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CHARACTERIZATION OF VILLAGE CHICKEN PRODUCTION SYSTEM WITH EMPHASIS ON SELECTED HEALTH PROBLEMS IN EASTERN ZONE, OROMIA, ETHIOPIA

BY

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DEBRE ZEIT, ETHIOPIA

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LIST OF ABBREVIATION

AACMC	Australian Centre for International Agriculture Research
ACIAR	Australian Centre for International Agriculture Research
CP	Crude Protein
DZARC	Debre Zeit Agricultural Research Centre
EARO	Ethiopian Agricultural Research Organization
ESRPEDO	East Shoa Zone Rural Planning Economic Development Office
FAO	Food and Agricultural Organization
HAI	Haemagglutination-Inhibition
HAU	Haemagglutinating Units
IAR	Institute of Agricultural Research
INFPD	International Network for the Development of Family Poultry
ME	Metabolizable energy
OIE	Office International des Epizooties
PBS	Phosphate Buffered Saline
RBCs	Red Blood Cells
SFRB	Scavenging Feed Resource Base
WADU	Wolita Agricultural Development Unit

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ABSTRACT

This study was carried out in three agro-ecologies in the East Shoa Zone of Oromia Regional State from October 2006 to April 2007. The study areas were Gimbichu (highland), Lume (midland) and Boset (lowland). The objectives of the study were to characterize poultry production system in the study areas and investigate the prevalence and determinants of selected poultry health problems. A questionnaire survey was carried out to collect data about poultry production system characteristics on 301 households (100 households from Gimbichu and Boset, and 101 households from Lume). A total of 328 adult chickens (105 from highland, 115 from midland and 108 from lowland) were autopsied to determine species of helminthes and counts of adult parasites. External parasites were collected from different parts of the skin to identify flea, lice and mite species. Haemagglutination-Inhibition (HAI) Test and Slide Agglutination Test were used to determine the seroprevalence of Newcastle disease and fowl typhoid, respectively. Collected data was analyzed using descriptive statistics and Chi-Square statistics. The results showed that poultry keeping was practiced mainly for egg and meat production as sources of income. The average poultry flock size for the overall study areas 7.53 and the flock was dominated by chicks in all the agro-ecologies. In most of the cases poultry had night shelters (40.6% in Lume, 55% in Boset and 75% in Gimbichu). Encouraging proportion of households in Gimbichu (69%) and Lume (49.5%) were supplementing their chicken with grains while households in Boset were dependent mainly on scavenging feed resources. Poultry attending was mainly the responsibility of women in general (81.1-91%) and wives in particular (67.3-73%). The predominant breeds of chicken reared in all the studied areas were indigenous and disease problems were serious during the main rainy season. The average chicks mortality was 2.33 (SE=0.12) while adult chicken mortality was 0.62 (SE=0.09). Significantly higher mortality was recorded in the highland (0.98±021) than midland (0.42±0.21) and lowland areas (0.45±0.13) ($p<0.05$). The seroprevalence of Newcastle disease and fowl typhoid was 23.17% and 22.87%, respectively. Significantly higher prevalence of Newcastle disease was observed in the lowland (30.56%) than the midland (24.35%) and highland (14.29%) areas ($p<0.05$). Regarding fowl typhoid, the seroprevalence was significantly higher in males (27.61%) than females (18.18%) ($p<0.05$). The helminth parasites identified in this study were three nematodes (*Ascaridia galli, Heterakis gallinarum and Subulura brumpti)* and six species of cestodes (*Raillietina* *echinobotridea, Raillietinea tetragona, Rillietinea cesticullus, Choantaenia infundibulum, Daveania proglottinea and Amebotenia sphenoids*). The later two cestodes were found only in the highland agro-ecology (Gimbichu). There was significant variation in the number of mixed infections in the three agro-ecologies ($p<0.001$). The highest proportion of mixed infection was observed in the lowland (59.26%) followed by midland (42.6%) and highland (25.71%) areas. The adult parasite count was significantly ($p<0.05$) in the lowland (7.57) than midland (5.88) and highland (6.53), and males (7.42) than females (5.90). Concerning ectoprasites, one species of flea (*Echidnophaga gallinaceamits*) and mite (*Cnemidocoptes mutans*), and two species of lice (*Goniodes dissimilis* and *Menopon* gallinae) were identified. It can be concluded that poultry production in the study areas is mainly traditional in management which is constrained by poor feeding, lack of proper housing and disease problems.

Keywords: Village chicken, production system, agro-ecology, Newcastle disease, fowl typhoid, endoparasites, ectoparasites, East Shoa Zone, Ethiopia

1. INTRODUCTION

Poultry are probably the most important livestock for many poor rural families in developing countries in Africa, Asia and Central and South America. Poultry in many parts of the modern world is considered to be chief source of not only cheaper protein of animal origin but also of high quality human food (Tadelle 1996; Sonaiya *et al*., 1999; Tadelle and Ogle2001).

