ADDIS ABABA UNIVERSITY
FACULTY OF VETERINARY MEDICINE

ASSESSEMENT ON HUSBANDRY PRACTICES AND PRODUCTION PERFORMANCE OF BRIOLERS UNDER SMALLHOLDER MANAGEMENT IN AND ARROUND DEBRE ZEIT TOWN, ETHIOPIA

BY

MICHAEL TEMESGEN MENGISTU

JUNE 2008
DEBREZEIT, ETHIOPIA

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A thesis submitted to the School of Graduate Studies of Addis Ababa University in partial fulfillment of the requirements for the degree of Master of Science in Tropical Animal Health and Production

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DEDICATION

I dedicate this thesis manuscript to my LORD for giving me health, strength and support for completion of my study, really unpaid: and to my beloved family and Dr Yoseph Mekasha and his family by wishing a successful future to them in this new millennium.

BIOGRAPHY

The author, Michael Temesgen, was born in Addis Ababa in 1978 and attended his elementary and secondary school education in the same place. After completion of his high school education, he joined Alemaya University of Agriculture in 1999 and graduated with Bachelor of Science degree in Animal Sciences in 2002.

Soon after graduation, the author employed in Kombolcha ATVET College and works as instructor up to now in the Department of Animal Science. In June 2005 he joined the School of Graduate Studies in Addis Ababa University to pursue Master of Science in Faculty of Veterinary Medicine (FVM), Tropical Animal health and production department majoring in poultry stream line.

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ABBEREVATIONS

AACMC	Australian Agricultural Consulting and Management Company
ANOVA	Analysis of variance
APC	Assured chicken production
AOAC	Association of Official Analytical Chemists
CF	Crude fiber crude
CFB	Commercial feed based
CI	Confident interval
CP	Crude protein
CSC	Cotton seed cake
CV	Coefficient of variation
CW	Carcass weight
DM	Dry matter
DPE	Dried poultry excreta
DZARC	Debre Zeit Agricultural Research Center
EARO	Ethiopia Agricultural Research Organization
EE	Ether extracts
ESAP	Ethiopian Society of Animal Production
FAO	Food and Agricultural Organization of the United Nation
FAOSTAT	Food and Agriculture Organization of the United Nations Statistical Database
FCR	Feed Conversion Ratio
IAR	International Agricultural Research
IFPRI	International Food Policy Research Institute
ILCA	International Livestock Center for Africa
ILRI	International Livestock Research Institute
Kcal	Kilo calories
m.a.s.l.	Meter above Sea Level
MM	Mineral Matter
MOA	Ministry of agriculture

MSBDG	Maize-Sorghum brewers' dried grains
NCD	Newcastle disease
NFE	Nitrogen Free Extract
NMSA	National Metrological Service Agency
NRC	National Research Council
NSC	Noug seed cake
NVI	National Veterinary Institute
OFFB	On Farm Feed Based
ppm	Parts Per Million
RSM	Rape seed Meal
SD	Standard Deviation
SPSS	Statistical package for Social Sciences
US	United State
SW	Slaughtering weight

ABSTRACT

The study has two parts. The first parts covers cross sectional study while the second part dealt with longitudinal investigation and conducted on private smallholder broiler farms having a flock size of 50-700 in Debre Zeit town, Ethiopia. Cross-sectional study was designed to gather information on the baseline poultry husbandry practices, while longitudinal study was designed to collect data on production performances and mortality of broiler chicks. A total of 65 broiler farms existed in the study area and all were considered for cross sectional study, while a follow up longitudinal study was conducted on 17 purposively selected broiler farms.

The household demographic profile showed that the age of most households lies within 31-40 years followed by 21-30, and most of the farmers were literate. The dominant farming system was raising livestock only. The study showed that 58.5% of the households were farmers, and 58.5% were females. All the surveyed households reared broilers chicken for sales as an income source, and 46.2% produce broilers 3 times per year. The average (mean ± SD) family size, flock size and flock density was 4.2±1.58, 386.87 ± 177.63 and 10.21 ± 2.18, respectively. About 93.8% of the households use separate housing for broiler, and the percentage of farms making house from mud was 50.8%. Most of the farms use flatted roofing (89.2%) and one sided openings (93.8%). With regard to health management, about 80% of the farms use vaccination only and the rest combine it with other medicaments. This study showed that Sodium hypochlorite account for the largest type's disinfectants chemical used in the farming system. The higher and lower mortality rate occurred at finisher and grower stage respectively. While 58.5% of the labor source was family labor, the remaining was accounted for hired labor. The most important constraints of the broiler farms were shortage of land (64.6%), day old chicks (83.1%), capital (44.6%), feed related problems (63%) and while labor was less important (4.6%).

The overall mean age at slaughtering, slaughtering weight, carcass weight, dressing percentage (%) and mortality rate (%) were 56.53±5.99 days, 2.64±0.17 kg, 1.84±0.17 kg, 69.9±2.71 % and 6.73±1.78 %, respectively. Commercial Feed Based (CFB) broilers

farms had age at slaughtering of 53.18±1.14 days, and slaughtering weight of males and females broilers were 2.74±0.13 kg and 2.49±0.12 kg, respectively, while carcass weight of male and female broilers were 1.97±0.10 and 1.69±0.12, respectively. On the other hand, On Farm Feed Based (OFFB) broiler farms had age at slaughtering of 62.67±6.40 days, and slaughtering weight of male and female broilers were 2.78±0.15 kg and 2.57±0.11 kg, respectively, while carcass weight of male and female broilers were 2±0.12 kg and 1.74±0.92 kg, respectively. Feed type and sex of birds had significant effect on the slaughtering and carcass weight and dressing percentages across all the farms. The male broiler chicks had heavier carcass compared to the female ones. Smallholder broiler farms that used CFB ration perform better compared to the OFFB ration. Even if the productive performance of broiler chicken owned by smallholder in the area is improving, the prevailing situations such as shortage of skill, feed problems and health care practices is still the bottleneck for better performance. Thus, broiler farms should improve the prevailing management standard through improved husbandry practices; supply of quality feed and improved health care of birds.

Key words: - broiler, husbandry, production performance, smallholder

INTRODUCTION

The domestic & international poultry industries have gone through many changes over the last 50 years. The poultry meat industries have remained to be one of the most successfully growing industries in agriculture in the world (Bremner & Johnson 1996). Broiler chickens account for about 75% of the world poultry meat production, while the remaining 25% distributed almost equally between turkeys and other avian species. In many countries poultry are now a head of all other livestock in economic importance (Sainsbury, 1992). The nutritional condition of many people in under developed parts of the world is poor & thus it is poultry, which provides superior food elements through a relatively cheap means of production (Teketel, 1987; Manson, 1984).

A broiler is young chicken, usually lowest aged, either sex that have tender meat with soft, pliable, smooth textured skin of flexible breast bone cartilage (Singh, 1998). These birds are required for broiler production, which should have fast growth rate, high feed conversion efficiency, early feathering, good body conformation & low mortality (Singh, 1998). The systems used for rearing broiler are probably more standardized than any other management. Almost invariably, the birds reared from day-old to about 46-70 days in a controlled environment (Sainsbury, 1992).

In developing countries broiler normally runs as hatched (Smith, 2001). However, in well developed countries because the cockerel and hen have different nutrient requirements they are often put into different pens. At this age, the males usually weigh 200 g or so more than the females and have had a better food conversion ratio (Smith, 2001). The chief broiler production cost ranked in order are feed, chicks, and labor respectively (Enmsinger, 1992), with the feed accounts for about 70 % of the total of cost production (Laughlin, 1995; Sainsbury, 1992).

The total poultry population in Ethiopia is estimated to be 65 million heads (FAO, 2000), while the total poultry meat production is estimated to be 72,300 millions tones, of which local birds, kept under the traditional systems of production, contributes 99.2 % (EARO,

2000). Poultry accounts for 15% of the total per capita meat consumption in Ethiopia (FAO, 1993). However, the indigenous birds are small in body size and low producers of meat and egg (EARO, 2000). The major constraints of poultry productivity are disease, poor feeding and management practice, low genetic potential of indigenous birds, poor extension service or lack of developed market infrastructures (Wilson, 1986; Mekonnen, 1998).

Though poultry raising has a long tradition, many people, both in rural area and urban centers of the country, have engaged in the activity of keeping small number of chicken in their back yards to produce eggs and poultry meat for home consumption and to generate some incidental income (Alemu, 1985, 1995). At present commercial broilers reach market weight of about 1.6 - 1.8 kg at 46-52 days. Consequently, the indigenous birds are not suitable for expansion of commercial poultry production (Alemu 1985). Although poultry sectors hold an important position for economic development and food security in Ethiopia, poultry industry remains highly underdeveloped and unorganized. Even with the development of ELFORA Agro- Industries PLC, the 1984 statistic stating that 99.2 % of all poultry have been produced and consumed within a private rural setting (Tadelle and Ogle, 1996).

The fast growing human population, coupled with malnutrition problems and low income of the developing world including Ethiopia strongly suggest that there is a considerable need for further establishment, expansion and promotion through appropriate livestock production systems of poultry farming in the country both in the urban and rural sectors (ILRI, 2004). However, information regarding the use of exotic poultry breeds and associated improved management practices has been very limited (Hailemarriam *et al.*, 2006). In addition, systematic studies have not been conducted to assess the role and intensity of adoption of exotic meat chickens and their production performances under smallholder farming conditions.

The objectives of this study were, therefore:

- To assessed the husbandry practices of broiler farms under smallholder management condition.
- To determined the production performance of broiler chicken in the area.

2. LITERATURE REVIEW

2.1. Poultry Production systems

Poultry production in most tropical countries is based mainly on scavenging production systems. It has been estimated that 80% of the poultry population in Africa is found in traditional scavenging systems (Gueye, 1998; Gueye 2000). The birds scavenge in the vicinity of the homestead during daytime where they may be given sorghum, millet, maize bran, broken grains, or other waste products as supplementary feed. These production systems are often entitled 'low input-low output' systems (Pandey, 1992). A range of factors such as sub-optimal management, lack of supplementary feed, low genetic potential and diseases (Pandey, 1992; Bagust, 1994; Permin and Bisgaard, 1999) cause the low output. Despite the low production, scavenging chickens still account for a major part of all meat produced in many developing countries, where poultry is an important component of rural, per-urban, and urban households. As such poultry plays a big role in rural as well as national economy (FAO, 2000).

Generally four poultry productions systems in developing countries can be described (Sonaiya *et al*., 1999).These include the free-range system or traditional village system; the backyard or subsistence system; the semi intensive system and the small-scale intensive system. These poultry management systems are also found in smallholder poultry sector in Africa (Kitalyi, 1998). Some important characteristics of these poultry production systems in Africa have been summarized in Table 1. However; according to Gueye (1998) free-range system and the backyard system are the main types of poultry husbandry system practiced in the traditional poultry production in Africa.

Table 1: Characteristics of major types of husbandry systems practiced in traditional poultry production systems in Africa.

Characteristics	Traditional free range	Backyard or subsistence	Semi-intensive	Small-scale intensive
Flock size	1-10 birds	10-50 birds	50-200 birds	50-500 birds
Key rearers	Majority of rural families	Moderate number of rural families	Few rural families	Urban families
Ownership	Mostly women & children	Mostly women and family	Middlemen	Business men
Type of breeds	Indigenous breeds	Indigenous and few crossbreds	Local/improved	Layers or broilers
Feed resources	Scavenging	Scavenging and supplementation	Commercial/local	Balanced diets
Health status	No vaccination/medication	Vaccination and little medication	Vaccination	Full vaccination
Housing system	No specific housing	Simple and small houses	Medium & improved	Big and improved
Egg production	30-50 eggsyear-1hen-1	50-150 eggsyear-1hen-1	80-160 eggsyear-1hen-1	250-300 eggsyear-1hen-1
Growth rate	5-10g day-1	10-20g day-1	10-20g day-1	50-55g day-1
Mortality rate	High mortality	Moderate mortality	Low mortality	Low mortality
Use of products	Home consumption	Home consumption and sale	Family income	Business income
Profit	Small cash income	Family income	Family income	Business income
Socio-economic	Social and cultural	Social and micro-credit	Credit based assets	little social

Source: (Kitalyi, 1998 and Sonaiya *et al.*, 1999)

According to Alemu (1995) poultry production systems in Ethiopia showed a clear distinction between traditional, low input system on the one hand and modern production systems using relatively advanced technology. In the classification of world livestock production system, poultry systems are described under landless monogastric systems, where feeds are introduced from out side the farm (FAO, 1996). The most important poultry production systems identified globally is the intensive system, the semi-intensive system, and extensive system (FAO, 1996).

In developing countries broiler normally, runs as hatched (smith, 1990). They are ready for slaughter in 8-12 weeks and weigh 1.6-1.8kg (Alemu, 1995). Broiler producer should aim for bird's weight to reach 2.2kg at 6 weeks of age; good feed conversion, & mortality under 1% (Ensminger, 1992). The poultry producers are interested in increasing product per birds, the efficiency of producing the product and improving the quality of the product produced (Ensgmiger, 1992).

2.1.1. The traditional Production systems

This production system is characterized as including small flocks, nil or minimal inputs, low outputs and periodic devastations of the flock by diseases. Birds are owned by individual households and are maintained under a scavenging system, with little or no inputs for housing, feeding or health care (Alemu, 1995). Typically, the flocks are small in number (an average of 7-10 matured birds) in each households typically consisting of 2-4 adult hens, a male bird and a number of growers of various ages (Tadelle, 1996). The AACMC (1984) gives an averages of 6 indigenous birds per households which was less than to the average flock size in Africa ranges from 5-10 birds (Sonaiya ,1990).

Majority of the poultry population consists of local breed types under individual household management (Alamagot, 1987). However, it is estimated that the commercial sector comprises only 1-2 percent of the nation's chickens (Tadelle *et al*., 2000).

Table 2: Contribution of local birds to the total poultry population in selected African countries.

Country	Contribution (%)	Source
Cameroon	65	(Agbede *et al.*, 1990)
Ethiopia	99	(Alamargot ,1987)
Gambia	90	(Andrews ,1990)
Kenya	80	(Mbugua, 1990)
Malawi	90	(Upindi, 1990)
Nigeria	91	(Adene, 1990)
Zimbabwe	30	(Kulube, 1990)

2.1.2. Large scale commercial system in Ethiopia

Modern poultry production in Ethiopia started in the early 1950's with the establishment of higher learning agricultural institutes (Tadelle and Peters, 2003). The activities of these institutions focused mainly on the introduction and distribution of exotic breeds (White and Brown Leghorns, Rhode Island Red, New Hampshire, Cornish, Australoup, Light Sussex etc.) to smallholder farmers with management, feeding, housing and healthcare packages (Alemu and Tadelle, 1997). Today a number of large commercial state farms are established. Private poultry farms are also starting to operate. Commercial farms with annual capacities of about 35,000 layers and 208,000 broilers are currently operating in and around Addis Ababa (Alemu and Tadelle, 1998). These farms with varying flock sizes have been owned by government institutions, peasant association and individual investors (Tadelle and Peters, 2003). There is, however, a fast trend of expansion in the number of private commercial enterprises of various sizes using exotic stock. The above broiler data were excluding those semi-intensive commercial small-holder farms in the potential area.

2.1.3. Small-Scale intensive system in Ethiopia

There is also a third up coming "small scale" intensive system with small number of birds (from 50 to 500) as an urban and peri-urban household income source using exotic birds and relatively improved feeding, housing and health care. The system have been organised along

commercial lines (Alemu and Tadelle, 1998). This activity has undertaken as a source of income especially by ex-soldiers, high school dropouts, women headed and resource poor families (Alemu and Tadelle, 1998). Most of the poultry houses used in this system are not made for the purposely. Poor ventilation and too high flock densities were characteristics of the housing system used. Most of the producers in this system have got day old chicks and mixed feed from large enterprises on loan basis at very high interest rates. The producers do not, thus, have a say on the quality of feed and chicks. Seasonality of marketing, poor input delivery system, disease challenge, product processing and other problems are peculiar to this system (EARO, 2000).

