.*, 2010). The difference in the coverage of study areas might have strongly influenced the differences in the diversity of species recorded, since the current study covered only 1 district compared with more than one districts in the other study.

Also, *Capillaria spp*. 13.3% (6/45) was other recorded nematode species in the current survey. This study agreed with (Trisha *et al*., 2014) reported prevalence (4.68%) in indiginous scavenging chickens.

The lower Mean faecal egg counts (FECs) were recorded in the scavenging with supplemented chickens as compared to the scavenging without supplementation. These findings are in agreement with the work by Idi et al. (2007).The low EPG in the scavenging with supplemented group in the present surveymight be related to both the low number of female worms and the low fecundity. It also might be related to the immune status of the supplemented birds as the commercial feed contained vitamin A. the low worm burden in the supplemented group can partly be related to the immune status of the supplemented birds(Villamor and Fawz, 2005).

The results of the laboratory analysis of the different feed ingredients used and the experimental rations are given in Table 19. From the analysis result, it can be seen that soybean meal (SBM) and noug seed (NS) are rich in CP content that make these ration ingredients to be a good source of protein supplement for poultry. Previous reports indicated that the CP content of SBM to be in the range of 41 to 50 % (Eekeren *et al*., 2006 and Waldroup, 2002). However, similar to the value noted in this study, a 38% CP content of SBM was reported in Ethiopia (Aregaw, 2010) and (Senayt 2011). The difference in the CP content of SBM might be due to various factors such as differences in variety, origin and the method of oil processing that the byproduct is obtained. The CP content of the NS used in the current experiment is slightly comparable to 29.2 and 28.9% CP reported by (Senayt 2011) and Fantie and Solomon (2008), respectively. Values for the CP and ME content of maize grain used in the current experiment were comparable with that reported by Mesert (2006) and (Senayt 2011).

The DM and CP content of wheat short used in this study were slightly similar to the 90.7% DM and 15.4 % CP values reported by Haftu (2012). The CP content of the treatment diets were between 16.45% and 17.8%, which was within the range of CP requirement (14-19%) suggested by Leeson and Summers (2001) for layers. Similarly, Tadelle (1997) noted that the protein requirement of high producing laying hens should be between 16-18% of the diet to meet the needs of egg production, maintenance and growth of body tissues. The ME content of treatment diets in homemade feed slightly lower than the commercial feed and was slightly greater than the anticipated 2800 kcal/kg DM ME. This appeared to be mainly due to the greater ME content of SBM. Ration in homemade feed contained relatively greater Crude Fat content due to relatively more level of CF in NS and SBM.

The low intake of DM recorded in homemade feed supplemented chickens may be due to higher crude fiber content of the diet (7.2%), which is almost close to the maximum limit (10% CF) for poultry. Xiohe (2010) showed that leghorn chickens fed ration consisting above 10% CF in the diet cannot maintain the required metabolic energy intake and consequently growth of the chickens is reduced. In line with these findings, (Senayt 2011) reported that an increase in CF content in the diet of poultry causes a reduction in digestibility of nutrients and therefore intake.

The slightly low DM intake in homemade feed could be also related to differences in the amino acid profile of the two protein supplements. Since animal source protein that used in commercial feed consists higher total and digestible amino acid content as compared to homemade feed that used plant protein sources (Campbell 2016), its inclusion at appropriate level might have provided the bird with better balanced amino acid than the ration containing plant source protein, which could also be the reason for the variation in the DM intake among treatments in this study. This may be due to differences in the palatability of diets formulated for the two treatments because of the fineness form of homemade feed used in this study. The ration used in the present experiment was mash form, and since the particle size of ration was very small (almost powder) the animals had difficulty in consuming more of the ration because of no appropriate grain milling masion.

Although initial body weights (BW) were slightly similar ($P > 0.05$) among treatments, the mean BW gain of the birds for the entire experimental period was variable ($P < 0.05$) among treatments (Table 20). The BW gain was greater for birds in commercial supplemented as compared to the ones in homemade supplemented. The lower body weight gain in homemade supplemented chickens might be due to the lower profile and/or levels of amino acids supplied; and partly may be associated with the low level of feed intake. Wu *et al*., (2001) noted that deficiency of essential amino acids affects feed consumption and growth in chicken.