Poultry production has been constantly increasing over the past decades (WATT, 1996), and a survey made by FAO shows that the whole poultry population in the world reaches about 14 billion, among these 75% are in the developing countries (FAO, 2000). Ethiopia has about 60% of the total chicken population of East Africa (Mekonnen *et al.,* 1991). Rural smallholder farmers under scavenging management conditions raise more than 95% of this population.

In Africa, the most reared poultry species is chicken; the domesticated indigenous fowl (*Gallus domestics)*. Village chickens are generally birds of indigenous breeds living in almost symbiotic relationship with human communities (Spradbrow, 1993). Most are kept under scavenge-based conditions, where their small size and ability to survive and produce on minimal inputs provides eggs and live birds for sale or barter (Rushton and Ngonji, 1998 and Guerne, 2003). The share of family poultry to total poultry population in developing countries, especially in Africa is not well documented but estimated to reach 70 to 80% (Sonaiya, 1990; Gueye 1998; Sonaiya et al., 1999). Thus, village poultry production is still catching the attention in smallholder agricultural systems, wherever low external production inputs are demanded (Soniya *et al*., 1999).

In Ethiopia, there are about 56.5 million poultry from which local chicken managed by small scale rural farmers represent about 99 % (Alemu and Tadele, 1997). The total poultry egg and meat production is estimated to be about 78,000and 72,300 metric tones, respectively. Poultry accounts for 15% of the total per capita meat consumption in Ethiopia (FAO, 1993). However, per-capita consumption of these products is very low relative to the world and African standards. The largest proportion of eggs and poultry meat in Ethiopia is produced by the village system based on indigenous animals (Tadelle, 1996).

The indigenous birds are small and low in meat and egg production (EARO, 2000). Tadelle (1996) and Alamu and Tadelle (1997) reported an annual production of 40-60 small-sized eggs/bird/year by scavenging hens. On the other hand, the modern poultry production system is limited and confined to urban and peri-urban areas and contributes less than 2% of egg and meat production in the country.

Ethiopia needs to intensify livestock production, particularly poultry production systems to be able to feed her people and ensure food security. Poultry production has, thus, the potential to create both rural and urban employment, improve the nutritional status of the people and can be easily sold in time of economic difficulty to generate income (EARO, 2000). However, Delgado *et al*. (1999) indicated that the dramatic increases in consumer demand for poultry products mainly in urban areas will increase demand for poultry products and also affect availability and prices of concentrate feeds that will in turn influence the development of intensive poultry production in most developing countries.

Wide arrays of constraints hamper the development of village chicken production in rural Ethiopia, of which rampant diseases, feed problems both in quality and quantity, predation and poor housing are to be mentioned (Alemu, 1995; Tadelle and Ogle, 1996). Nevertheless, poultry diseases are the standing constraints incriminated for reduction of total flock size and impairment of performances (Ashenafi, 2000). Mortalities due to diseases are estimated between 20% to 50% but can go as high as 80% during times of epidemics (Alamargot; 1987; Alemu, 1995). Further, systemic approach of studies in poultry production is being practiced to a limited extent. The study areas of this research are also among the areas where there is a very good potential and opportunity for poultry keeping, however, there have been few studies carried out in poultry production and health in these areas. Therefore, this study was initiated with following objectives:

- To characterize the poultry production systems;
- To quantify the prevalence of selected poultry diseases;
- To determine the effects of different risk factors on the prevalence of selected poultry diseases

2. LITERATURE REVIEW

2.1. Poultry production systems in Ethiopia

Poultry production systems in Ethiopia show a clear distinction between traditional, low input systems on the one hand and modern intensive systems using relatively advanced technology in housing, feeding, breeding, marketing and processing on the other hand (Alamu, 1995).

2.1.1. Traditional (‘farmyard’) poultry production system

The chickens kept under this system comprise of various ecotypes of indigenous breeds and crosses. In addition, there are also few exotic chicken distributed in this system by the Ministry of Agriculture, research centers and colleges. About 99% of the flock in the country are raised under this system (Alamargot, 1987).Virtually every rural family other than the nomadic population practices ‘farmyard’ poultry production. It is estimated that there are on average six indigenous birds kept by every household in this system (AACMC, 1984). The system is characterized by minimum input, with birds scavenging for most of their food and no investment beyond the birds and if present, it is limited to simple enclosures. Chickens are viewed as “bank accounts” for rural households as they are conveniently converted to cash required to meet household requirements such as school fees, school books and planting seeds, and also other farm inputs (Ndegwa *et al.*, 2000).

Scavenging poultry are often fed either grain or the leftovers from the diet of humans which tends to be energy rich (Smith, 1990; Tadelle, 1990). Scavenging poultry can have a protein intake from consumption of insects and other invertebrates (Smith, 1990; Tadelle, 1990). The size of soil fauna population depends on the food supply and on the physical condition of the soil (Newman, 1989). The survey of nutritional status of village poultry in central highlands of Ethiopia based on analysis of their crop content has revealed that CP, ME and Ca intakes from scavenging poultry are below the requirements for optimum egg production and show seasonal and altitudinal variations (Tadelle and Ogle, 1996). In the same study, the main constraints of production in the region were found to be disease, predation, lack of feed, poor housing and parasites in the order of their relative importance (Tadele and Ogle, 1996).