2.2 Socio economic aspects of poultry production

Rural poultry production represents a significant part of the national economy in general and the rural economy in particular (Table 2). This segment of production represents an asset value of US $ 5.75 billion in Africa (Sonaiya, 1990). A number of authors including Veluw (1997); Sonaiya (1990); Gunaratne *et al.* (1992) have outlined that the rural poultry play a significant role through their contribution to the cultural and social life of rural people. The major uses and benefits of poultry in the rural societies in the central highland of Ethiopia are outlined in the Table 3.

Table 3: Major uses of poultry in the rural central highland of Ethiopia

	Eggs (%)	Chicken (%)
Hatching	51.8	---
Sale	22.6	26.6
Home consumption	20.2	19.5
Reproduction	---	20.3
Scarifice	---	25
Gift	5.4	8.9

Source (Tadelle and Ogle, 1996)

The International Food Policy Research Institute (IFPRI)forecasts that globally, poultry will contribute about 40% of the total animal protein by 2015 (IFPRI, 2000). Available data show that family poultry have been contributing significantly to the supply of animal protein in Africa, especially in the rural areas. The estimated population of family-produced chickens in Africa is 700 million, compared with 191 million for cattle, 182 million for goats, 158 millions for sheep and 15 million for pigs (FAOSTAT, 2000). Because they are available in such a large number, they make notable contribution to the animal protein supply.

Of the total national egg and poultry meat production, 98.5 and 99.2%, respectively, were contributed by local birds (ILRI, 2004), resulting in an annual output of 72,300 metric tons of poultry meat and 78,000 metric tons of eggs. It is believed that the contribution of the commercial sectors that uses exotic birds has increased substantially in the recent years.

The per capital egg and chicken meat consumption in Ethiopia have been reported to be about 57 eggs and about 2.85 kg of chicken meat per annum (Alemu, 1987); these were very low figure as compared to the international standards. Although there have been no current data on the present per capita consumption of poultry products in Ethiopia, similar or even declining trends were expected because the population of Ethiopia has increased by 3% per annum over the last ten years without any marked increased in production of poultry meat and egg.

Poultry keeping in most developing countries is the responsibility of women. Tadelle and Ogle (1996) in a study of three villages found that the women look after the birds, and have earned from the sale of eggs and chickens were often their only source of cash income. Teketel, (1987), Tadelle, (1996), Leulseged, (1998) and Tadelle and Ogle, (2001) reported that the households in rural Ethiopia keep birds also for socio-religious functions at home.

2.3. Factor considered for optimal broiler performance

Broiler performance is the result of the interaction effect of both the genetic constituents of the animal as well as the environmental factors. From the environmental factors, the amount and the type of feed is dealt with as follows together with the genetic factors.

2.3.1. Genetic factors

Selection and crossbreeding techniques have enabled to the production of a meat type chicken that will weigh over 2 kg at six weeks of age, having been fed only 3.5 kg of a balanced diet. This compares very favorably to the figures achieved in the 1930s of 2 kg in fourteen weeks on 10 kg of feed (Smith, 2001). Various investigations have been conducted to show that a difference in rates of growth in different strains exists. In comparison of Dwarf and non Dwarf broiler type chicks, Marks (1980) showed that mean body weights of normal birds were about ten percent larger at hatching and the absolute differences in body weights between the lines continued to increase through eight weeks of age. Similarly, Holsheimer and Veerkamp (1992) showed that the average weight gain of Arbor Acres chickens at six and seven weeks of age were higher when compared to that of the Ross chickens.

2.3.2. Environmental factors

Environmental factor includes the type of feed and its nutrient content, housing, the health status, the weather condition and related factors. To achieve their genetic potential for growth, broilers must be provided with optimal environmental conditions. Any deviation from optimal conditions can result in decreased performance. High stocking densities that may contribute to reduced performance include poor air quality due to inadequate air exchange, increased ammonia, and reduced access to feed and water. The overall effect on broiler chickens of reducing floor space can be reduced growth rate, feed efficiency, live-ability, and, in some cases, carcass quality (Puron *et al*., 1995).Therefore, Environmental conditions are extremely important to bird rearing and affect bird behavior directly. Temperature, relative humidity and sun radiation are important indexes of environment quality to the animal (Bockisch *et al*., 1999), since these factors may cause stress (Furlan *et al.*, 1999; Silva, 2001).

The thermal ambient is represented by temperature, humidity and radiation, and affects birds directly, compromising the most important vital function, i.e., maintenance of the homeothermy. The combined effects of temperature, humidity and radiation might be

quantified by the black globe and humidity index (BGHI) (Curtis, 1983). BGHI values higher than 76 have been observed during the summer, which decreases the productive performance of birds and constitutes one of the most important problems in broiler rearing (Curtis, 1983).In such situations, climatic limitations might be minimized as a result of adequate building plan together with rational feeding and management, as well as techniques of ambient thermal modifications (Curtis, 1983).

Poultry house conditions

As in other husbandry fields, the aim in chicken production is to obtain the yield in a desirable level at the lowest cost. As the chickens have spent their life in poultry houses, in order for the chicken to be able to perform their yield capacities entirely, they should be kept in a good environment conditions with a good care as well as genetic features. An adequate environment within poultry houses is a very important requirement for success in the poultry industry (Payne, 1990).

In poultry houses environmental conditions mean physical (heat, humidity and air movement) and chemical factors (ammonia and carbon dioxide in the compound of the air). Chickens and their wastes in poultry houses generate different forms of air pollution, including ammonia, carbon dioxide, methane, hydrogen sulfide and nitrous oxide gases, as well as dust (Kocaman *et al.*, 2005). Gases such as carbon dioxide, ammonia and methane may accumulate and reach toxic levels if adequate ventilation is not maintained. These different air pollutants may cause risk to the health of both chickens and farm workers. Poor environments normally don't cause disease directly but they do reduce the chickens' defenses, making them more susceptible to existing viruses and pathogens (Quarles and Kling, 1974).

Aerial ammonia in poultry facilities is usually found to be the most abundant air contaminant. Ammonia concentration varies depending upon several factors including temperature, humidity, animal density and ventilation rate of the facility. Chickens exposed to ammonia showed reductions in feed consumption, feed efficiency, live weight gain,

carcass condemnation, and egg production (Charles and Payne, 1966; Quarles and Kling, 1974; Reece *et al*., 1985). Humidity and temperature also have an impact on air quality.

Obviously, when ammonia levels are high enough to blind birds, production is seriously affected; however, ammonia levels of just 25 ppm have been found to depress growth and increase feed conversion in broilers (Miles and Jacob, 1998). In addition, a greater incidence of airsacculitis, viral infections and condemnations have been linked to ammonia levels in this range.

Ammonia concentrations of just 5 ppm (undetectable by the human nose) have been shown to irritate and injure the protective lining of the chick's respiratory system, causing increased susceptibility to respiratory disease (Charles and Payne, 1966; Caveny *et al.*, 1981). If one waits until levels are high enough to detect by sense of smell before taking steps to control ammonia, some damage has already occurred.

Generally, factors which impact on internal air humidity of poultry house include: external air humidity, type and management of drinker system, water consumption, stocking density, bird age and weight, ventilation rates, temperature profile and disease status of the birds (Scahaw, 2000).

Brooding temperature and light Requirement of broilers

The chick does not become completely homeothermic until sometime one to two weeks of age. Therefore ability of the broiler to regulate its temperature effectively has a direct impact on growth and efficiency, and thus subjecting chicks to low temperatures results in excess energy being expended to warm the bird by increasing heat production. Under ideal conditions of around 20-25^{o}C, the bird uses a minimum of feed to maintain body temperature. In cooler conditions, more diet energy must be used to maintain body heat and consequently feed efficiency will deteriorate (MAFRA, 2008).

As long as possible, ambient conditions should thus be managed to prevent negative effects on the productive performance of birds, since they might affect metabolism and result in negative effects on meat production (Macari & Furlan, 2001). Generally, animal behavior depends on the rearing environment (Craig & Muir 1996;Ferrante et al., 2001), whereas Jones et al (2000) ; Von et al. (1999) reported that improvement in ambient conditions might also result in benefits.

It has been suggested that restricted lighting programs may enhance the bird's immune system by producing light/dark periods. There have been reports that melatonin, a hormone produced by the pineal gland and associated with the bird's 'biological clock', may also affect the immune system. Animals produce melatonin only during dark periods and broilers on light restriction programs have been shown to have higher levels of this hormone than broilers raised under continuous light conditions (Davis and Siopes, 1996).

Broiler Feed Types, forms and Water Consumption

Researches have undertaken since the 1930s on ways of enhancing feed efficiency, such that growth rate may be improved to boost broiler meat yield. Trials have been done using pelleted and mash feed to find out the most efficient form of feed that yields high growth rate and reduced production cost (Mutetwa, 2001).

Mash feed is obtained by grinding feed ingredients using a hammer mill into very fine particles. Whereas pelleted feed is that form of feed that has been grounded and then compressed into pellets (McDonald *et al.*, 1995). Research shows that pelleted feed improves feed efficiency but it is not clear whether there is a significant impact on profitability (McDonald, 1987).

Munt *et al.* (1995) compared growth rate, carcass composition and profitability of meat chickens given pellets, mash or free choice diet. In their comparison, they find that the total feed consumption is higher for pellets followed by mash and free choice. Mortality is greater for pellets followed by mash and there is no mortality among birds given free choice feed. At the end of the trial, the live weights of the birds are significantly different and pellets result in highest body weight followed by mash and free choice. Here there are no significant differences in gain to feed ratios or in dressing percentage of live body weight. They further note non-significant differences among the treatments in the fat content of plucked empty bodies.

Water, in addition to being a vital nutrient, is involved in many aspects of poultry metabolism including body temperature control, digestion and absorption of food, transport of nutrients, and the elimination of waste products, via urine, from the body (Jafari *et al*., 2006). Shanwany (1988) indicated that as stocking density increases, feed intake decreases, because physical access to feed and water is impeded. However, in this study, increasing stocking densities did not decrease feed conversion. In this experiment, the maximum distance from a feeder was less than 1.5 m. When some birds may have to travel farther to access a feeder, or if feeder space is limiting, feed conversion may be negatively affected by increased stocking density. Monitoring daily water consumption is a reliable measure of broiler performance and is much less expensive than bird or feed bin scales. A critical fact that producers may not be aware of is that feed and water consumption are very closely related. Lott *et al.* (2003) estimate the correlation between feed and water consumption at 0.98.

A bird can survive several weeks without food, but only a few short days without water. Broilers drink a great deal of water. During its lifetime, a 2.3 kg broiler will consume about 8.2 kg of water, compared to just 4.6 kg of feed. Studies show that the daily water consumption of a broiler can be approximated by multiplying the age of the bird in days by 5.9 ml of water (Pesti and Fletcher, 1984). For example, a ten-day old bird will drink about 59 ml of water during a 24-hour period. In another study, it was shown that a broiler could drink 2ml of water for each 1gm of feed (Lacy, 2002).

Standard nutrient requirement of broiler chicken

A sound nutrition program is essential for a successful poultry operation. From an economic standpoint, feeding accounts for highest percent of the cost of production. To maximize production at the least cost, producers should pay close attention to the nutritional requirements of the species. The word nutrient refers to a broad category of organic and inorganic compounds found in food that are essential for maximum growth, egg production and feed efficiency. Feed efficiency refers to the amount of food, in kg, required to produce a kg of body weight, or in the case of egg production, kg of feed required to produce a dozen eggs. Nutrients essential for building and maintaining a successful poultry flock includes water, carbohydrates, fat, protein, vitamins, and minerals. The wider understanding of the function of individual nutrients and variations in nutrient requirements among classes of poultry feed staffs have been useful for small flock producers, hobbyists, and commercial producers (Leeson *et al.*, 1997).

Satisfying the nutritional requirements of a particular class of livestock is rapidly becoming a difficult task. This is due to scarcity and high cost of feed and feed ingredients. Meeting the protein needs of broilers represents a very substantial part of the cost of feeding (Oyedeji & Atteh, 2003). Although NRC (1984) recommended a feeding standard for broilers among other classes of livestock under temperate climatic conditions, this has not been totally practicable in the tropics for the obvious reasons of environmental differences and type and quality of available feed ingredients. Efforts have been made to determine feeding standards for broilers under tropical environments (Aduku, 1992 and Olomu, 1995). However, due to

high cost and scarcity of feed and feed ingredients poultry farmers still occasionally and haphazardly mix one or two ingredients together without due consideration for age and nutrient requirements of the class of birds involved. In addition to the above reasons, most of the farmers operated in the rural and sub-urban areas with bad and inadequate access roads and transportation. Thus, it is difficult to reach areas where complete feed can easily be found on time; hence the practice of on-farm feed production.

Nutrient requirements of broilers should be 3,200 kcal per kilogram of metabolic energy and as percentages of crude protein, crude fiber, Ca and Phosphorus, for starter and finisher diet were 23, 5, 1, 0.45% and 20, 5, 0.9 and 0.4 respectively (Jeffre, 1984).

Alternative feeding trial of broilers in intensive production system

The high level of competition between man and livestock for available feed ingredients has posed a great concern to nutritionists over the years particularly in developing countries (Ravindran and Blair, 1993; Fasuyi, 2005). This is a major obstacle to the expansion of the poultry industry in most developing countries in the world (Ademosun, 1973; Tewe, 1988).

Nutritional trials conducted on intensively managed chicken focused; among other things; on measuring the advantages of increasing levels of locally available feed resources in different feed resource in different region of the country in relation to poultry feed rations for comparative evaluation of different feed resources and evaluation of different feed supplements in improving the product quality (Alemu and Tadelle, 1997). However, very little research work has been done on broiler chicken (EARO, 2000). In trials to evaluate inclusion rates of locally available feed resources in broiler feeds, the following results were reported. Rations based on local feed ingredients and agro-industrial by-products were developed, tested and recommended.

- Inclusion of 6% sun dried bovine blood in broiler diets has been found to result in very good performance of broilers (Alemu and Tadelle, 1997).

- In an experiment conducted to evaluate the value of dried poultry excreta (DPE) in broiler rations, it has found that it can be included up to 10% without significant effects on growth and feed efficiency (Maaza, 1984).
- Noug seed cake (NSC) can be included up to 21% in starter diets and up to 35% in finisher diets by replacing cotton seed cake (Alemu and Tadelle, 1998).
- Cotton seed cake (CSC) can be included up to 28% in starter diets and up to 35% in finisher diets. In finisher phase birds displayed have better gain in body weight displayed in Table 4 (Alemu and Tadelle, 1997).
- Pellets have been shown to improve feed conversion by up to five points, possibly due to an increased palatability, reduced ingredient segregation and decreased energy used during feed consumption (Briggs *et al.*, 1999).
- The increased body weight of the groups of birds on MSBDG (Maize-Sorghum brewers' dried grains) at 10 and 20% agreed with the reports of Ademosun (1973) that the crude protein content and amino acid profile of MSBDG may have an added nutritional advantage when MSBDG is incorporated in starter poultry diets. MSBDG may also serve as an alternative source of protein in poultry diets.

Supplementary poultry feed resources also available in Ethiopia includes energy, protein, mineral sources and premixes. The most importance energy sources are wheat bran, maize and brewery grains. Meat, bone and blood meals constitute the animal's protein sources. While oilseed cakes are source of plant proteins. Mineral supplements are derived mainly from bone meal, limestone and salt (Alemu and Guenther, 1992).

Table 4: On farm evaluation of CSC in broiler starter and finisher rations.