Animal source protein is better than plant source protein in amino acid composition and profile, especially in lysine content and is also better in nutrient digestibility due to the less fiber content. This might have resulted to significantly better nutrient supply and improvement in growth rate of birds when commercial feed is supplemented. Hassan *et al*., (2000) reported that hens fed high protein diets had higher final body weight than those fed lower protein diets. Similarly, El-Sayed *et al*., (2001) noted that body weight of birds fed diets with high protein levels were significantly heavier than those fed diets of high energy level.Differences in BW gain in the present study might also in part be attributable to the slight differences in CP and ME content of the treatments rations. This suggestion is supported by the results of BW gain reported by Haitham (2010) that noted decreased BW because of dietary protein reduction from 17 to 14% in treatment rations.

Total egg produced per bird and HDEP was greatest ($P < 0.05$) for commercial supplemented birds, and slightly lower for homemade supplemented birds (Table 20). The overall mean HDEP for homemade supplemented birds (68.23±1.34%) in the present experiment were lower than the mean for commercial supplemented birds (76.87±1.03%). The lower egg production in homemade supplemented birds noted in this study might be associated with the lower DM intake and possibly lower content of CP of homemade supplemented bird’s diet that might have limited nutrient supply for egg production. Similarly, the highest egg production in commercial supplemented birds was due to greatest DM intake by birds and could also be due to the improvement in balanced nutrient supply due to the added premix in the diet. Onwudike (1981) noted that reduction in hen- day egg production was associated with amino acid deficiency and imbalance. The rate of lay observed in this experiment for homemade supplemented birds higher than the report of (Senayt 2011) that reported the overall mean HDEP (58.5±1.22%). The authors reported 92.4% and 73% HDEP and HHEP, respectively. Such differences might have been due to strain and breed purity difference.

Feed conversion ratio did not differ among treatments. The values obtained here were above the optimum value of 2.0 for layer noted by Peter (2011) but were however better than the range (4.0-5.0) reported by Haftu (2012) and Uko and Kamalu (2008). Hirnik *et al*., (1977) also showed that the variation in feed conversion efficiency is highly dependent on the number of eggs produced (by 51%) followed by feed consumption (31%) and egg weight (18%). Since the variation in egg weight and feed consumption between treatments is not wide, large difference in feed conversion ratio is also not expected.

Results of the experimental study indicated that the chicken were infected with *Ascaridia galli, Heterakis gallinarum, Eimmiria species and Raillietina tetragona.* Levamisole HCL at a dose of 30 mg/kg body weight reduced FECs in the first round. No appreciable difference in FECs was noticed up to 3rd period of experimentation in the two groups of chickens. The probable reason was that effect of the anthelmintic medication of the chickens prior to start of the experiment might have played some role in preventing the establishment of the worms. Results showed decreased in EPG after treatment with Levamisole 30mg/kg, this agree with results of (Begum *et al.*,2012) which showed significant decrease in EPG , due to decreased in numbers of infested worms in alimentary tract , the decrease occur due to anthelelementic activity of Levamisole in which agonist nicotinic receptors and elicit spastic muscle paralysis due to prolonged activation of the excitatory nicotinic acetylcholine receptors on nematodes body wall muscles (Akhtar *et al.*,1985) .

An increase in faecal egg count in the second round might be due to that levamisole has noresidualeffectunless delivered using a slow-release device. This means that a single administration will kill the parasites present in the host at the time of treatment, but it will not protect the host against re-infestations.Levamisole is not ovicidal, which means it will not affect eggs already present, but it will affect the larval stage of the wormor the chickens may probably ingest an intermediate host or paratenic hosthouseflies that are considered paratenic hosts, for some nematode as they can ingest the egg in feces and a juvenile may hatch in tissues, which stays dormant until eaten by birds or may ingested the egg in contaminated water as running water (which parasite tranismit with running water) provided (Permin and Hansen 1998).

A significant increment in the EPG was recorded in the homemade feed supplemented chickens after 3rd period whereas, in commercial feed supplemented groups the FECs remained unchanged throughout the 90 days experimental period (Figure 5). The low worm burden in the commercial feed supplemented group can partly be related to the immune status of the commercial supplemented birds (Villamor and Fawz, 2005).

Because commercial feed contains premixes that contain vitamin A, there are lines of evidence that vitamin A improves immunity, thus when birds are supplemented they develop strong immunity that interferes with establishment of the worms and also lowers fecundity of the fertile female worms (Idi *et al*., 2007). In addition, vitamin A improves the integrity of the intestinal mucosa and hence interfering with both the migration phases of the larvae and the attachments of the adult worms to the mucosa (Crompton and Nesheim, 2002). These perhaps interfere with the overall establishment of the worms. Chickens fed on diets containing animal protein acquire fewer worms compared with those fed mainly on plant protein. Increasing levels of essential amino acids especially, lysine and calcium, in feed also lessens the number and length of parasite Hafiz *et al*., (2015). Furthermore, feed rich in vitamins A and B minimized the chances of worm establishment in the intestine (Walker & Farrell, 1976).