2.1.2. Small-scale intensive production system

This is a newly emerging system which is developing in and around urban areas. The primary objective of this system is income generation. In this system small numbers of poultry (usually 40 to 500) birds) are produced along commercial lines. Exotic birds (mostly broilers) are raised using relatively modern management methods (Alamu, 1995).

2.1.3. Large-scale production systems

Modern poultry production is started in the early 1950's with the establishment of higher learning agricultural institutes. The activities of these institutions mainly focused on the introduction of exotic breeds to the country and the distributions of these genotypes to farmers with recommendation of appropriate feeding, housing, health care and other husbandry practices (Alemu and Tadelle, 1997). This was expected to have a considerable positive influence for the expansion of large-scale commercial farmers in the country. However, after 40 years of effort, the contribution of exotic birds in terms of eggs and meat production is less than 10%. A number of factors can be cited as causes for this low rate of adoption. First, one should recognize that poultry particularly exotic birds are food converters not food producers. The foodstuffs used to feed chicken are often of a quality that could be fed directly to humans. Thus, in grain deficient countries like Ethiopia, adopting intensive poultry industry will be frustrated by the severe shortage of grain to feed the animals and shortage of foreign exchange to import breeding stocks and other associated inputs. Unless the grain production and foreign exchange reserve in the country is improved, such a system can not be economically sustainable and socially acceptable (Tadelle, 2003).

2.2. Flock characteristic and different ecotypes

The traditional production system is characterized by high variability in flock sizes and management practices. The flock structure in village chicken productions of Ethiopia is characterized by Rushton (1996). He reported that the village chicken flock was composed of 3.4 hens, 1.31 cocks, 1.66 growers and 2.87 chicks. He further noted that egg production and chick survival are the key parameters on village chicken flock characteristics.

Indigenous birds in the country differed widely in plumage colour, comb type, down colour, feather cover and morphometrical variables. Pandey *et al*. (1993) reported that in Tepi region, more than 50% of the chicken were found to be of the naked neck type and predominantly vertical in their body positions. Birds in Tilili and Chefe market sheds were taller and heavier compared to birds from the other regions. Jarso birds exhibited an intermediate body position. These distinctive differences in body shapes were particularly manifested in male chicken. The plumage colour of birds in Tilili and Tepi were predominately red with black down colour or black, respectively, but the other ecotypes showed considerable heterogeneity.

2.3. Socio-economic aspects of poultry production

Poultry has been providing cash income for the farmers in the rural areas from the sales of eggs and chickens particularly during holidays and festivals and they also sell birds when they need to meet a cash requirement for small household expenditures. The scavenging chickens also serve as an efficient waste disposal system converting left-over grains and food, and insects in to valuable protein (Dessie, 1996).

Poultry create also good opportunity for wives to get manage income generated from poultry. This is because management of poultry has been associated with women for various historical and social reasons (Bradley, 1992). Survey in four African counties (Ethiopia, Gambia, Tanzania and Zimbabwe) showed that women dominate most activities except for shelter construction and marketing (Kitalyi, 1998).

2.4. Poultry feed resources and feeding

2.4.1. Scavenging feed resource base (SFRB)

Scavenging feed resources can be categorized into three main groups: (1) household wastes; (2) materials from the environment such as protein sources (worms, snails, termites insects, grasshoppers and frogs), grain products (rice, maize and rice and maize bran), green leaves and seeds and (3) Cultivated and wild fodder materials such as grasses, herbs, fodder trees and aquatic plants (lemna, azolla, duckweed, water spinach etc) (Roberts, 2000).

The scavenging feed resource base (SFRB) is not constant, and the proportion that is available varies with season and the extent of activities such as land preparation, sowing, grain harvesting and processing. The availability also varies with grain abundance in the household, and the life cycle of insects and other invertebrates (Dessie, 1996).

As in most other sub-Saharan African countries (Sonaiya, 1998), the largest proportion of the feed of village chickens in Ethiopia is based on free-range scavenging feed resources (Tadelle and Ogle, 2001). The amount of feed available for scavenging in relation to the carrying capacity of the land areas and flock dynamics across the different seasons and agro-ecologies is still not quantified. However, studies on the physical quantities of nutrient supply conducted in three villages of the central highlands in Ethiopia revealed that the materials present in the crop as visually observed were seeds, plant materials, worms, insects and unidentified materials (Tadelle and Ogle, 2000). According to the same report during the short rainy season (March to May) the percentage of seeds in the crop contents was higher at all the three study sites probably because of the increased availability of cereal grains which had been just harvested. In addition, the study showed that amounts of plant materials, worms and insects were relatively higher during the rainy season (June to September).