Performance of broiler starter (0-28) fed either diets containing CSC or commercial ration			
Parameters	With CSC	Commercial ration	Significance
Mean feed intake (g/bird/day)	94	50	**
Initial body weight (g/bird)	40	37	NS
Final body weight (g/bird)	775	610	*
Gain/bird (g)	735	573	*
Daily gain (g/bird/day)	26.3	20.4	*
Feed conversion ratio (feed: gain)	3.6	2.5	*
Performance of broiler finisher (29-56) fed either diets containing CSC or commercial ration			
Parameters	With CSC	Commercial ration	Significance
Mean feed intake (g/bird/day)	200	143	**
Initial body weight (g/bird)	775	610	Na
Final body weight (g/bird)	2376	1870	*
Gain/bird (g)	1601	1260	*
Daily gain (g/bird/day)	57	45	*
Feed conversion ratio (feed: gain)	3.4	3.1	Na
Cumulative gain (0-56 days)	2336	1833	--

Source: (Alemu and Tadelle, 1997)

2.4. Carcass characteristics of broilers

The primary goal of broiler breeding is to improve profitability of broiler meat production. Until recently most birds were sold whole, but there has been a dramatic increase in the proportion of birds being grown for portioning and further processing (Ewart, 1993). Therefore, the success of poultry meat production has been strongly related to improvements in growth and carcass yield, mainly by increasing breast proportion and reducing abdominal fat (Griffin, 1996).

2.4.1. Comparative carcass yield of broiler chickens

Retrospective research studies on some of the indigenous birds from the tropics have shown that their potential for egg and meat production is low. These results are very low when compared with the improved egg and meat breeds, which produce + 250 eggs and +2kg body weight in 6 weeks with an average egg weight of 60g (Table 5).

Ethiopia is representative of countries where village poultry plays a prominent role in total poultry production. More than 98 % of total meat and egg production comes from village poultry (Dessie, 1996 cited in Udo *et al*., 2001). There are different constraints in village chicken production system. These include poor growth rates, diseases, predation and lack of organized markets. This system is constrained by a number of factors. The most important are mortality and low performance. According to Tadelle and Ogle (2000), the major reasons for the low poultry productivity are low standard management and low performance of the indigenous chicken. The majority of the hatched chicks die mainly due to disease. In addition, chickens in the village system have low performance level (Table 5).

Table 5: Some comparative production performances of the scavenging and commercial chickens

Parameter	**Scavenging village chicken**	**Commercial chickens**
Age at mature weight (weeks)	>24	<8 for broilers <20 for layers
Egg production (eggs/hen/year)	40-60	>250
Egg weight (g)	30-49	>60
Mature weight (kg)	1-1.7	>2
Mortality rate (%)	Chicks >60 Adults 45-100	<20

Source: (Kitalyi, 1997)

As generally known, broiler meat quality is a very complex issue that can be looked at from several aspects. In terms of the meat processing industry and consumers' interests, fattened chicks should be characterized by good dressing percentage, desired conformation, as much meat on the carcass as possible, optimal distribution of fat tissues, appropriate skin colour and least damage possible occurring during fattening, loading and unloading. With respect to that, the proportions of major basic carcass parts (breast, drumstick and thigh) as well as the presence of certain tissues in them are regarded as vital parameters determining broiler meat quality (Holcman *et al.*, 2003 and Ristic, 2003). The above-mentioned quality traits depend on a number of factors. Of the biological ones, the greatest impact is produced by genotype, sex and age (Bokkers and Koene, 2003 and Hellmeister *et al.*, 2003).

Based upon the data from Table 6 it could be concluded that the male chicks had heavier carcass compared to the female ones. The differences exhibited in terms of the sex influence were statistically highly significant. Horn *et al.* (1998) stressed that the coefficient of live weight variation increased more in male chicks in the second part of the rearing period, compared to the females with the less pronounced increase. The reason for this is that female birds tend to deposit proportionally more fat in the carcass. Body fat takes 9 times more feed energy to produce as does muscle. The reasons for this is that fat contains more energy than does protein per unit of weight, and more importantly, muscle is only about 20% protein by weight, the remainder being water. For this reason it is usually uneconomical to grow female broilers much beyond 45days unless special emphasis is placed on reducing fat deposition. Likewise with heavy male birds, feed efficiency is going to be greatly influenced by the growth of fat vs muscle (Ministry of Agriculture Food and Rural Affairs, 2008).

Table 6: Effect of sex and rearing systems on the proportions of major basic carcass parts and abdominal fat (%) in broiler chickens

Trial group	Sex	*X* = mean, Cv	Carcass (g)	Breasts (%)	Drumsticks (%)	Thighs (%)	Abdominal fat (%)
Free range	Male	X	2690	30.4	14.3	16.1	1.774
		Cv	5.62	5.06	7.47	6.21	28.2
	Female	X	2295	31.7	13.4	16.0	2.02
		Cv	2.57	4.98	5.00	3.37	44.5
Extensive indoor	Male	X	2523	29.8	14.5	16.4	1.71
		Cv	13.8	3.58	3.79	6.71	24.6
	Female	X	2279	31.1	13.7	15.9	2.24
		Cv	3.81	5.97	4.08	4.40	27.2

Source: (Horn *et al.*, 1998)

2.5. Factor affecting broiler production

2.5.1. House Management Factors

Confinement buildings are one of the most likely sources of odor in a broiler operation. The buildings must be ventilated, either mechanically with fans or relying on natural airflow, to prevent animal mortality and enhance animal health. Consequently, odors generated within the building are carried to the surrounding environment by the ventilation system (Elwinger, K., and L., Svensson, 1996)

Production of broiler chickens in the US is primarily done within enclosed structures in which the floor is covered in an absorbent material (i.e., litter). Conditions within these confinement buildings are managed to optimize bird health and productivity. Factors that affect the interior conditions include seasonal climate and weather conditions; building ventilation, heating and cooling; and factors that affect the litter (e.g., feed spillage, flock husbandry, and litter management). These factors are interrelated in establishing the composition of the interior air in the building. Because commercial broiler production is totally confined, the air in the building contains all of the materials emitted to the atmosphere; some of which are potential pollutants (e.g., ammonia, dust, and odorants).

Those factors related to poultry house and flock management include dietary manipulation, adequate bedding, exhaust air cleaning, and use of ventilation systems to dry litter (Reece *et al.*, 1985).

In poultry high concentrations of ammonia in the house reduce growth rate and feed efficiency, decrease egg production, damage the respiratory tract, and increase susceptibility to Newcastle disease, incidence of airsacculitis, levels of *Mycoplasma gallisepticum,* and incidence of keratoconjunctivitis (Nahm, *et al*., 2005). Carlile (1984) suggested that 25 ppm of ammonia should not be exceeded in a poultry house.

2.5.2. Feed Management Factors

Feed efficiency of broilers is affected by bird age, sex, health and environmental temperature, although the major factor is usually diet energy concentration (Table 7).

Proportions of major carcass tissues and distribution of these tissues throughout the carcass is important to carcass value. Manipulation of these traits depends on the combined genetic and nutrition. Abdominal and subcutaneous fat deposition in chickens selected for rapid growth is associated with changing concentrations of hormones and neural control mechanisms (hunger-satiety control mechanisms) that regulate feed intake. Therefore, most modern meat type chickens eat more than they require for muscle growth and maintenance (Smith and Pesti, 1998). This excessive energy intake leads to increasing fat deposition in the body. Fat tended to accumulate differentially in different carcass parts and the patterns of accumulation varies with species. In chickens fat accumulates in great quantity in thigh followed by breast. The large differences between genetic and phenotypic correlations for carcass traits may entail a relatively large influence of environmental conditions for these traits.

Table 7: High nutrient density diets (high energy + protein) increase breast meat but also abdominal fat (effect of energy: protein ratio)

Eviscerated Carcass %		**Nutrient density**	
		Low 11.7 MJ/kg	High 13.3 MJ/kg
		18.8 %CP	19.9 % CP
Breast Meat	Male	20.8	22.5
	Female	21.7	22.4
abdominal fat	Male	2.7	3.2
	Female	4.1	4.6

Source: **(**Groom, 1990).

Carcass composition in broilers can be manipulated through genetic and nutritional routes. Increasing protein: energy ratio resulted in increasing carcass leanness and decreasing body fatness with the opposite effect was elicited by a low protein: energy ratio (Leenstra, 1986; Bartov and Plavnik, 1998). Also, carcass leanness can be achieved by feeding animals and birds' low energy, low-cost high fibrous diets and by restricted feeding (Leeson *et al*., 1996 and Khantaprab *et al*., 1997).

2.5.3. Feed availability, quality and cost

Availability, quality and cost of feed are major constraints to increased poultry production in Ethiopia. The future of commercial poultry production in Ethiopia is limited unless ways of utilising alternative feed resources are investigated and evaluated under the different production systems and agro-ecological zones. To that end laboratory and animal evaluation of locally available feed resource aimed at developing least cost regional poultry rations and supplementation scheme is appealing and plausible (EARO, 2000).

The intermittent droughts characterizing most tropical countries pose challenges for the poultry industry given that feeds are mostly derived from crops such as maize, sorghum and other grain crops. As a consequence, feed ingredients need to be acquired from distant supply areas and this has resulted in problem of high cost of feed. (Nyoupayou, 1990)

argued that the high cost of feeds is an important problem affecting smallholder broiler production in Africa because of inadequate financial resources.

In commercial systems the profit from poultry production can be attained by minimizing feed cost which accounts for more than half of the total cost of production. According to Wilson and Beyer (2000) feed cost accounts 60-70% of the poultry production. Any attempt to improve commercial poultry production and increase its efficiency therefore, needs to focus on better utilization of available feed resources (DZARC, 1997). Availability, quality and cost of feed ingredients are the major constraints to poultry production regardless of the system of production and geographical location. Ethiopia is not self-sufficient in cereal grains which form the bulk of the concentrate feeds for poultry (Solomon, 1996).

Thus, exploring of alternative feed resources and knowledge of the nutritional characteristics of these feeds and its optimal level of inclusion is a corner stone of successful poultry production. Of the oil meals produced in Ethiopia, RSM is the third or fourth, both in terms of area coverage and production (Negussie, 1990). It is also the cheap in cost and contains up to 40% crude protein and could potentially be a good source of protein for both ruminants and non-ruminants (Fenwick and Curtis, 1980).

2.5.4. Prevalence of major diseases and Mortality rate

In livestock health and production economics, disease in the herd or flock has been referred to as a negative input. It reduces productivity by reducing the efficiency into which inputs are converted into useful products and necessitate use of additional inputs not required under normal condition, thus raising the cost of production (Thrusfied, 1995). Disease causes losses in the form of mortality, stunting, reduced productivity, and reduced market value. It also causes indirect losses in the form of drug, vaccine and other veterinary costs incurred for disease treatments and control (Rushton *et al.*, 1999).

Some of the major killer diseases such as NCD, coccidiosis, salmonellosis, respiratory infections, and various other wide spread contagious and parasitic diseases limit poultry

production in Ethiopia. Fast and easy dissemination of diseases make poultry production a risky business. This, in turn, limits investment and improvement measures. The importance of chicken diseases in rural Ethiopia is obvious from the desperate attempt of farmers to sell their stock at the beginning of the rainy season at a considerably low price and purchase new ones at the end of the rainy season. However, carrying out extensive vaccination programs could control many of the major chicken diseases like New Castle disease by significantly reducing mortality in poultry farms. Therefore, the technology encourages producers to use genetically upgraded birds and better quality feeds and housing (EARO, 2000).

2.5.5. Lack of farmers training

The development of innovative ideas for improving poultry production requires a complete understanding of the system by its operators. Furthermore, research directions and strategies should be geared to address farmer's real problems and constraints. As Roling (1988), indicated the development and transfer appropriate technologies should be a function farmers socio economic management practices at the field level. Hence, an important element in the sustainable development of a community is the active involvement of community members in any development activity, which should start with their participation in identifying their problems and constraints, and deciding on the best alternatives and most appropriate strategy to meet such needs.

2.5.6. Climatic condition

Although cold weather and cool brooding temperatures increase feed intake and body weight gain, they are also known to be one of the factors that increase the susceptibility of broilers to ascites. Broilers brooded at low temperatures caused increased mortality, primarily due to an increased incidence of ascites, has also been noted. In addition to increased feed intake, low temperatures also cause an increased metabolic requirement for oxygen (Wideman and Tackett, 2000). The increased need by broilers for oxygen at low temperatures, coupled with the requirement to metabolize increased quantities of feed consumed to maintain body temperature, set up an ideal situation for ascites to become a problem (Deaton et al., 1996).

2.5.7. Poor marketing channel

Scarborough and Kydd (1992) suggest that relationships exist between structural characteristics of a market and competitive behavior of market participants and that their behavior in turn influences the performance of the market. Among the major structural characteristics of a market is the degree of concentration, i.e., the number of market participants and their size distribution; and the relative ease or difficulty of an entry into the market. Generally, there are several factors, which could influence the pricing behavior of different market participants at given marketing levels or locations. Kinnucan and Forker (1987); Ward (1982) noted that market participant's access to and assimilation of market information, structural differences and diversity at each marketing level and location and the nature of the product influence the pricing behavior of market participants.

In Ethiopia, information concerning the chicken marketing system, constraints and factors that hinder chicken marketing efficiency is lacking. One means of investigating the efficiency of the chicken marketing system is through studying and identifying suppliers and individual consumer characteristics and chicken attributes that determine the market value of chicken. The relation between market value of a product and its characteristics can be useful to identify factors that hinder marketing efficiency. Such study can also help to understand the complexities of price discovery mechanisms between market agents. This is particularly important where there is no regular market information on prices, supplies, grades and standards is not available and consequently price is fixed by a long one to one bargaining between sellers and buyers (EARO, 1999).

Therefore, Identification and market evaluation of live chicken attributes also have important implications for long term investment decisions of producers, purchasing decisions of traders and consumers and government policy formulation to promote production and marketing (Akunzule, 2005). In Ethiopia the market dependent population, i. e., the population that depends on the market for all or part of its food supply, was estimated to be about 42% of the total population (Alemayehu, 1993). Almost all urban consumers have been dependent on the functioning of agricultural markets to acquire their food. It is

clear that an inefficient marketing system entailing substantial costs to consumers will have detrimental effect on the food security and well being of the poor.

3. MATERIALS AND METHODS

3.1 Description of the study Area

The study was conducted in and around Debre Zeit town (Figure, 1). The town of Debre Zeit is located at 9^0N and 40^0E latitude and 47 km away south East of Addis Ababa with a human population of about 95,000. It has an altitude ranging from 1500-2250 m.a.s.l. (NMSA, 2003). The study was conducted from November 2007 to June 2008.

Debre Zeit experiences bimodal pattern of rainfall with the main rainy season extending from June to September (of which 84% of rain is expected) and a short rainy season from March to May with an average annual rainfall of 800mm. The mean annual minimum and maximum temperatures are 12.3^{o}C and 27.7^{o}C, respectively, with an overall average of 18.7ºC (NMSA, 2003). The average relative humidity is 58.6 percent (DZARC, 2002). Highest temperatures are reached in May and the mean relative humidity is 61.3%. Debre Zeit is the center of Ada'a district " *Woreda* " and the district has a total land area of about 1610.56 Km^2 and is divided in to three agro-ecological zones namely mid land (94%) high land (3%) and low land (3%) (Government of Oromia Region, 2006).