GI parasitism increases the amino acid requirement of GI tissues and consequently peripheral tissues are denied the nutrients required for optimal growth. Normal animal performance in the face of larval challenge may be possible if the protein supply is increased, and this is possible by balanced feed supplementation, which improves the bio-availability of proteins. (Dey *et al*., 2008; Dubey *et al.*, 2012).

The economic return in terms of partial budget from birds under different treatments is presented in Table 26. The highest value for marginal rate of return was recorded in homemade supplemented chickens. According to partial budget analysis, hen fed commercial feed returned a higher total net income than homemade supplemented chickens. Even though, layers in hen fed commercial feed showed higher percentage of egg production, it was not found economically feasible as compared to layers in homemade supplemented. This means, the income obtained from hen fed commercial feed returned less per unit of expenditure, suggesting homemade supplemented to be the treatment of choice in terms of profit. Therefore, substitution of commercial feed with homemade feed is profitable because of the highest value for marginal rate of return. Thus, homemade feed can be substituted for commercial feed economically without affecting body weight, egg production and health status of chickens. However, if cost of locally available ingredients changed, recommendation could change based on the existing conditions for egg production.

6. Conclusions and Recommendations

6.1 Conclusions

The survey was conducted to identify exotic chicken constraints in Kersa district on chickens those fed supplementary feeding given by the LIVES project and left as scavenging only. The exotic chicken production suffers from the scarcity of feed, diseases, unavailability of reliable veterinary and extension services, inadequate knowledge and skills in the management of exotic chickens amongst the farming community. Infestation of chickens with ectoparasites and endoparasites were important constraint observed in the study area. To tackle these problems and improve production performance with lower cost, a feeding experiment on layer chickens was conducted using feed concentrates from commercially purchased feed and homemade from locally available ingredients. Parasiticinfections in chickens induce low levels egg production and body weights. Supplementation of commercial feed significantly improved egg production, body weight gain and total profit but when feed cost is taken in consideration lower profit than homemade feed. The effects of parasiticinfection on the above-mentioned parameters can be reversed by supplementing the chickens with mixed feed especially commercial feed as it contained premixes that contained vitamin A eventhough it has lower profit as compared to homemade feed. Vitamin A moderates parasiticinfection in chickens particularly by reducing egg counts and fecundity of fertile female worms. Vitamin A has, therefore, beneficial effect on moderating the effect of parasiticinfestation. Higher profit will expected by using premixes with homemade feed.

6.2 Recommendations

It is recommended that extension packages that would enhance the knowledge and skills of the exotic chicken farmers on exotic chicken production, be initiated and sustained for the improvement of the productivity of the birds. Given the current low interaction between the veterinary profession and chicken producers, efforts to increase chicken health and production through veterinary input may need to include both improved training for veterinarians and efforts to demonstrate the benefits of veterinary input to farmers and veterinarians alike. Animal-health technicians may also be able to make an important contribution to provision of preventive health care.

The evidence on the effects of parasiteson the above-described parameters necessitates strong measures to control helminths infestations in chickens. Similarly, considering the benefits of vitamin A described above supplementation of homemade feeds with vitamin A is recommended to be a routine practice for farmers raising chickens for various purposes. The above-mentioned recommendations are particularly important for free range chickens, which are usually highly infested by worms and depend on natural sources of vitamin A, which vary significantly with seasons. While the present study reports association of different concentrate with performance and parasiticinfestation under experimental condition, it could be worth to have similar study conducted in the field inorder to provide an insight of what happens in a typical field condition, where feed and parasites were a problem.

In the present study, it is not clear whether the reduction in FEC was due to reduced worm load or due to decreased fecundity of GI nematodes. Nevertheless, the present findings have got tremendous implications on the epidemiology of infection. Reduced FEC means less contamination of the environment with infective larvae, which in turn results into less infection in the chickens scavenge on the area. Moreover, the mean FECs of the treated groups were much lower, which warrants for anthelmintic medication. Thus, the frequency of medication can be curtailed in the balanced fed and good management. This is especially important in the study area where inadequate veterinary service is raised as the constraints.

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