The protein and energy supplied from the SFRB in villages of the central highlands of Ethiopia, as determined from chemical analyses of crop contents of scavenging local hens, were on average 8.8% CP and 2864 Kcal/kg ME (Table 1). The protein contents fall even lower during the short rainy and dry seasons, while energy supply is more critical in the drier months (Tegene, 1992; Tadelle and Ogle, 2000). The amount of protein supplied by the SFRB were reported to be below the protein requirement of free ranging local hens in the tropics, which is estimated at about 11g/bird/day and the ME supply could only meet the requirement of a non-laying hen (Scott *et al*., 1982; Cumming, 1992; Guarantee *et al*, 1992). This indicates that the SFRB has limitations in fulfilling feed requirements of village chicken for increased productivity. Furthermore, Tegene (1992) reported that the SFRB is critically deficient in CP and Ca.

Table 1.Nutrient compositions of the crop contents of scavenging hens

Nutrient Compostion	Mean ± SD
Dry matter (%)	50.7 ± 12.5
Crude protein (CP)	8.8 ± 2.3
Crude fiber (CF)	10.2 ± 1.6
Ether extract (EE)	1.9 ± 0.9
Calcium (Ca)	0.9 ± 0.4
Phosphorus (P)	0.6 ± 0.3
Energy (ME)(Kca1/kg)	2864.3 ± 247

Source: Tadelle and Ogle (2000)

2.4.2. Supplementary poultry feed resource

Supplementary poultry feed resources available in Ethiopia include energy, protein and mineral sources and premixes. The most important energy sources are wheat bran, maize and brewer's grains. Meat, bone and blood meal constitute the animal protein sources while oilseed cakes are sources of plant proteins. The mineral supplements are derived mainly from bone meal, limestone and salt (Alemu and Guenther, 1992). The details of the nutritional value of the supplementary poultry feeds are presented in Table 2.

According to Tadelle (1996), it was possible to attain a hen-day production of about 30% from local chickens by supplementing a combination of 15g maize and 15g noug (*Guizotia abyssinica*) cake per bird per day in the short rainy and dry seasons compared to a 14% production under scavenging conditions. In addition, the improvement in feeding resulted in increment of annual egg production of local hens by about 100%.

Table 2. Nutrient composition of supplementary poultry feeds in Ethiopia

Supplementary feeds	DM (%)	CP (%)	EE (%)	CF (%)	Ash (%)	ME (MJ/kg)
Wheat bran,	89.77	18.17	2.58	11.2	5.65	8.68
Maize feed meal	90.84	9.16	12.62	9.23	3.34	11.42
Maize grain	89.39	10.54	5.42	3.07	2.19	15.45
Brewers grains	90.00	21.54	4.43	15.68	11.88	7.58
Meat and bone meal (dehydrated)	95.69	44.68	19.89	1.81	30.58	13.6
Gossypium spp.	93.34	38.34	5.96	16.67	6.21	9.18
Guizotia abyssinica	92.67	33.11	7.43	21.67	10.12	8.77
Bone meal, steamed, dehydrated	93.82	29.65	2.00	0.52	65.8	5.27
Limestone	99.22	98.07	-	-	-	-
Salt	99.49	97.50	-	-	-	-
Alfalfa meal, seeds crushed	89.15	29.31	3.30	15.23	16.43	7.02

Source: Alemu and Guenther (1992)

2.5. Housing system

In general, there is no special housing provided for indigenous birds. In most cases (88.5%) they roosted inside the family dwelling at night, the roost being made of two or three raised parallel planks of wood. Tadelle and Ogle (2001) reported that few households (11.5%) had small enclosure outside the house as night shelters. In the same study, occasionally poultry houses were cleaned by the house wife.

2.6. Production performance

2.6.1. Egg production

Research studies on some of the indigenous birds have shown that their potential for egg production is very low. Early studies in the college of Agriculture at Alemaya University have indicated that under local management practices, the average egg production from chicken native to Ethiopian is 40 eggs per annum, whereas under experimental conditions with improved feedings, housing and health care, the production rate can be raised to 99 eggs per hen per year (Bigabee, 1965). In a study at Sodo by the WADU (Kidane, 1980), it was reported that the egg production of indigenous birds was 84 eggs per hen per year. According to a survey by the Ministry of Agriculture (1980), the average annual egg production of native chickens under village conditions is between 30 and 40 eggs, but this figure could be increased to 80 eggs when birds are provided with improved nutrition, housing and health care. A study at the Assela Livestock Farm revealed that the average production from local birds in Arsi under scavenging conditions was 34 eggs per hen per year, with an average egg weight of 38g. This equals to a total yearly production of 1.3 kg of eggs per hen. Feed efficiency of local hens was also low (Branang and plarsory 1990). About 20kg of poultry feed is needed to product l kg of eggs. These values are extremely low when compared with the productivity of exotic egg type birds that typically lay over 200 eggs per hen per year with an average egg weight of 60g. White Leghorns were observed to produce over 236 egg per hen per hen per year at Debre Zeit Agricultural Research Centre (DZARC, 1991).