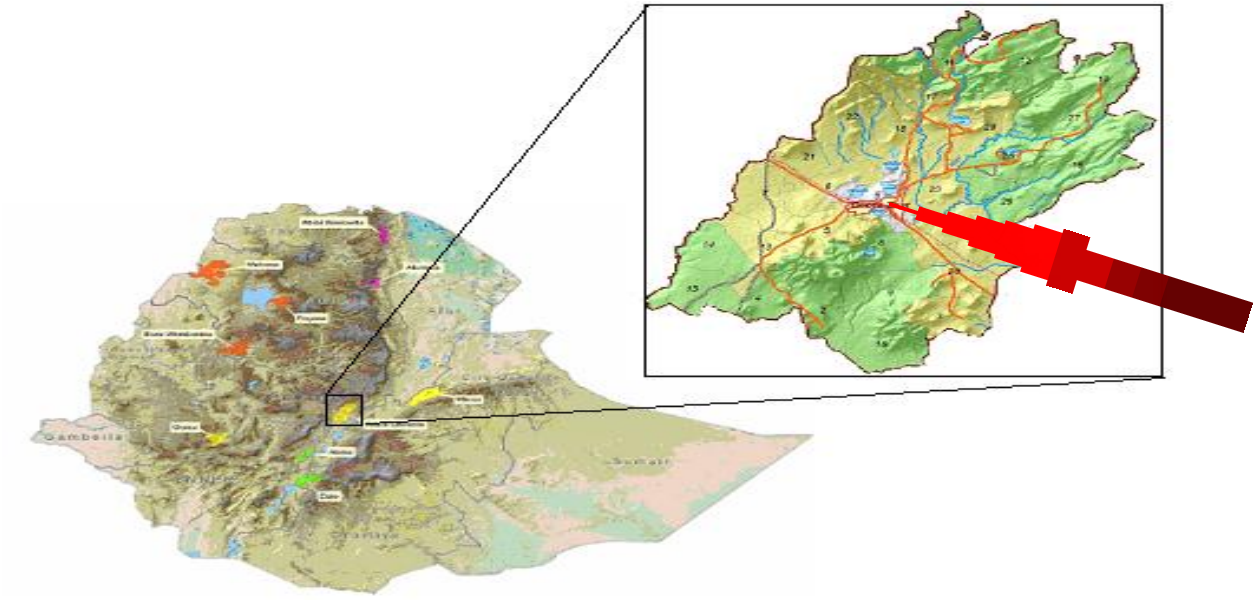

Figure 1: Geographical location of Debre Zeit town showing the study site
Source: (ILRI, 2005)

3.2. Study population

Smallholder semi-intensive commercial poultry farms in and around Debre Zeit constituted the study population. Semi-intensive farming was characterized by use of exotic chicken breeds of cobb-500 strain with parental stock that were imported two years ago from Holland, provision of some sort of housing and feed for chicken.

3.3. Sample size determination and sampling method

Prior to commencement of the study, list of all semi-intensive broiler farms in and around Debre Zeit was obtained from the hatchery unit of *Alema* farm and from the Agricultural Office of Bishoftu Town Administration. From this list farmers who keep 50-700 exotic broiler chickens were considered for this study.

The sample size for the present study was determined by using the following formula as recommended by (Arsham, 2005)

$$N = 0.25/SE^2$$

Where N: Sample size and SE: Standard error assumed

With the assumption of 5% SE or 95% confident level and 10% of confident interval, a total of 96 smallholder semi-intensive broiler farms need to be sampled. However, as the number of broiler farmers in the area was only 65 (less than the computed sample size) all of them were considered for the description of the general husbandry practices of broiler chicken farming (cross sectional study).

3.4. Research designs

3.4.1. Cross-sectional study using Questionnaire survey

Before designing the questionnaire, the study areas were repeatedly visited towards the beginning of November 2007. The questionnaires were semi-structured type. The questionnaires that were pre-tested and adjusted were focused on socio-economic and farming system characteristics, poultry flock characteristics, housing, feed resources and feeding practices, poultry products and marketing, poultry health management, availability of support services to poultry production and constraints. One enumerator and the researcher himself administered the questionnaire. Prior to the administration of the questionnaire thorough explanations were made to the interviewees about the purpose of the interview and the way how it should be handled.

3.4.2. Longitudinal study (Farm visit and follow up study)

Broiler farms that used all-in all-out production system and just started with day-old chicken at the start of the research were considered for this part of the study. Accordingly 17 semi intensive farms were purposively selected from those included in cross sectional study on the ground that they meet the criteria described above of which 6 farms were used on farm produced feed. Then a follow-up sheet developed (Appendix, 1, 2, 3) and the following data on production performance were collected on weekly bases until the end of production cycles. The over all duration of this study was about 4.5 months.

Feedstuffs and feeding strategy (per phase)

Respective samples of commercial and on farm produced feed ingredients that were made ready to be given to broilers per phase were taken with plastic bags**.** Random sampling was used from each grower starters and finisher rations with 500 g per samples and analyzed per phase.

The chemical composition of feeds was analyzed following proximate Weende method. Thus, crude fiber (CF), total ash (TA) and ether extract (EE) contents was determined according to (A.O.A.C., 1990). Nitrogen (N) content of the feed was determined by Kjeldahl procedure and crude protein (CP) was estimated by multiplying N x 6.25. Dry matter content of the feeds was estimated by drying the feed overnight at 105 degree Celsius. Calcium and phosphorous were determined by atomic absorption spectrometer at National Veterinary Institute (NVI), Debre Zeit. The metabolizabe energy values (ME) were calculated indirectly from the EE, CF and ash adopting the equation proposed by (Wiseman, 1987) as follow.

$$ME\ (kcal/\ kg\ DM) = 3951 + 54.4\ EE - 88.7\ CF - 40.80\ Ash$$

Body weight measurement

Live weight of broilers was taken on weekly basis in each farm every morning by using electronic portable balance with 40 kilogram capacity. Starting from day-old, approximately 5% of the flock size in each farm was randomly picked and weighed for live weight estimation. From the age of five weeks onwards equal numbers of male and female broilers samples were weighed. Finishing weight was taken at the day of slaughtering.

Age at slaughtering in days

Ages at slaughtering in days were taken for a particular farm production period per cycle as one parameter of production performance for the birds.

Health and Mortality status

Health and mortality status of the flock were monitored on weekly basis. Broilers were visually inspected. Moreover information from farm records and attendants were gathered for health and mortality statuses between visits. The over all mortality rates were determined at the end of the production cycle.

3.5. Carcass weight and dressing percentage determinations.

A total of 732 broilers with a minimum of 40 finished broilers (20 male and 20 female) per farm were randomly taken for carcass weight measurements. Slaughtering was done by cervical dislocation followed by cutting the head. Manual de-feathering was done after scalding in hot water. This was followed by evisceration. The respective dressed carcass of birds was packed in plastic and weighed after complete bleeding, removal of feather, head, shank, lungs, and all the visceral contents.

Then dressing percentage was determined as the proportion of the hot carcass weight to slaughter weight multiplied by 100 (Kubena *et al.*, 1974).

3.6. Statistical Analysis

Collected data and results of both the Cross-sectional and follow-up study were entered in to Microsoft® Excel sheet (Microsoft Corporation, 2003) and the statistical analysis was made by employing Statistical Package for Social Sciences software (SPSS; release 14, 2005).

Descriptive statistics was used to summarize most of the data generated from both cross sectional and longitudinal studies and Analysis of Variance and T-test were used to compare the effect of feeds and sex on performance of broiler chicks.

4. RESULTS

4.1. Household Demographic characteristics

As age profile of the household showed nearly half of the household heads (47.7%) were within the age range of 31-40 years. Female headed households were relatively higher in proportion (58.5%) than male headed ones (Table 8). The mean age and family size per household were 32.36 ±6.36 and 4.2 ±1.58 respectively (Table 9). Almost all household heads can read with education status ranging from primary to tertiary. As indicated in Table 8 smallholder broiler producers are also engaged in other income generating activities and broilers were kept in conjunction with other farm animals. The trend of broiler flock size was reported to be increasing for most (61.5%) farms surveyed.

Table 8: Demographic characteristics of the households engaged in broiler production (65 smallholders, 2007/2008)

Category of variable	Category	Frequency	Percentage
Age	21-30	24	36.9
	31-40	31	47.7
	>40	10	15.4
Gender Ratio of household headed	Female	38	58.5
	Male	27	41.5
Education level	Primary	12	18.5
	Secondary	47	72.3
	Tertiary and above	6	9.2
Other livestock kept	Dairy cows	5	7.69
	Sheep	9	13.8
	Pigs	1	1.5
	Layers	6	9.2
Occupation	Farmer	38	58.5
	Civil servant	14	21.5
	Retired civil servant	10	15.4
	Ex-soldier	3	4.6
Trend of flock size per cycle	Increasing	40	61.5
	Stable	15	23.1
	Decreasing	10	15.4

4.2. General husbandry practices

4.2.1. Importance of broiler production

All the surveyed households indicated that they reared broiler chicken for sale as a source of income. The income generated from this activity was said used for chicken stock replacement, household expense and as support for crop inputs purchase. The average flock size of broilers was 386.87 birds per farm (Table 9). The number of production cycles or batches produced per year varied from 2 to 5 in different farms. Nearly half of the farms (46.2%) had 3 production cycles per year (Table 10).

Table 9: Average family and flock size per household in the study area

Variables	Mean	SD	95%CI
Family size of the household	4.20	1.58	3.81-4.59
age of the household	31.36	6.36	29.8-32.9
Flock size of broilers	386.87	177.63	335.29-438.45
Flock density	10.21/m^2	2.18	9.58-10.84

Table 10: Purpose of rearing broiler chickens (65 smallholders, 2007/2008)

Variables	Categorical variables	Frequency	Percentage
Categories of expenses	chicken stock replacement	44	67.7
	Household & maintenance costs	18	27.7
	For support of crop agriculture	3	4.6
Production Cycles/year	2 – Times	4	6.2
	3 – Times	30	46.2
	4 – Times	24	36.9
	5 – Times	7	10.8

4.2.2. Housing practices

Most farms (93.8%) used a separate well constructed house for their broiler chicken while the rest (6.2%) used a some what temporary simple house (Table 11). The materials used for construction were brick, mud, corrugated sheet, carton and wood. All house used corrugated iron sheets with 89.2% flatted roof type and 10.8% has ridged roof (Appendix 9, 10). The walls were open at the top in one side in 93.8% and in two sides in 6.2% of the farms. The openings were covered with wire meshes. Teff straw was used for the deep litter purpose in all farms (Appendix 12). In general, an average stocking density of 10.2±2.2 birds per meter square was observed (Table 9).

Table 11: House management practice of broilers chicken in the area (65 smallholders, 2007/2008)

Variables	Category	Frequency	Percentage
Types of house	Simple shelter	4	6.2
	Separated house	61	93.8
Types of construction materials	Only brick	12	18.5
	Brick and muddy	16	24.6
	Totally muddy	33	50.8
	Corrugated sheet, carton and wood	4	6.2
Type of roofing	Flatted roof	58	89.2
	Ridged roof	7	10.8
Number of opening	One sided	61	93.8
	Two sided	4	6.2
Floor management	Deep litter with concrete	28	43.1
	Deep litter with soiled	37	56.9

4.2.3. Feeding practices

As indicated in table 12 the majority of smallholders (86.2%) were using purchased feeds from the local commercial milling company while 3.1% used both commercial and on farm produced feeds. Nearly 11% of the farms totally rely on farm produced feeds. Feed was

provided *ad libitum* in 52.3% of the farms and distributed thrice per day in the rest (47.7%). Seventy two percent of the farms were given vitamins and antibiotics premix as a supplement and few farms were no supplemented at all (Table 12).

Table 12: Feeding systems and feed supplementations used for broiler chicks in and around Debre Zeit town (65 smallholders, 2007/2008)

Variables	Category	Frequency	Percentage
Feeding systems	Commercial feed based	56	86.2
	On farm feed based	7	10.8
	Commercial grower and on farm finisher	2	3.1
Feeding and watering	Thrice per day	31	47.7
	ad libitum	34	52.3
Supplemented items	Vitamins	10	15.4
	Vitamins and antibiotics	47	72.3
	No supplementation	8	12.3

4.3.2. Feed chemical Analysis of broiler ration and feeding strategy

In all farms birds were fed a starter mash from 1 - 28 days of age and finisher mash from 29 on wards until the end of production period. The results of chemical analysis of feed samples were presented in Table 13. Commercial feed base (CFB) had relatively higher nutrient contents than on farm produced feed base (OFFB) regarding CP and ME.

Table 13: Chemical composition of feed stuff in CFB and OFFB systems

Feeding system	Type of ration	DM%	MM%	CF%	CP%	EE%	NFE	Ca%	P%	ME (KCal/Kg)
Starter ration	CFB	93.16	7.19	5.33	19.71	8.42	59.30	1.14	0.42	3643.64
	OFFB	93.18	7.25	7.32	15.67	4.95	64.75	1.13	0.46	3275.84
Finisher ration	CFB	93.74	6.53	7.11	19.69	10.6	58.75	1.18	0.46	3629.03
	OFFB	93.82	10.15	6.28	22.65	6.91	53.95	1.49	0.35	3356.66

►CFB = commercial feed based, OFFB = on farm feed based feed samples; DM=Dry Matter, MM=Mineral Matter, CF=Crude Fiber, Crude Protein, EE=Ether Extract, NFE= Nitrogen Free Extract, Ca=Calcium=phosphorus, ME=Metabolic energy.

4.2.3. Health management practices

Table 14 illustrates summary of broilers health related activities. All farms were vaccinating their chicken against Newcastle disease. Some 20% of the farms also use antibiotics as prophylactic measure.

While the other used both vaccine and medicine according to the occurrence of particular symptom observed. Currently disease outbreak was not happened in all broiler farms in the area. The results in Table 14 also highlight the fact that the broiler houses were thoroughly cleaned and disinfected after each cycle/batch mostly with water and Sodium hypochlorite, disinfectant chemicals and with all types of options used respectively. Regarding the manure management, one third of the farms used as part of animal feeds while the others used as fertilizers, sold as source of income and buried or burned (Table, 14).

According to the respondents in Table 14, the highest and lowest mortality recorded were at the starter and grower stages of birds. Most of the respondents used isolation (39, 60%) as the major preventive measure taken for bird's health (Figure, 2).

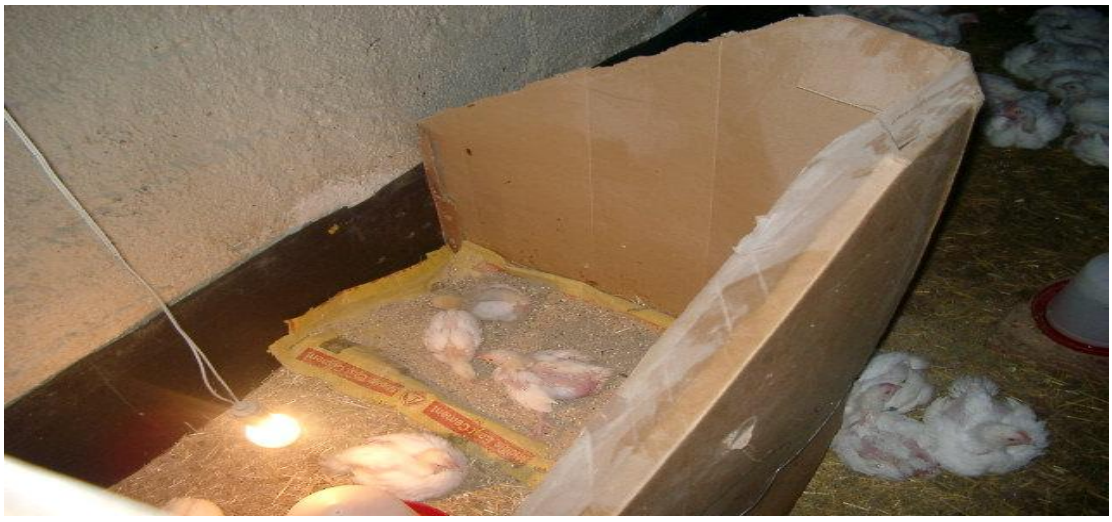

Figure 2: Isolation practices used for weak and abnormal birds in the study area.

Table 14: Health management practices of broiler farms (65 smallholders, 2007/2008)

	Category	Frequency	Percentage
Types of medicament used	Vaccination only	52	80.0
	Vaccine and other medicine	13	20.0
Types of disinfectant	*Sodium hypochlorite* only	26	40.0
	Sodium hypochlorite and local materials	16	24.6
	Disinfectant chemicals	20	30.8
	All types used	3	4.6
Highest mortality Age	Starter stage(1-3wks)	24	36.9
	Grower stage(4-6wks)	12	18.5
	Finisher stage(>6wks)	15	23.1
	Starter and finisher stage	14	21.5
Preventions methods	Isolation and follow up	39	60.0
	Immediate slaughter if older	18	27.7
	Isolation and Treatment	8	12.3
cleaning time interval	Daily	10	15.4
	Weekly	25	38.5
	Monthly	8	12.3
	Once per production cycle	22	33.8
Possible source of infection	House management condition	42	64.6
	Environment	6	9.2
	Not clearly understood	17	26.2
Use of broiler manure	Part of animal feed	23	35.4
	Fertilizer	15	23.1
	Sold	15	23.1
	Buried(burn)	12	18.5

4.2.7. Labor and marketing practices

Table 15 shows distribution of responsibilities of broiler production and the marketing practices. Nearly 42% of smallholder broiler farms use hired labor. In most of the farms (63%) females were the ones doing the work. Large majority of the farms (83%) sell their finished product to middle men and the product marketed in most cases (84.6%) was dressed carcass.

Table 15: Labor and marketing activities in smallholder farms (65 smallholders, 2007/2008)

Variables	Category	Frequency	Percentage
Labor source	Family labor	38	58.5
	Hired labor	27	41.5
Gender ratio	Male	24	36.9
	Female	41	63.1
Marketing system	Through middle men	54	83.1
	Local market & Middle men	11	16.9
Form of market product	Dressed carcass	55	84.6
	Live and dressed carcass	10	15.4
Factors affecting selling price	Holidays	5	7.7
	Weight	52	80.0
	Breed & color	8	12.3

The selling price was highly affected by broilers' weight. However, breeds, color and holidays have also effect on selling price.

4.2.8. Constraints of broiler production

Table 16 shows the different constraints of broiler production as ranked by smallholder producers. Space for expansion of their farms was indicated as the most limiting factor followed by financial constraint. Labor was not considered as a limiting factor in smallholder production.

Table 16: Constraints of broiler production as ranked by smallholder households (65 smallholders, 2007/2008)

Constraint	Rank				
	1	2	3	4	5
Shortage of space	42	19	1	1	2
Shortage of capital	29	14	12	6	4
Supply of day-old chicks	54	10	1	-	-
Feed cost	41	12	6	4	2
Labor problem	-	-	3	20	42

►Rank 1: most important and Rank 5: least important

The supply of day old chicks (83.1%) and escalating feed cost (63.1%) were also among the most important constraints reported found in the study area, mainly due to the fact that there is only one active hatchery unit and feed milling company in the town.

4.3. Production performances parameters

4.3.1. Live weight and carcass yield of broiler

Table 17 gives summary of mean values of production performances of broilers under semi-intensive commercial production system. The mean age of broilers at marketing was 56.5 days, while the mean slaughtering weight and carcass weight were 2.64 and 1.84 kg, respectively. The overall mean dressing and mortality percentages were as indicate in Table 17.

Table 17: Performances of broilers under smallholder management condition in and around Debre Zeit Town (17 farms, 2007/2008)

Parameters	Mean	SD	95% CI	
			Lower	Lower
Age at slaughtering (days)	56.53	5.99	53.45	53.45
Slaughtering weight (kg/bird)	2.64	0.17	2.62	2.62
carcass weight (kg/bird)	1.84	0.17	1.83	1.83
Dressing percentage (%)	69.9	2.71	69.69	69.69
Mortality (%)	6.73	1.78	5.81	5.81

4.3.2. Age and weight of broilers at slaughtering under different feeding systems

The performance parameters for both commercial feed based (CFB) and on farm feed based (OFFB) broiler farms under smallholder management condition is listed in Table 18. The average age of CFB broilers at marketing was found to be 53.18±1.14 days; the average slaughtering weight of males and females broilers were 2.74±0.13 and 2.49±0.12 kg respectively while the average carcass weight of males and females' broilers were 1.97±0.10 and 1.69±0.12, respectively. The average age of OFFB broilers at marketing was found to be 62.67±6.40 days; the average slaughtering weight of males and females broilers were

2.78±0.15 and 2.57±0.11 kg, respectively, while the mean carcass weight of males and female of OFFB broilers were 2±0.12 and 1.74±0.92, respectively.

There were highly significant difference (P<0.001) found for age at slaughtering in days between farms (Table 18). Commercial fed based broilers nearly attained marketing weight 10 days before than on farm fed broilers with similar performance.

There was significant difference (P< 0.001) between sexes for slaughter weight, carcass weight and dressing percentage in each of CFB and OFFB systems; where males were superior compared to females (Table 18, Figure 3).

In general, broilers in OFFB feeding system achieved higher slaughtering and carcass weights compared to CFB feeding system. There was also high significant difference (P< 0.001) for mortality rate between farms (Table 18) However; mortality was higher and long production duration for the former than the latter system.

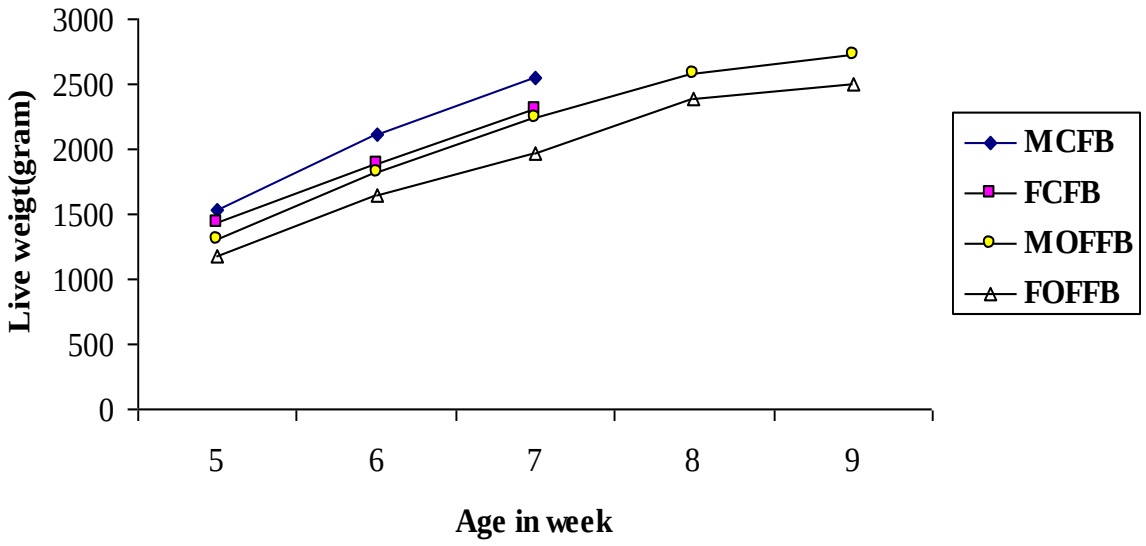

Figure 3: Growth and Sex status for broilers in CFB & OFFB systems in the study area

►MCFB = Male in CFB, FCFB = Female broilers in CFB

Table 18: Mean slaughtering day, live and carcass weight, dressing and mortality (%) of broilers in CFB and OFFB systems in and around Debre Zeit town (17 farms, 2007/2008)

Parameters	Feeding system	Sex	N	Mean	SD	P-value	95% Confidence Interval for Mean
Age at slaughtering (day)	CFB		11	53.18	1.40	0.000**	52.24-54.12
	OFFB		6	62.67	6.40		55.9- 69.4
Slaughtering weight (kg)	CFB	M	240	2.74	0.13	0.000**	2.72-2.75
	CFB	F	240	2.49	0.15		2.49-2.51
	OFFB	M	127	2.78	0.15		2.75-2.81
	OFFB	F	127	2.57	0.12		2.55-2.59
Carcass weight (kg)	CFB	M	240	1.97	0.12	0.000**	1.95-1.98
	CFB	F	240	1.69	0.12		1.68-1.70
	OFFB	M	127	2.00	0.10		1.98-2.02
	OFFB	F	127	1.74	0.12		1.72-1.75
Dressing percentage	CFB	M	240	71.87	1.39	0.000**	71.70-72.05
	CFB	F	240	67.92	1.49		67.73-68.11
	OFFB	M	127	72.07	2.31	0.000**	71.67-72.48
	OFFB	F	127	67.64	2.15		67.27-68.02
Mortality (%)	CFB		11	6.08		0.000**	4.85-7.31
	OFFB		6	7.92			7.01-8.82

►CFB = commercial feed based, OFFB = on farm feed based, CI= Confidence Interval for the Means.

Performance parameters of broilers for the two feeding systems (CFB and OFFB) at different stages of growth were presented in Table 19. Live weights of day-old broiler chicks taken in farms that use CFB and OFFB were similar. Starting from week one the CFB group attained higher growth rate than the OFFB group (Figure 4). The difference became significant at ($P<0.05$) for week 2 and 3 and highly significant at ($P<0.001$) starting from week 4 on wards.

Table 19 : Live body weight of broiler chicks at different age, sex and feeding systems during 1-7 weeks of age in the study area (16 farms, 2007/2008)

Age (Week)	Sex	Type of feeds /Systems	No. of farms	Mean Live weight (g)	SD	P-value	95% Confidence Interval for Mean
Day old		CFB	11	36.8	1.24	0.93	35.97-37.63
		OFFB	5	36.7	1.23		35.21-38.27
1		CFB	11	114.48	5.65	0.88	110.68-118.29
		OFFB	5	114.00	6.52		105.90-122.09
2		CFB	11	304.31	9.05	0.01*	298.22-310.39
		OFFB	5	287.40	14.38		269.54-305.26
3		CFB	11	605.99	19.22	0.05*	593.08-618.90
		OFFB	5	568.80	53.22		502.71-634.88
4		CFB	11	940.70	26.58	0.00**	922.84-958.56
		OFFB	5	801.60	23.79		772.05-831.15
5	M	CFB	11	1529.91	34.99	0.00**	1506.4-1553.4
		OFFB	5	1260.60	137.49		1089.9-1431.3
5	F	CFB	11	1428.36	44.03	0.00**	1398.8-1457.9
		OFFB	5	1134.60	140.98		959.5-1309.6
6	M	CFB	11	2114.82	69.18	0.00**	2068.3-2161.3
		OFF	5	1748.40	185.17		1518.5-1978.3
6	F	CFB	11	1894.18	22.20	0.00**	1879.3-1909.1
		OFFB	5	1559.80	163.30		1357.0-1762.6
7	M	CFB	11	2542.82	64.87	0.00**	2499.2-2586.4
		OFF	5	2245.40	210.31		1984.3-2506.5
7	F	CFB	11	2303.36	61.01	0.00**	2262.4-2344.3
		OFFB	5	1962.60	141.87		1786.4-2138.7

►CFB = commercial feed based, OFFB = on farm feed based, M = male, F = female, CI = Confidence Interval for Mean

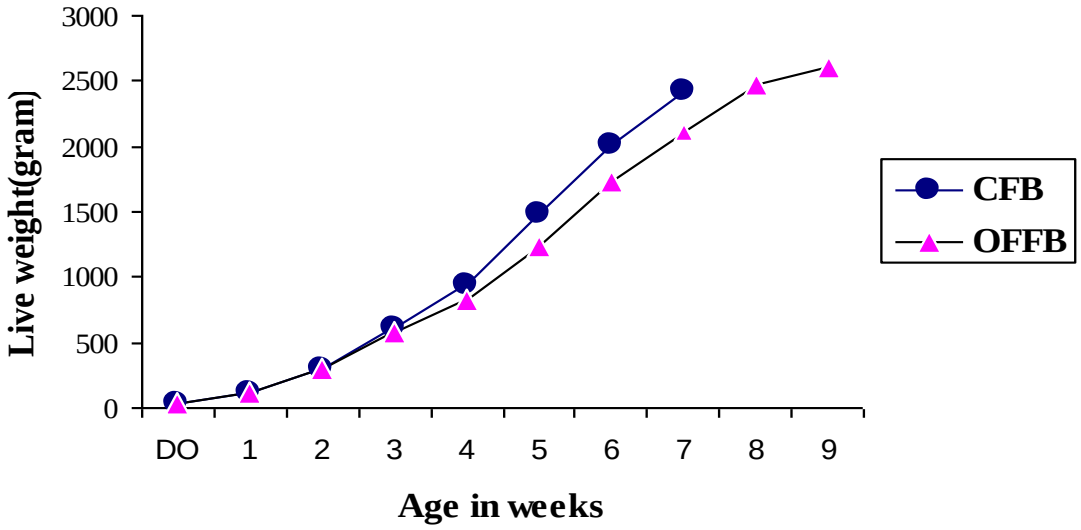

Figure 4: Growth curve for broilers in CFB & OFFB systems in the study area.

► DO = Day Old chicks

There was significant difference (P< 0.001 and P< 0.05) between CFB and OFFB systems for slaughter weight and carcass weight respectively. Dressing percentage was not significantly different between the feeding systems (CFB and OFFB) (Table 20).

Table 20: Effect of feeding system on performance of broilers in the study area

Variables	Sex	N	Mean	SD	P- value	95% CI for Mean	
						Lower Boundary	Upper Boundary
Slaughter	CBF	478	2.6157	0.175	0.000**	2.6000	2.6314
weight	OFFB	254	2.6756	0.169		2.6547	2.6966
Carcass	CBF	478	1.8307	0.167	0.02*	1.8157	1.8458
weight	OFFB	254	1.8714	0.172		1.8501	1.8926
Dressing	CBF	478	69.89	0.167	0.862	69.68	70.12
percentage	OFFB	254	69.86	0.172		69.47	70.25

►CFB = commercial feed based, OFFB = on farm feed based and CI = Confidence interval for mean values

4.3.2. Health and Mortality status

The overall average mortality rate throughout the study period was 6.73±1.78 % across all broiler farms (Table 17). Most of the death incidences were observed in the earlier and finishing age (Figure 5). Relatively OFFB fed broilers had higher mortality rate (7.92±0.86) than CFB fed ones (6.08±1.84) (Table 18). Major symptoms observed were death before vaccination and sudden death around finishing age, difficulty in breathing, eye problems (unable to see), deep green and yellowish faces in most farms.

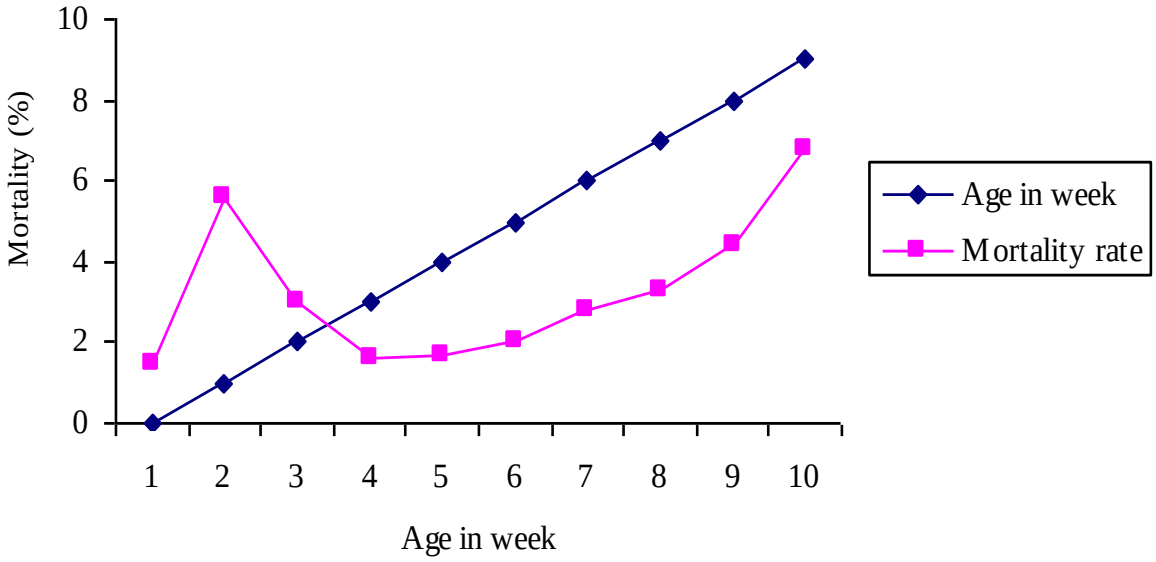

Figure 5: Death patterns of broilers per farm per weeks in and around Debre Zeit

5. DISCUSSION

The large majority of smallholder broiler producers were in the age range of 31-40 years. Producers below 30 years of age were few in number; probably due to financial limitation at young age. Similar study carried out in Botswana indicated low number of young people involved in broiler production (Badubi *et al*., 2004). The study revealed that lack of credit is potentially a major constraint to the growth of broilers farms in the area (Badubi *et al*., 2004).