2.6.2. Meat production

Only a few reports are available from researches on the meat production capabilities of local birds. The AACMC (1984) reported that local males can reach live-weights of 1.5kg by six months of age and females about 30% less. Teketel (1986) also found that under station conditions, local birds reach 61% and 85%, respectively, of the body weights achieved by White Leghorns at six months of age and at maturity. Abebe (1992) reported that local birds in eastern

Ethiopian attained 71.5% of the weight of White Leghorns at six moths of age. The mean carcass weight of the indigenous birds at six months of age was 550g, a figure significantly lower than the 875g reported for White Leghorns (Teketel, 1986).

2.7. Major poultry health problems

The problem of disease in village chickens is compounded by the interactions of different entities that are of significant importance to the disease epidemiology. At the village level, contacts between flocks of different households, the exchange of birds as gifts or entrusting, sales and purchases are the main source of infection and routes of transmission. Similarly, other domestic fowls and wild birds also serve as sources of infection because the chickens in village system roam freely in the surrounding. Andy (1993), describing the epidemiology and economics of village poultry production in Africa, suggests the need to develop appropriate epidemiological techniques for village poultry, because of the nature of the host-pathogen-environment interaction in village chickens. The complex nature of disease epidemiology in village chickens is found both in epizootic as well in enzootic diseases (Pandey *et al*., 1993).

The most common disease symptoms observed by farmers under village conditions are presented in Table 3. Although farmers are familiar with the signs and symptoms of disease, the underlying causes are less well known.

2.7.1. Viral and bacterial diseases

Newcastle disease

Newcastle Disease (ND) is a highly contagious and commonly fatal viral poultry disease, which is present allover the world (Aini, 1990; Spradbrow, 1999). It is characterized by lesions in respiratory tract, visceral organs and brain and causes moderate to serve mortality and morbidity in susceptible flocks (Hanson, *et al*., 1978). In many tropical and subtropical countries virulent strains of ND virus (NDV) are endemic (Spradbrow, 1990) and cause serious economic losses (Atienza, 1987; Supramaniam, 1988; Martin, 1992).

Table 3.Symptoms of poultry diseases as described by poultry keepers

Signs	Frequency (%)
Chickens huddle together	16.1
Coughing, sneezing, rapid breathing	13.2
Discharge from mouth and nostrils	10.9
Dullness, no appetite, closed eyes	10.9
Paralysis of legs and wings	9.2
White droppings	8.6
Turned or twisted neck	8.0
Dark red colour of head and comb	6.9
Greenish or yellow droppings	4.6
Bloody reddish droppings	4.0
Swellings of head and comb	2.9
Pale comb	1.7
Worms in faeces	1.7
Eye worm	1.1

Source: Ramm *et al.*, 1984

In Ethiopia, Newcastle disease is the most important cause of economic loss in poultry production. The first documented evidence of ND in Ethiopia dates back to 1971 and is was reported in Eritrea. The Epidemiology of ND in village birds is poorly understood. This is due to the failure on the part of the backyard owners to notify outbreaks. And the disesae appears to be most important and re-occurring every year. Chicken mortality due to the disease in rural areas is as high as 80%. Most of the time the disease outbreaks occur during the rainy season between the months of May and July (Almargot, 1987).

Serological studies in village chickens were made in several countries. Positive serological results in unvaccinated adult birds are clear evidence of exposure to NDV. According to Thitissak *et al*. (1989), the mean HI titre for ND was high in newly hatched chicks, and declined as maternal antibodies disappeared at about 90 days. Thereafter, mean titres rose steadily as the age of birds increased, peaking in birds 3 years of age. However, the proportion of sero samples was not stated. In Morocco, Bell and Moulodi (1988) found a seroprevalence of 5-83% in village chicken in different regions. High prevalences of Newcastle disease were found in Niger (72%) (Ezeokoli *et al*., 1984) and Benin (56-69%) in traditionally managed backyard flocks. Lower prevalence was reported in Tanzania (13.3%) (Minga *et al*., 1989). In Ethiopia, 43.68 % seroprevalence was reported in the cool central highlands (Ashenafi, 2000) while 19.78% seroprevalence was found in the rift valley (Aschalew *et al*., (2005).

Fowl typhoid

It was given the name fowl typhoid in 1902 and recognized as a clinical entity distinct from fowl cholera. The causal organism is Salmonella gallinarum. Fowl typhoid differs from other avian salmonella infections in that the clinical disease is usually seen in growers or adult birds, although chicks can be affected. (Clifford and Robert, 2002).

Fowl typhoid is transmitted by either horizontal or vertical mode of transmission (Berchieri *et al*., 2001). The chickens may be exposed to fowl typhoid disease at a very young stage without showing any morbidity or mortality. They can harbor infection until they develop to layers and then produce infected eggs (Mcllroy *et al*., 1989; Wigley, 2001). Poultry feed, water or litter is among the important means of transmission (Shivaprashad, 1997). Under favorable conditions, S. gallinarum can persist in the feces for at least one month and in infected carcasses for a prolonged period of time (Wray *et al*., 1996).

Fowl typhoid can appear in either hyper acute, acute or chronic forms. In hyper acute forms, the birds may die without showing predominant clinical signs (Shivaprasad, 2000). In growers and adults, watery to mucoid yellowish diarrhea is the most characteristic clinical signs in the acute phase of the disease (Shivaprasad, 2000). In case of a chronic form, severe anemia is the predominant sign (Assoku and Penhale, 1974). In addition to these, progressive loss of body weight reduced feed consumption and egg production, ruffled feathers, shrunken pale combs and wattles are the characteristic signs (Wray, 1996). The chicks exhibit lassitude, huddle together, have droopy wings, pasted vent, labored breathing and distorted body appearance (Shivaprasad, 1997). *S. gallinarum* reduces the laying capacity by 50% and hatchability by 14.96% (Tran and

Dao, 2000). In Ethiopia, Melese (1991) reported an incidence rate of 16.05% in commercial layers and replacement pullets around Addis Ababa and Debre Zeit. In another reports, Lobago, *et al*., (2003) were confirmed based on the bacteriological examination of tissue samples; salmonella gallinarum was isolated in 23 cases in debreziet commercial poultry farm.

2.7.2. Parasitic diseases

External parasites (Ectoparasites)

External parasites of poultry include arthropods that live on or in the skin and feathers (Arends, 2003). Lice are permanent ecto-parasites, spending their entire life cycle on the host. The life cycle lasts approximately 3 weeks depending on the temperature and humidity. As many as 60 eggs are laid by the adult female louse and are glued to the host's feathers. A pair of lice may produce 120,000 descendants within a few months (Arends, 1991). Mites do not spend their entire life cycles on the bird, except for the scaly leg mite. Adult mites spend most of their lives on the host but will wander from the bird into crevices and cracks. Adult female mites complete egg laying in two days and the number of eggs laid average 2 to 5 per female (Hinkle, 1996).

DeVaney, (1980) reported that mammals might act, as temporary carriers for *A. persicus*, but completion of the life cycle require an avian host. The life cycle takes about 7 to 8 weeks in the warm dry season and longer during the cold season (Soulsby, 1982). The adults feed once a month and the females lay eggs after each meal. One batch consists of 20-100 eggs.

The nymphs and adults are nocturnal in their behavior and may survive without a blood meal for more than 5 years in cracks or other suitable places (Permin and Hansen, 1998). The female flea lays up to 20 eggs at a time and about 400-500 during her lifetime. The rate of development of the flea to adult stage greatly varies depending on temperature and humidity. The life cycle is, however completed in one to two months under optimal conditions (Soulsby, 1982, Arends, 2003). In Ethiopia, different types and degree of ectoparasites were recorded by Gedion, 1991, Ababa *et al* 1997 Bersabeh, 1999, and Ashanafi, 2000).

Internal parasites

Internal parasites are very common in scavenging chickens and may result in sub-clinical diseases when they occur in lower numbers (Magwisha *et al*., 2002). They have also immuno-suppressive effect enhancing the pathogenic cite of other diseases (Permin and Pedersen, 2002). The most important internal parasites of chicken are classified as Eimeria species and helminthes.

Eimeria species are causes a disease called coccidiosis, which is important in poultry production (Reid and McDougald, 1991). *Eimeria* multiply in the intestinal tract and cause tissue damage, with resulting interruption of feeding and digestive process or nutrients absorption; dehydration; blood losses and increased susceptibility to other disease agents (McDougald, 2003).

Helminthes are classified as nematodes, cestodes, and trematodes (Permin and Hansen, 1998). These parasites are using the host as a food source and hence cause irritation to tissues they are feeding on, loss of nutrients, transmission of diseases as they move from one animal to another, and in general reduction on the overall health of the host. According to Permin and Hansen (1998), the parasites contribute significantly to low productivity levels. The most common helminthes in poultry along with their predilection site and mode of life cycle are presented in Table 4. Nematodes are the most common and important helminth species in poultry both in terms of number of species and pathology. More that 50 species have been described in poultry (Norton and Ruff, 2003).

Table 4.The most common helmithes in poultry with predilection sites and mode of lifecycle

Parasite	Predilection sites	Life cycle	Intermediate host
Nematodes			
Oxispirura mansoni	Eye,lacrimal duct	Indirect	Cockroaches
Syngamus trachea	Trachea	Direct/ Indirect	Earth worm,snails
Capillaria contorata	Mouth,oesophagus,crop	Indirect	Earth worm
Capillaria annulata	Oesophagus,crop	Indirect	Earth worm
Gongylonema inguvicola	Oesophagus,crop,proventriculu m	Indirect	Beetle,Cockroaches
Echinura uncinata	Oesophagus, proventriculum,gizzard,small intestine	Indirect	Water fleas(genusDaphnia)
Dispharynxnasuta	Proventriculem	Indirect	Sowbug
Tetrameres spp	Proventriculem	Indirect	Grasshopper, Cockroaches
Cheilospirura hamulosa	Gizzard	Indirect	Grasshopper,beetle
Ascaridia galli	Small intestine	Direct	
Heterakis gallinarum	Cecum	Direct	
Acuria hamulosa	Gizzard	Indirect	Grasshoper,beetle
Alodapa Suctoria	Caeca	Indirect	Beetle Cockroaches
Stronyloides avium	Caeca	Indirect	
Cestodes			
Choanotaenia infundibulum	Small intestine		Slug, Snail
Davainea proglottina	Small intestine		Beetle
Hymenoolepis spp	Small intestine		House fly, beetle
Raillietina spp	Small intestine		Ant