The large majority of smallholder broiler producers were literate. This could be considered as advantageous due to the fact that education is positively associated with technology uptake. The high level of education might enable respondent to access relevant information to stimulate their production. A supportive situation found in Ghana showed that courses in poultry husbandry have been made compulsory in rural schools as a way of disseminating better practices (Acheampog, 1996). The average family sizes of 4.2 persons per household and mean age of 32 years shows the availability of family labor for poultry production. Relatively higher proportions of the urban broiler keepers were women (58.5%) who generate most of their income from poultry. This finding is consistent with Gueye (1998) who reported that in rural areas of sub-Saharan Africa more than 70% of chicken owners are women. The majority (67.7%) of respondents in the present study also indicated that the main reason for family poultry production was for income generation. In fact, Sonaiya (1995) noted that in poor producer families, poultry products are not consumed but are mainly sold when household is in need of cash. Similar study demonstrated that income from family poultry contributes significantly to women cash economy in Nigeria (Alabi and Osifo, 2004).

In this study, relatively higher number of broiler farms used family labor. Similar result was reported from Botswana where small batch size used only family labor. Family provides most of the labor in small-scale broiler farming's because producers who owned these farms are almost unemployed previously while farms with bigger batch sizes (>1000 birds) used hired labor (Badubi *et al*., 2004).

It was observed that all house used corrugated iron sheets (89.2%) flatted and ridged roof (10.8%). Such a house also preferably practiced in most producers in Botswana due to low flock size, relatively cheap to construct and easier to heat than ridged houses (Badubi *et al*., 2004). However, this type of housing has an impact on the performance of birds since it affects the physical (heat, humidity and air movement) and chemical factors (ammonia and carbon dioxide in the compound of the air) which facilities the accumulation of wastes in poultry houses and generate different forms of air pollution, including ammonia, carbon dioxide, methane, hydrogen sulfide and nitrous oxide gases, as well as dust (Kocaman *et al*., 2005). The recommended stocking density of meat chicken is 8 birds/m^2 (Wilson *et al*, 1997). However, in this study an average stocking density of 10.2±2.2 birds/m^2 were observed.

In Ethiopia a 60 days broilers weigh 1.8kg and a mortality rate of 6.8% was reported for commercial farms in Ethiopia (Tadelle and Ogle, 2001). However, in the present study the mean age of broilers at marketing was 56.5 days, while the mean slaughtering weight and mortality rate were 2.64 and 6.73 % respectively. Smith (2001) also showed that the production of a meat type chicken that weigh over 2 kg at six weeks of age. The marketing age range in this study also similar to the finding of Sainsbury (1992) reported that the systems used for rearing broiler were probably reared from day-old to about 46-70 days in a controlled environment.

Standard broilers diets should contain 3,200 ME kcal per kilogram. Nutrient requirements of broilers in crude protein, crude fiber, Ca and Phosphorus, for starter and finisher diet were 23%, 5%, 1%, 0.45% and 20%, 5%, 0.9% and 0.4% respectively (Jeffre, 1984). Relatively the result obtained from chemical analysis of commercial and on farm prepared ration showed that almost all the feed met the requirements of broilers (Table 13). CFB had higher metabolisable energy than OFFB.

In the present study it was observed that the male broiler chicks had heavier carcass compared to the female ones. The difference was similar to the reports of Horn *et al*. (1998)

who stressed that the coefficient of live weight variation increased more in male chicks in the second part of the rearing period, compared to the females with the less pronounced increase. The feed efficiency of female broilers is usually higher than male birds with a corresponding weight, after about 30 days of age. The reason for this is that female birds tend to deposit proportionally more fat in the carcass. Body fat takes 9 times higher feed energy to produce as does muscle. For this reason it is usually uneconomical to grow female broilers much beyond 45days (Ministry of Agriculture Food and Rural Affairs, 2008).

Assessment of the health aspect revealed deaths before vaccination and sudden death around finishing age. The overall average mortality of 6.7% throughout the study period was beyond the maximum recommended mortality rate of 5% irrespective of slaughtering age (Anonymous, 1984; APC, 2006). This might be due to management problems observed during the farm visits.

Regarding manure management, one third of the farms used manure as source of alternative animals for dairy cows in the area. Similar practice observed in U.S. with 5.6 million tons of litter dry matter is produced per year and used as alternative feed source for their animals (Joseph and John, 2001).

This study highlighted several areas that constrained the realization of full potential of this sector. Most respondents had a big problem of space (land) and capital where accessing of loan service in the area was complex .The availability of day old chicks and feed cost, zero extension services and feed related problems (63.1%) were also the most important constraints found in the area. Similar problems existed in Botswana where inadequate livestock services, unavailability of easy credit for smallholder producers, poor farmer training, irregular feed supply, lack of quality control, irregular supply and poor quality of day-old chicks, poor on farm records and lack of research on local poultry are the major challenges. However farmer training alone remain the most significant means through which broiler producers learn more about husbandry practices and improved productivity (Acheampong, 1996).

6. CONCLUSIONS AND RECOMMENDATIONS

Small scale broiler production business was largely owned by women. Absence of disease outbreak in any one of the studied broiler farms was indicator of a good disease prevention practice. However the overall mortality rate of 6.7%, which was higher than the maximum recommended mortality rate of 5%, shows much to be improved in the husbandry practices. Chemical analysis of feed samples showed the superiority in nutrient contents of commercial feeds over on farm prepared feeds. This was also reflected in broilers performances fed on the two feed types. Broilers fed on commercial feed base attained higher market weight in a relatively shorter time than the ones that used on farm prepared rations. Other than feed type sex had also effect on performances of broilers. Generally, production performances of broilers were optimal and indication of improvement in broiler husbandry in the area.

Generally, the present study revealed that several factors are hindering the advancement of semi-intensive broiler farms in the study area; space (land), scarcity of day old chicks, feed cost, unavailability of credit facility, luck of extension service and marketing through intermediate channels.

Finally, based on the present study results the following recommendations were made

- Extension service should be further strengthened to reach smallholder broiler producers and provide service on improved poultry nutrition, health care and other infrastructures needed.
- Organizing smallholder producers in cooperatives will contribute a lot in input access and to sell their products.
- Further studies on improving and expanding exotic chicken production at smallholder level should be encouraged.
- Further study is strongly recommended to investigate the actual causes of chick's mortality in the area.
- Detail studies should prioritize alternative low cost feed ration resources.

REFERENCE

AACMC, (1984): Project preparation report draft final. Poultry production project, Australian Agricultural Consulting and Management Company.Annex-5 and Main report. Addis Ababa, Ethiopia.

Abebe Hassen., (1992): Terminal report on the comparative evaluation of native chicken in the Hararge Administrative region and their crosses with the single comb white leg horn. Mimeo graphical report. Alemaya University, Ethiopia, Pp 22.

Acheampong, C.K., (1996): Revitalizing the poultry industry. Ghana education Services measures. **In:** Proceeding of the 20th world poultry congress, New Delhi, India, **3:**489-493.

ACP, 2006: Assured chicken production standards. 2005- 2006, ACP.

Ademosun, A.A., (1973): Evaluation of brewer's dried grains in the diets of growing chicks. *British Poultry Science*, **14:** 463-468.

Adene, D.F., (1990): The management and health problems of rural poultry stock in Nigeria. **In:** CTA-Seminar proceedings on smallholder poultry production, 9-13 October, 1990, Thessloniki, Greece, **2:**175-182.

Aduku A, O., (1992): Practical livestock feed production in the tropics. Zaria: S. Asekome and Co. Publishers; 1992.

Agbede, G., Demey, F., Verhuls, A.T. and Bell, J.G. (1990): The impact of NCD in the traditional chicken farms of Cameroon. **In:** CTA-Seminar proceedings on smallholder poultry production.9-13 October 1990, Thessloniki, Greece, **2:**49-54.

Alabi, R.A and Osifo, A.A. (2004): Constraints to self-sufficiency in Backyard poultry production in Edo State. **In:** Proceedings of 9th Annual Conference of Animal Science, Pp 174-176

Alamargot, J. (1987): Avian pathology of industrial poultry farms in Ethiopia. **In:** Proceeding of first National Livestock improvement conference, February 11-13 1987, Addis Ababa, Ethiopia Pp 114-117.

Alemayehu Lirenso, (1993): A Study of the Impact of Deregulation on the Structure and Performance of Grain Markets in Ethiopia, Unpublished PhD Dissertation, University of East Anglia, Norwich.

Alemu Yami and Guenther K.D., (1992): Study on the chemical composition of some poultry feeds of Ethiopian origin. *Journal of Tropical Agriculture and Veterinary Medicine volume*, 3(**4): 427-450.**

Alemu Sida, (1987): Small scale poultry production. **In:** Proceeding of the first national livestock improvements conference, 11-13 February, 1987, Addis Ababa, Ethiopia. Pp 100-101.

Alemu, Y., (1995): Poultry production in Ethiopia. *World's poultry Science Journal*, **51:** 197-201.

Alemu, Y. and Tadelle, D., (1997): Status of Poultry Research and Development in Ethiopia. Research Bulletin No 4, Debre Zeit Agricultural Research Center, Alemaya University of Agriculture, Pp 63.

Alemu, Y. and Tadelle D., (1998): The Status of poultry research and development in Ethiopia. **In:** Proceedings of the Fifth National Conference of Ethiopian Society of Animal Production (ESAP), 15-17 May 1997, Addis Ababa, Ethiopia, Pp 40-60.

Akunzule, A.N. (2005): Economics of smallholder commercial poultry production in Sefwi-Wiawso District, *INFPD Newsletter,* **15 (1):** Pp18.

Andrews, P., (1990): Rural poultry development in the Gambia. CTA- Seminar proceedings on smallholder rural poultry production.9-13 October 1990, Thessloniki, Greece, 2: 81-85.

Anonymous, (1984): Project preparation Report .Ethiopian Ministry of Agriculture, Addis Ababa.Ausrian Agricultural Consulting and Management Company, Pvt.Ltd.

AOAC, (1990): Association of Official Analytical Chemists Official methods for analysis.15th Edition, AOAC, Washington, USA, Pp 12-98.

Arsham, H., (2005): Questionnaire design and surveys sampling, 9th Edition. (Retrieved July 15, 2007), *http://home.ubalt.edu/ntsbarsh/stat-data/Surveys.htm*.

Badubi, S.S., Ravindran, V., and Reid. (2004): A Survey of small scale broiler production systems in Botswana. *Tropical Animal Production and health* **36:** 823 834.

Bagust, T.J. (1994) Improving health for a poultry industry in Asia: a developmental perspective. *Avian pathology*, **23:** 395-404.

Bartov, I. and Plavnik, I., (1998): Moderate excess of dietary protein increases breast meat yield of broiler chicks. *Poultry Science* **77:** 680- 688.

Bockisch, F.J., Jungbluth, T., Rudovsky, A., (1999): Technical indicators for evaluation of housing systems for cattle, pigs and laying hens relating to animal welfare. *Zuchtungskunde* , **71:**38-63.

Bokkers, E.A., and Koene P.M (2003): Behavior of fast- and slow growing broilers to 12 weeks of age and the physical consequences. *Applied Animal Behavioral Science*, **81:** 59-72.

Bremner, A., and Johnston, M., (1996): The poultry meat industry: Poultry meat hygiene and inspection. Central Stastical Inventory WB Sounder campany Ltd. London, Philadalpia.

Briggs, J.L., Maier, D.E., Watkins, B.A., and Behkne, K.C., (1999): Effects of ingredients and processing parameters on pellet quality. *Poultry Science,* **78:**1464.

Carlile, F. S., (1984): Ammonia in poultry houses: A literature review. *Worlds Poultry Science Journal*, **40:**99-113.

Charles, D.R. and Payne ,C.G., (1966): The influence of graded levels of atmospheric ammonia on chickens. *British Poultry Science,* **7:** 189-198.

Craig, J.V., and Muir, W.M., (1996): Group selection for adaptation to multiple-hen cages: behavior responses. *Poultry Science,* **75:** 1145-1155.

Caveny, D. D., Quarles, C. L. and Greathouse. G. A., (1981): Atmospheric ammonia and broiler cockerel performance, *Poult. Sci.,* **60:**513–516.

Curtis SE., (1983): Environmental management in animal agriculture. Ames: The Iowa State University Press.

Davis and Siopes, (1996): Light intensity preferences of domestic male turkeys. Division of Animal Health and Husbandry, Department of Clinical Veterinary Science, Langford House,University of Bristol,UK. *www.cobbvantress.com/Publications/documents/focus_product*

Deaton, J. W., Branton, S. L., Simmons, J. D, and Lott, B. D., (1996): Poultry Science Association. Department of Animal and Poultry Science, University of Guelph, Ontario, Canada.

DZARC, (1997): Annual Research Report 1996/1997. Debre Zeit Agricultural Research Center, Debre Zeit, Ethiopia. Pp 86.

DZARC, (2002): Monthly meteorological report. Debre Zeit Agricultural Research Center, Debre Zeit, Ethiopia.

EARO, (2000): Summary of Livestock Research strategies. Animal Science Directorate, Ethiopian Agricultural Research Organization, Addis Ababa, Ethiopia, Pp73.

EARO, (1999): The socio-economics Research Strategy, execulsive summery, Addis Ababa, Ethiopia.

Elwinger, K., and Svensson, L., (1996): Effect of dietary protein content, litter and drinker type on ammonia emission from broiler houses. *J. Agric. Eng. Res.,* **64:**197-208.

Ensminger,M.E.,(1992): Poultry Science. Animal agricultural Series, Iterstate publisher, Inc. Danville, Illinois. Pp 312.

Ewart, J., (1993): Evaluation of genetic selection techniques and their application in the next decade. *British Poultry Science,* **34:** 3-10.

FAO, (1993): Ethiopian Livestock Sector Development. Project report, Number 24/93cp ETH 4S, 18, February 1993, Volume 2, Rome, Italy

FAO, (1996): Food and Agricultural Organization of the United Nations. Production Year Book, Volume 48, Rome, Italy.

FAO, (2000): Food and Agricultural Organization of the United Nations. Production Year Book, Volume 53, Rome, Italy.

FAOSTAT, (2000): Food and Agricultural Organization of the United Nations. Retrieved

July 15, 2004, from FAOSTAT on-line database, *http://apps.fao.org/default.htm.*

FAOSTAT, (2004): Food and Agricultural Organization of the United Nations Statistical Database. Retrieved July 15, 2004, from FAOSTAT on-line database, *http://apps.fao.org/default.htm.*

Fasuyoi, A.O., (2005): Maize sorghum based brewery by-products as an energy substitute in layer starter effect performance carcass characteristics, organs and muscle growth. *Int. J. Poultry Science,* **4:** 334-338.

Fenwick, G. R. and Curtis, R. F., (1980): Rapeseed meal and its use in poultry diet. *A review: Animal Feed Science Technology,* **5:** 255-298.

Ferrante, V., Verga, M., Mangiagalli, M.G., and Carenzi, C., (2001): Behavior reactions, semen quality and testosterone levels in cocks: genetic implications. *Animal Welfare* **10:** 269-279.

Furlan, R.L., Macari, M., Moraes, V.M., Malheiros, R.D., Malheiros, E.B., and Secato, E.R., (1999): Alterações hematológicas e gasométricas em diferentes linhagens de frangos de corte submetidos ao estresse calórico agudo. Revista Brasileira de Ciência Avícola **1:**77-84.

Government of Oromia Region, (2006): Socio-economic profile of East Shewa Zone (Last accessed August 1, 2006) *http://oromiagov.org*

Griffin, H.D., (1996): Understanding genetic variation in fatness in chickens. Annual report. Roslin Institute, Edinburgh.

Groom, G. M., (1990): Factors affecting poultry meat quality. Agricultural Development and Advisory Service (ADAS), Ministry of Agriculture, Fisheries and Food, Cambridge ,UK.

Gueye, E.F., (1998): Poultry plays an important role in African village life. *Worlds Poultry journal* **54:** 73-86.

Gueye, E.F., (2000): Approaches to family poultry development. **In:** Proceeding 21st World's Poultry congress, Montreal, Canada.

Gunaratne, S.P., Chandrasiri, A.D., Hemalatha, W.A., and Roberts, J.A., (1992): The productivity and Nutrition of village chicken in Srilanka. **In:** Proceeding of an International Work shop on NCD in village chickens, control with Thermo stable oral vaccine 6-10 October, 1991, Kuala Lumpur, Malayisia, Pp 21-24.

Hailemmariam, T., Legesse, D., Alemu, Y and Negesse, D., (2006): Adopting poultry breeding in the high lands of Ethiopia. Ethiopian Institute of Agricultural Research (EIAR), Research Report 65, Addis Ababa, Ethiopia.

Hellmeister, F.P., Menten, J.F., Neves, M.A., Coelho, A.D., and Savino, V.J., (2003): Efeito de genótipo e do sistema de criacao sobre o desempenho de frangos tipo caipira. *R. Brsa. Zootec.,* **32:** 1883–1889.

Holcman A., Vadnjal, R., Zlender B., Stibilj, V., (2003): Chemical composition of chicken meat from free range and extensive indoor rearing. *Arch. Geflügelk.,* **67**: 120–124.

Holisheimer, J.P., and Veerkamp, C.H.,(1992): Effect of dietary energy, protein and lysine content on performance and yields of two strains of male broiler chickens. *Poultry Science,* **71:** 871- 879.

Horn, P., Suto, Z., Jensen, J.F., and Sorensen, P., (1998): Growth, feed conversion and mortality of commercial meat type chicken during a twenty week growing period. *Arch. Geflügelk.,* **62:** 16–20.

IFPRI, (2000): World Food to 2020. International Food Policy Research Institute, Washington, D.C. *www.ifpri.org*.

ILRI, (2004): Red Meat and Poultry Production and Consumption in Ethiopia and Distribution in Addis Ababa. International Livestock Research Institute, Addis Ababa, Ethiopia.

ILRI, (2005): Map of selected pilot learning site area. International Livestock Research Institute ,Ada,a-liben woreda, Pilot Learning Site Diagnosis and Program Design.

Jafari, R.A., Fazlara, A. and Govahi, M., (2006): An investigation into Salmonella and faecal coliform contamination of drinking water in broiler farms in Iran. *International Journal of Poultry Science*, **5:** 491- 493.

Jeffre D. F., (1984): Nutrient Requirements of Poultry.8th edition. National Academy Press, 2101 Constitution Ave., Department of Animal Science, N.W. Washington, DC.

Jones, R.B., Carmichael, N.L., and Rayner, E., (2000): Pecking preferences and pre-dispositions in domestic chicks: implications for the development of environmental enrichment devices. *Applied Animal Behavioral Science,* **69:** 291-213.

Joseph P. F., and John W. H., (2001): Utilization of poultry litter as feed for beef cattle. Department of Animal and Poultry Sciences, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061.

Kinnucan, H. W. and Forker, O. D., (1987): Asymmetry in Farm-Retail Price Transmission for Major Dairy Products. *American Journal of Agricultural Economics*, **69:** 285-292.

Khantaprab, S., Nikki, T.,and Nobukuni, K., (1997): Effect of restricted feed intake on the growth of muscle and fat deposition in broiler chickens. *Japanese Poultry Science* **34:** 363-372.

Kitalyi, A. J., (1997): Village chicken production systems in developing countries: what does the future hold? *World Animal Review*, **89**: 48-53.

Kitalyi, A.J, (1998): Village chicken production systems in rural Africa Household food security and gender issues. FAO Animal Production and Health Paper, 142: *http://www.fao.org/DOCREP/003/W8989E/W8989E00.htm.*

Kocaman, B., Yaganoglu, A.V and Yanar, M., (2005): Combination of fan ventilation system and spraying of oil-water mixture on the levels of dust and gases in caged layer facilities in Eastern Turkey. *Journal of Applied Animal Research*, **27:** 109-111.

Kubena, L.F., Chen, J.W., and Reece, F.N., (1974): Factors influencing the quantity of abdominal fat in broilers. *Poultry science*, **53:**574-576.

Kulube, K., (1990): Smallholder rural poultry production in Zimbabwe. **In:** CTA-Seminar proceeding on smallholder rural poultry production 9-13 October 1990, Tesslonki, Greece; **2:**263-270.

Lacy, M.P., (2002): Broiler management: Commercial chicken meat and egg production. 5th Edition, Kluwer Academic Publishers, Netherlands, Pp 829- 868.

Laughline,K.,(1995): Stock management, Broiler management Guide ,The Cobb breeding company Ltd,USA Pp 1-5.

Leenstra, F.R., (1986): Effect of age, genotype and environment on fat deposition in broiler chickens: A review. *World's Poultry Science Journal* **42:** 12-25.

Leeson, S. and Summers, J. D., (1997): Commercial Poultry Nutrition. 2nd Edition, University books, Guelph, Ontario, Canada, Pp 177-178.

Leeson, S., Caston, L. and Summers, J.D., (1996): Broiler response to diet energy. *Poultry Science* **75:** 529- 535.

Leulseged, Y., (1998): Study on production systems of Indigenous and Improved poultry on Rural Areas of North Wollo. M.Sc.Thesis, Alemaya University of Agriculture, Ethiopia.

Lott, B. D., Dozier, W. A., Simmons, J. D. and Roush, W. B., (2003): Water flow rates in commercial broiler houses. *Poultry Science***, 82:** 102.

Macari, M., and Furlan, R.L., (2001): Ambiência na produção de aves em clima tropical. Ambiência na produção de aves em clima tropical. Piracicaba (SP): Degaspari, Macillan Press, LTD, London , Pp.31-87.

Manson, I.L., (1984): Domestic fowl. **In:** Evaluation of domestic animals. Longman Inc. New York.

Marks, H.L, (1980): Early feed intake and conversion of selected and non-selected broilers. *Poultry Science,* **59:** 1167-1171.

Maaza Sahle, (1981): Comparative laboratory and animal evaluation and estimation of nutritive values of Noug and Pea nut seed cakes. M.Sc. Thesis, Alemaya University of Agriculture, Ethiopia.

MAFRA, (2008): Is feed efficiency still a useful measure of broiler performance? Ministry of Agriculture Food and Rural Affairs, Government of Ontario, Queen's printer for Ontario, E-mail: *ag.info.omafra@ontario.ca.*

McDonald, D., (1987): Animal Production. 3rd Edition, Longman New York, U.S.A, Pp 584-604.

McDonald, P., Edwards, R. A., Greenhalgh, J. F., and Morgan, C. A., (1995): Animal Nutrition, John Wiley and Sons, Inc, New York, Pp 607.

Mekonnen, H., (1998): Egg laying performance of White leghorn and their crosses with local birds at Debre Zeit, ESAP, Addis Ababa, Ethiopia, Pp141-150.

Microsoft Excel (2003): Microsoft Corporation 2003, (11, 5892, 5606).

Miles, R.D. and Jacob, J.P., (1998): Using Meat and Bone Meal in Poultry Diets. PS28, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, UF/IFAS.

Ministry of Agriculture Food and Rural Affairs, (2008): Is feed efficiency still a useful measure of broiler performance? Government of Ontario, Queen's printer for Ontario, *ag.info.omafra@ontario.ca*

Munt, R.H., Dingle, J.G. and Sumpa, M.G., (1995): Growth, carcass composition and profitability of meat chicken given pellets, mash or free choice diet. *British Poultry Science,* **36:** 277- 284.

Mutetwa, L., (2001): Irvin"s National Foods and ZIMVET Newsletter.Volume 8, Number 2.

Nahm, K. H., Choi, I. H., and Do, J. C., (2005): Effects of Chemically Amended Litter on Broiler Performances, Atmospheric Ammonia Concentration, and Phosphorus Solubility in Litter. Feed and Nutrition Lab, College of Natural Resources, Taegu University, Gyong San, 712-714, *South Korea Poultry Science,* **84:** 679–686.

NRC, (1984): Nutrient requirement of poultry. National Research Council, Subcommittee on Poultry Nutrition, National Academy Press, Washington DC, USA.

Negussie, A., (1990): Yield and yield components of Ethiopian mustard and rapeseed as affected by some agronomic practices. M.Sc. Thesis, Alemaya University of agriculture, Ethiopia.

NMSA, (2003): National Metrological Center Agency Rain fall, humidity and temperature data. Addis Ababa, Ethiopia.

Nyoupayou, J.D., (1990): Country Report of Small Rural International on Rural Poultry Production, Thessalonik, Greece.

Olomu, J.M., (1995): Monogastric animal nutrition: principle and practice. NG, A Jachem Publication, Benin.

Oluyemi, J. A. and Roberts, F. A., (1979): Poultry production in tropical climates. The Macmillan Press, LTD, London.

Oyedeji, J.O., and Atteh, J.O., (2003): Response of broilers to three weeks feed restriction initiated at different time periods. *Nigerian Journal of Animal Production*, **30:** 157-162.

Pandey, V.S., (1992): Epidemiology and economics of village poultry production in Africa: Overview. **In:** Proceedings Conference of Village poultry production in Africa, 1992 Rabat, Morocco, Pp 124-128.

Payne, W. J. A. (1990): An Introduction to Animal Husbandry in the Tropics. 3rd Edition. John Wiley and Sons INC., New York, Pp 684-744.

Permin, A. and Bisgaard, M., (1999): General review on some important diseases in free-range chickens: Poultry as a tool in Poverty Eradication and Promotion of Gender Equality. **In:** Proceedings of a Workshop, March 22-26, 1999, Tune Landboskole, Denmark, Pp 181-187.

Peters, K.J, (1988): Principles in evaluation of goat populations in tropical and subtropical environments. World Review of Animal Production, Volume 24, No.1, January-March, 1988.

Pesti, G.M. and Fletcher, D.L., (1984): The response of male broiler chickens to diets with various protein contents during the grower and finisher phases, *British Poultry Science*, **25:** 415-423.

Puron, D., R., Santamaria, J. C. and Alamilla, J. L., (1995): Broiler performance at different stocking densities. *Journal of Applied Poultry Research*, **4:**55–60.

Quarles, C.L. and Kling, H.F., (1974): Evaluation of ammonia and infectious bronchitis vaccination stress on broiler performance and carcass quality. *Poultry Science,* **53:** 1592-1596.

Ravindran, V. and Blair, R., (1993): Feed resource for poultry production in Asia and Pacific. Animal protein sources, *World Poultry Science Journal*, **49:** 219–235.

Reece, F. N., Lott, B. D. and Bates, B. J., (1985): The performance of a computerized system for control of broiler-house environment. *Poultry Science,* **64:** 261–265.

Ristic M. (2003): Fleischqualität von broilern aus der ökologishen produktion. Biotechnology in animal husbandry. Institute for Animal Husbandry, Belgrade-Zemun, 19, 335–343.

Roling, N., (1988): Extension science: information systems in agricultural development.2nd Edition, Cambridge University press, Cambridge, Pp 233.

Rushton, J., Thornton, P.K., and Otte, M.J., (1999): Method of Economic impact Assessment. *Rev. Sci. Thech. Off. Int. Epiz.,* **18:** 315-342.

Sainsbury, D., (1992): Poultry health and management chickens Ducks, Turkey, Geese, Quail. 3rd Edition, Black well Scientific publisher, London, Edinburgh Botson, Pp 91.

Scahaw, (2000): The Welfare of Chickens Kept for Meat Production (Broilers). European Commission – Scientific Committee on Animal Health and Welfare 2000, Brussels, Belgium.

Scarborough, V. and Kydd, J., (1992): Economic Analysis of Agricultural Markets: A Manual. Chatham, U.K.

Shanwany, M. M., (1988): Broiler performance under high stocking densities. *British Poultry Science,* **29:** 43–52.

Singh, K.S., (1998): Poultry nutrition.Kalyani Publisher, New Delhi, Ludhiana.

Silva, I.J., Barbosa, F., Coelho, A.A., Savino, V.J., (2001): Behavior and performance of broiler strains reared under semi-intensive system with shaded areas. Dep. de Engenharia Rural–NUPEA/ESALQ/USP

Smith, A.J., (1990): Poultry. Tropical Agriculturist series (CAT), Macmillan Publisher Ltd., London, Pp 43-45

Smith, A.J., (2001): The Tropical Agriculturalist Series (CTA). Poultry Revised Edition, Macmillan Education Ltd, London and Oxford, Pp 12-221.

Smith, E.R. and G.M. Pesti, (1998): Influence of broiler strain cross and dietary protein on the performance of broilers. *Poultry Science,* **77:** 276-281.

Sonaiya, E.B., (1990): The context and prospects for development of small holder rural poultry production in Africa. In: Proceedings of a Seminar on smallholder Rural poultry Production, 9-13 October, 1990, CTA, Thesseloniki, Greece, Pp 35-52.

Solomon Demeke, (1996): Study on the egg production of White Leghorn under intensive, semi-intensive and rural household conditions in Ethiopia. Livestock Resource and Rural Development, 8: 89-92.

Sonaiya, E.B., (1995): Feed resources for smallholder poultry production in Nigeria. *World Animal Review* **82:** 25-33.

Sonaiya, E. B, Brackets, R. D and Gluey, E .F, (1999): Research and development options for family poultry. First INFPD/FAO Electronic Conference on Family Poultry: 7 December1998-5March1999. *http://www.fao.org/ag/aga/agap/lpa/fampo1/Intropap.htm*

SPSS, (2005): Stastical package for Social Science. Inc. for window (version 15), Chicago, Illinois, USA.

Tadelle, D., (1996): Studies on village poultry production systems in the central highlands of Ethiopia. M.Sc. Thesis, Swedish University of Agricultural Sciences, Pp 70.

Tadelle, D., Alemu, Y., and Peters, K. J., (2000): Indigenous chicken in Ethiopia: Genetic potential and attempts at improvement. *World's Poultry Science Journal,* **56:** 45-54.

Tadelle, D. and Ogle, B., (1996): A survey of village poultry production in the central highlands of Ethiopia. MSc.Thesis, Swedish University of Agricultural Sciences, Pp 22.

Tadelle, D and Ogle, B, (2000): Nutritional status of village poultry productions in the central high land of Ethiopia as assessed by analysis of crop contents. *Ethiopian Journal of Agricultural Science,* **17:** 47-56.

Tadelle, D and Ogle, B., (2001): Village poultry production systems in the central highlands of Ethiopia. *Tropical Animal Health and Production,* **33 (6):** 521-537.

Tadelle, D. and Peters, K. J., (2003): Indigenous chicken in Ethiopia; neglected but worth the cost of conservation through improved utilizations of animal biodiversity in Ethiopia: status and prospects. **In:** Proceedings of the 11th Annual Conference of ESAP, August 28-30, 2003, Addis Ababa, Ethiopia.

Teketel, F., (1987): Studies the meat production potential of some local strain of chicken in Ethiopia. IAR, Proceedings, First National Livestock Improvement conference, Addis Ababa, Ethiopia, Pp 85-87.

Tewe, O. O., (1998): Sustainability and Development. Paradigm from Nigerian Livestock Industry. *Inaugural Lecture Series.* University of Ibadan, Ibadan.

Thrufield, M., (1995): Veterinary Epidemiology. 2nd Edition ,UK: Blackwell science Ltd, Pp 313-321.

Udo, H. M., Asgedom, A. H. and Viets, T. C., (2001): Modeling the impact of interventions in village poultry systems. In: Proceedings of the 10th Conference of the Association of Institutions for Tropical Veterinary Medicine, October 7-9, 2001, Copenhagen, Denmark.