Source: Norton and Ruff, 2003

Several species of cestodes (tapeworms) may live in the intestinal tract of chicken. More than 1400 tape worm species have been described in domesticated poultry and wild birds. They are commonly encountered in poultry from free-range or backyards flocks (Ruff, 1999). These parasites are found more frequently in the warm seasons, when intermediate hosts are abundant (McDougal, 2003).

The prevalence of helminthes was reported by different authors from different parts of the world. Abebe *et al* (1997) reported an overall prevalence of 97.9% in rural chicken in Ethiopia. Very close prevalence values were reported by Hassen (1996) (94.5%) in Pakistan, Ayeni (1973) (94.3%) in Nigeria, Mpoame and Agbede (1995) (93.7%) in Western Cameroon and Yadav and Tandon (1991) (90.9%) in India. Slighter lower values were reported by Negesse (1993) (88%) in Leku (Southern Ethiopia), Saad *et al*. (1989) (77.3%) in Sudan.

2.7.3. Miscellaneous diseases

Ascities is an accumulation of non-inflammatory fluid in one or more of the peritoneal cavities or potential body spaces. It is an increasingly common condition in broilers. Although seen at higher altitudes, the condition also occurs at sea level (Urequart *et al*., 1987).

3. MATERIALS AND METHODS

3.1. Study area

The study was conducted in three districts of Eastern Shoa Administrative Zone. The districts include Lume, Gimbichu and Boset which are located within 160km radius southeast of Addis Ababa.

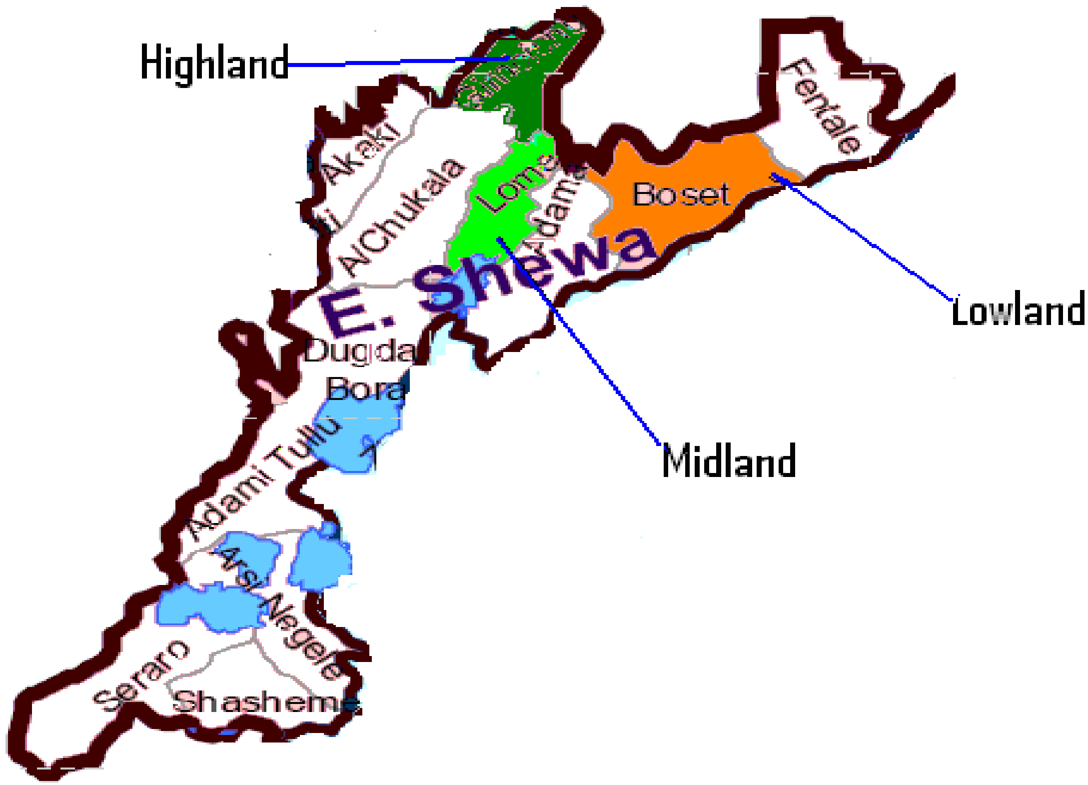

Figure 1 Map of East Shoa Showing the locations of village where the study was done.