Upindi, B, G., (1990): Smallholder rural poultry production in Malawi. **In:** CTA-Seminar proceeding on smallholder rural poultry production, 9-13 October 1990, Tesslonki, Greece; **2:**141-146.

Veluw, V. K., (1997): Traditional poultry keeping in Northern Ghana. Center for Information of Low External Inputs and Sustainable Agriculture, **3:** 12-13.

Von, B. E, Van, D., and Weghe, S., (1999): Development of criteria for the assessment of housing systems for cattle, pigs and laying hens relating to animal welfare and environmental impact. *Zuchtungskunde* , **71:** 8-16.

Ward R. W., (1982): "Asymmetry in Retail, Wholesale, and Shipping Point Pricing for Fresh Vegetables." *American Journal of Agricultural Economics,* **64:** 205-212.

Wideman, R. F. and Tackett, C. D., **(**2000): Cardio-Pulmonary Function in Broilers Reared at Warm or Cool Temperatures: Effect of Acute Inhalation of 100% Oxygen. Department of Poultry Science, University of Arkansas, Poultry Science Association, *www.poultryscience.org/ps/abs/00/Feb00ab257.html*

Wilson, K. J. and Beyer, R. S., (2000): Poultry Nutrition Information for the Small Flock. Kansas State University Agricultural Experiment Station and Cooperative Extension Service, *http ://www.oznet.ksu.edu*

Wilson, R.T., (1986): Poultry production in sub Saharan Africa. International Livestock Center for Africa, Addis Ababa, Ethiopia.

Wilson R.T, Mather, F. B. and Jacob, J.P., (1997): Poultry Management Specifications. Dairy and Poultry Sciences Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. *http://edis.ifas.ufl.edu.*

Wiseman, J., (1987): Feeding of Non-Ruminant Livestock. Butterworth and Co. Ltd., Pp 9-15.

APPENDICES

Appendix 1: Questionnaire format for the Survey part

I. Household demographic, Flock and Farming System Characteristics

Farmers/owner name ---------- Telephone No ----------

1. Age ----------

2. Sex (a) Male ☐ b) female ☐

3. Occupation

a) Farmer b) civil servant c) Retired civil servant d) ex-soldier

4. Level of Educational status ----------

5. Family size ----------

6. Type of farming 1) Crop-Livestock 2) Livestock Only

7. Type of livestock kept

Name	Number	Name	Number
Dairy		Donkey	
Sheep		Horses	
Goat		Poultry	

8. Trend of livestock population (Since the last three years)

Species	Increasing	Stable	Decreasing	Reason
Dairy				
Sheep				
Goat				
Equines				
Poultry				

9. If day old chickens are purchased, where is source of purchase_____?

10. Number of years since you started poultry production. _____?

11. What is the main objective of keeping chicken?

a) Source of income (for sale) _____

b) Household consumption & replacement_____

c) For support of crop agriculture

12. Proportion of expenses allocation?

a) For replacement of stock _____

b) For Household consumption _____

c) For support of crop agriculture_____

13. Do you have the plan to expand your poultry business?

a) Yes b) No

14. Are there any taboo /regulation concerning the raising of a particular type of chicken?

a) Yes b) No

II. Management and Husbandry

1. Do you keep records? a) Yes b) No

2. If yes, on what parameters

a) Production costs b) feed intake c) water intake d) weight gain

e) Medical history f) all production related parameters

3. Poultry Management systems

a). Semi-intensive (Partly confined + commercial feeding based only)

b). Semi-intensive (Totally confined + on farm feeding based only)

c). Semi-intensive (Totally confined + both types feeding based only)

4. Which one has the role on routine activity for poultry keeping?

a) Family labor b) hired labor

5. Sex ratio on job division for the farm a) male b) female

6. How much time (approx.) in hr. do you spend each day on poultry keeping ___?

7. How do you house chickens?

a) Have a simple shelter for night enclosure

b) Separate house constructed entirely for poultry

8. Number of opening sides for the poultry house_____

9. Orientation of the house

a) East-west b) north-south c) other possible sided

10. Housing density and lighting management

Class	Type of house	No of bird/m^2	Night lighting hrs
Starter			
Finisher			
Grower			
Layer			
Other-------			

12. Shape of roofing a) flatted type b) ridged type

10. How is your floor management?

a) Deep litter with concrete floor b) Deep litter with soiled floor

c) If others, specify_____

11. What are the materials the chicken house is made of ?

a) Totally brick c) Totally muddy

b) Partly brick and partly woody d) If others, specify_____

12. What are your house floor (bedding) materials?

a) Straw, specify b) Saw dust c) wood shivering (d) other, specify_____

13. Floor area in birds /m^2 of poultry house ----------

14. How often do you clean the house?

a) Weekly b) daily c) Monthly d) once per production cycle

15. Which one does you used as disinfectant?

a). Berkina only

b). Berkina and locally used materials

c). The available disinfectant chemicals

d). All option used

16. What system of the housing do you used when transferring birds between house or batches?

a) All in all out b) at any time c) if other ways, specify_____

17. How much time (in days) in one production per cycle took under your farming condition? __

18. Does the house have enough ventilation?

a) Yes b) No c) if yes specify the type? _____

19. Degree of ventilation access for the house

a). Bad b). Medium c). Goods

20. Do you practice culling birds? a) Yes b) No

If yes reasons for culling

a) Old age b) Reduced productivity c) Sickness d) other, _____

21. How do you handle poultry manure?

a) As animal feed b) Fertilizer c) Burn d) Sale e) others_____

III. Feed Resources & Feeding Strategy

1. Do you feed Commercial feed (concentrates)? a) Yes b) No
2. If yes what type?
   a) Commercial feeds only
   b) On farm produced feeds only
   c) Both Commercial plus farm produced
   d) House hold wastes (kitchen wastes) e) Others (specify)_____
3. Where do you get these feeds?

   a) Factories b) Retailers c) Commercial farms

   d) Feed mills e) others (specify) _____
3. If you provide commercial feeds, specify the types and quantity.
4.

Type of bird	Type of commercial feed Ration type	Quantity provided per day/per bird/gm	Quantity provided per phase
Growers			
Mature Broilers			

5. If your birds are supplemented, what are the items the birds provided with?

_____,_____,_____

6 How frequently do you provide feed and water to birds per day?

	Morning	Afternoon	Evening
Once			
Twice			
Thrice or more			

7. What is the source of water?

a) Ground water b) River water

c) Tap-water d) other _____

8. Indicate feed and feeding management related problems in your farm?

a) Shortages b) wastage c) Cost

d) Availability e) other, _____

IV. Breed used and flock size

a. Poultry Population and breed type at the time of filling questionnaire

Class	Number	Breed type
Broiler		
Layers		

V. Poultry Products and Marketing

1. To whom are you selling your poultry products?

a) Local market b) at farm gates

c) Retailers d). Retailers and local market

2. In which form are your poultry meat products are sold?

A) Live form B) dressed form

3. How the price is set?

a) On live weight bases b) On dressed weight bases

c) By simple estimation d) if others way (please specify) _____

4. Factors that affect the selling price of chicken.

a) Color b) Comb type c) Breed d) Weight

e) Age f) others (please specify) _____

5. How do you transport poultry and poultry products to markets?

_____, _____

VI. Poultry Health Management

1. Do you practice vaccination of your chicken? a) Yes b) No

If yes, specify for which disease_____

2. What is your immediate measure when you observe sick birds in the flock?

a) Isolation b) immediate slaughter c) Leave with the flock

d) Treating with different drugs until recovery or death e) other_____

3. Do you experience serious disease outbreaks previously?

a) Yes b) No

4. What type of disease (s) do you frequently observe in your flock?

Disease (Local name)	Major symptoms	Season of occurrence	weeks Mostly affected	Treatments applied

5. Do you apply any modern medicaments as treatment or growth promoter?

a) Yes b) No

If yes, specify_____

6. What is your immediate measure when you observe sick birds in the flock?

a. Isolation and follow up b. Immediate slaughter if older

C. Isolation and treat them until recovery

7. Which age group has the highest mortality? (Rank)

(a). Starter (1-3wks) (b). Growers stage (4-6wks)

c) Adult (finisher) stage (more than 6 wks)

8. In which season do you loose most of your chickens?

a) Long dry season (oct.-Jan.) b) short rainy season (Feb.-Mar.)

c) Short dry season (Apr.-May) d) Long rainy (Jun.-Sep.)

9. Do you control the free movement of the chickens? (Fencing)

a) Yes b) No

If yes, would you mention the reasons?

a) To protect from mixing with the village flock or to avoid risk of contagious diseases

b) To protect the birds from picking and destroying crops/vegetables

c) To protect from predator attack 4. Other reasons (specify)

d) If no, why? _____

10. How do you dispose dead birds?

a) Throw away b) Burning c) Burying d) Other, _____

11. What could be the possible source of infection?

a.) House management condition c) Not clearly understood

b.) Environment d) If other (specify) _____

VII. Institutional Support:

1. Do you receive any assistance (extension service) regarding poultry production?

a) Yes b) No

2. If yes, what was (were) the extension service you get?

(Rank them in order of importance)

a) supply/distribution/ of pullets, b) technical advice only,

c) To help you with their education, d) feed,

e) Treatment f) a complete package

3. Are you provided with improved and/or exotic breeds of poultry?

a) Yes b) No

4. If yes, which chicken breeds you received? _____,_____

5. Are there any institutions giving credit services for poultry production?

a). Yes b). No

6. How long does it take you to reach to the extension agent (distance)?

_____kms

7. How frequently do you see the agent?_____

VIII. Constraints

1. What are the major constraints of poultry production in the area (put them in order of importance, constraint no. 1 being the most important one)?

No	Types Constraints	1	2	3	4	5
1	Shortage of land					
2	Shortage of feeds					
3	Disease problem					
4	Access of market					
5	Access of broiler breed					
8	Technical information					
9	Predator attack					
10	Labor problem					
11	Capital					

If constraints were out of mentioned in the table, please list down below

_____

2. What possible solutions would you suggest to lessen the constraints?

Thank You Very Much for Your Sincere Cooperation!!

Appendix 2: Smallholders broiler husbandry follow-up sheet form

Name of Owner---------- No. of day old broilers housed at wk. 1-----

Hatching Weight---------- Final No. of broilers at the end the cycle----

No. of Weeks	1	2	3	4	5	6	7	8	9	10
Average Body weight per weeks at 5% of the flock size										
No. of dead birds per weeks										
Type of feeds used per phase										
Daily feed consume/gm										

Appendix 3: Chick list form for slaughtering follow up sheet

Name of Owner---------- Age at slaughtering in days ------

Average final weight_____ Final No. of broilers at the end of cycle----

No.	Date	Sex of birds	Final weight	Carcass weight	Offal weight

Appendix 4: Smallholders Broiler Health management follow-up sheet in and around Debre Zeit

Name of Owner---------- No. of day old broilers housed at wk. 1-----

Hatching Weight---------- Final No. of broilers at the end of cycle----

Vaccination/Vitamins/Medicines_____

Date	Symptoms observe	Ages or weeks Mostly affected	Treatments applied		
			modern	Traditional	Other preventive

Appendix 5: Analysis of variance (ANOVA) on weight performance comparison for CFB and OFFB broiler farms until week 7 under smallholder management condition in and around Debre Zeit Town

Age in weeks		Sum of Squares	df	Mean Square	F	Sig.
Day old	Between Groups	.012	1	.012	.008	.930
	Within Groups	21.432	14	1.531		
	Total	21.444	15			
1	Between Groups	.810	1	.810	.023	.881
	Within Groups	490.015	14	35.001		
	Total	490.825	15			
2	Between Groups	982.841	1	982.841	8.353	.012
	Within Groups	1647.189	14	117.656		
	Total	2630.030	15			
3	Between Groups	4754.625	1	4754.625	4.430	.054
	Within Groups	15025.049	14	1073.218		
	Total	19779.674	15			
4	Between Groups	66511.534	1	66511.534	99.780	.000
	Within Groups	9332.180	14	666.584		
	Total	75843.714	15			
5-M	Between Groups	249312.8	1	249312.891	39.722	.000
	Within Groups	87870.109	14	6276.436		
	Total	337183.00	15			
5-F	Between Groups	296646.19	1	296646.192	41.996	.000
	Within Groups	98891.745	14	7063.696		
	Total	395537.93	15			
6-M	Between Groups	461526.60	1	461526.601	34.922	.000
	Within Groups	185024.83	14	13216.060		
	Total	646551.43	15			
6-F	Between Groups	384351.00	1	384351.001	48.217	.000
	Within Groups	111598.43	14	7971.317		
	Total	495949.43	15			
7-M	Between Groups	304072.91	1	304072.914	19.438	.001
	Within Groups	219002.83	14	15643.060		
	Total	523075.75	15			
7-F	Between Groups	399162.00	1	399162.005	47.468	.000
	Within Groups	117727.74	14	8409.125		
	Total	516889.75	15			

► CFB = commercial feed based, OFFB = on farm feed based, M = male, F = female

Appendix 6 : Mean Slaughtering and carcass weight and dressing percentages of commercial feed based broilers under smallholder management condition in and around Debre Zeit Town

		Sum of Squares	df	Mean Square	F	Sig.
CSw	Between Groups	7.123	1	7.123	455.177	.000
	Within Groups	7.449	476	.016		
	Total	14.573	477			
CCw	Between Groups	8.995	1	8.995	983.011	.000
	Within Groups	4.355	476	.009		
	Total	13.350	477			
CDP	Between Groups	1875.203	1	1875.203	900.891	.000
	Within Groups	990.793	476	2.081		
	Total	2865.997	477			

► Mean value with asstreix were significantly different (P<0.001), CSW= commercial slaughtering weight, CCW= carcass weight =, CDP= dressing percentage

Appendix 7 : Mean Slaughtering and carcass weight and dressing percentages of on farm feed based broilers under smallholder management condition in and around Debre Zeit Town

		Sum of Squares	df	Mean Square	F	Sig.
OSw	Between Groups	2.761	1	2.761	153.940	.000
	Within Groups	4.519	252	.018		
	Total	7.280	253			
OCw	Between Groups	4.439	1	4.439	370.713	.000
	Within Groups	3.018	252	.012		
	Total	7.457	253			
OD%	Between Groups	1247.383	1	1247.383	250.399	.000
	Within Groups	1255.359	252	4.982		
	Total	2502.742	253			

► Mean value with asstreix were significantly different (P<0.001), OSW= on farm slaughtering weight, OCW= carcass weight =, OD= dressing percentage

Appendix 8: Analysis of variance (ANOVA) result for broiler performance feeding system as main effect

		Sum of Squares	df	Mean Square	F	Sig.
SW	Between Groups	.595	1	.595	19.882	.000
	Within Groups	21.853	730	.030		
	Total	22.448	731			
CW	Between Groups	.274	1	.274	9.606	.002
	Within Groups	20.807	730	.029		
	Total	21.081	731			
DP%	Between Groups	.222	1	.222	.030	.862
	Within Groups	5368.774	730	7.354		
	Total	5368.996	731			

► SW=Slaughter weight, CW = Carcass weight and DP = Dressing percentage

Appendix 9: Model of flatted roof housing system in the area

Appendix 10: Model of ridged roof housing system in the area

Appendix 11: Floor, brooding and litter management practices in the area

Appendix 12: Pre-slaughtering weighing of birds using portable electronic sensitive balance

Appendix 13: Carcass of birds after completion of slaughtering process in the study site

SIGNED DECLARATION SHEET

This thesis is my original work, has not been presented for a degree in any other university and that all sources of material used for the thesis have been duly acknowledged.

Name: Michael Temesgen

Signature: _____

Date of submission: ____/____/_____

This thesis has been submitted for the examination with our approval as an advisor.

Mekonnen Hailemmariam (DVM, MVSc. Associate professor) _____

Dr. Kelay Behailu (DVM, PhD, Assistance Professor) _____