The Zone covers about 109,571 hectares of land and has 101 administrative units (kebeles). From the total land coverage about 31.60% of the land area is highland, 47.7% midland and 20.61% lowland. Among the 101 kebeles, 33 are located in high land, 53 in midland and 15 in low land. There are about 45,662 hectares in the study areas.

The highlands have elevation over 2300m with isolated high peaks as well in the rift floor. These areas experience a mean annual temperature of 10 to 15^{0}c. Regarding annual rainfall, the highlands enjoy maximum rain. The southeastern highland sections of the Zone receive up to

1400mm mean annual rainfall. The northeastern extreme part of the Zone including pocket of areas of the rift floor with elevation between 1000-1500m, come under mean annual temperature category of 20-25^{0}c (ESRPED.,1999). The rift valley floor of East Shoa Zone, because of its low elevation and its distance from the rain bearing winds, receives mean annual rainfall of 700-800mm.

The whole of East Shoa Zone, except Fentale, Northeastern Boset and the lake regions of the rift floor come under the category of mixed crop-livestock farming where crop and livestock productions are integrated. In the few exception areas, pastoralism is the dominant means of livelihood. The Zone owns about 43.3% of cattle, 33.4% of sheep, 6.9% of goats and 16.4% of pack animals in the Oromia Regional State (ESRPEDO, 1999). In addition, East shoa is among the top poultry producing zones of the Regional State. It ranks fourth in poultry population and had the highest poultry density (60.9/km^2) in the Region (ESRPEDO, 1999).

3.2. Study population

The smallholder farmers keeping poultry in the study districts and the chicken population kept by these farmers represented the study population.

3.3. Study design

A cross-sectional type of study was carried out from October 2006 to April 2007 to collect data on the poultry production system characteristics and major poultry health problems in the study areas using structured questionnaire and field survey of selected poultry diseases (GI-helminthes, external parasites and two specific infectious diseases (Newcastle disease and fowl typhoid).

3.4. Sample size determination and sampling method

In this study, smallholder farmers were considered as the sampling units and the list of all small holder farmers keeping poultry in the selected districts and kebeles were taken as sampling frames. The sampling procedure followed was the one recommended by (Arsham, 2006) as follows:

$$N= 0.25/SE^2$$

With an assumption of 5% standard error, the total number of sample size required was 100. Thus, 100 households were selected from Gimbichu and Boset Districts and 101 households were selected from Lume Districts which made a total of 301 households.

The districts were selected purposely considering their climatic condition, status of poultry keeping and accessibility for field survey. Then, a stratified type of random sampling was carried out to select two kebeles from each district and then 50 households from each kebele. The selected kebeles were Lemlem Chefe and Haro seftu from Gimbichu, Tuluree and Jogo from Lume and Kachacule and Bole from Boset Districts.

For the study of the prevalence of selected poultry diseases (internal and external parasites, Newcastle disease and fowl typhoid) a total of 328 adult chickens were purchased from local markers of Gimbichu, Lume and Boset districts.

3.5. Data collection

3.5.1. Questionnaire Survey

A structured questionnaire was prepared and pre-tested on 5 households in each selected kebele to check the appropriateness of queries and amend as the need arises. Then a single visit interview was carried out to collect data from 301 households. Data collected using questionnaire include socioeconomic characteristics of farmers, chicken production system characteristics, chicken management practices, performances on chicken, constraints of chicken production and major health problems of chicken (Annex 1).

3.5.2. Necropsy of chicken and collection of helminths

After the clinical examination performed, study chickens were euthanized and necropsy examination carried out following the procedures described (Zander *et.al*, 1991).Then body of each chicken was eviscerated and the alimentary canal separated, removed and legated at esophageal and cloacae ends. The alimentary canal from each chicken was opened longitudinally with a pair of scissors. The contents of the alimentary canal were washed and sieved. All the larger helminths were picked up from the sieve with thumb forceps while the smaller adult worms were identified directly under the stereomicroscope using at 40 x magnification. Once identified and counted all the adult parasites were transferred to 70% alcohol. All helminths were identified using helminthological keys of Soulsby (1982) and Toncy (1989). Cestodes were counted by their Solaces.

3.5.3. Identification of external parasites

Ectoparasites were collected from the head, the areas under the wings and thighs and stored in 70% alcohol for identification as fleas, lice, mites and ticks. Alcohol (70%) was applied on the skin before ectoparasites were collected from different areas of skin (heads, areas under wings and thighs) using forceps. To collect ectoparasites from legs, the skin (scale) was scrapped and ectoparasites collected using forceps. The ectoparasites were then stored in potassium hydroxide (10%). The identification was carried out using a light microscope at 40X magnification.

3.5.4. Serum collection for serological studies

A total of 328 adult chicken blood samples were collected from the humeral region of the wing vein with a syringe and needle of 3ml size. Each sample had a volume ranging from 2 to 3ml. The syringe with blood was then kept horizontally until the blood clotted. After clotting the syringe was returned to a vertical but inverted position and left on a bench overnight to permit the serum to ooze out. The separated serum was transferred into eppendorf tubes, labeled and stored at -20^{0}C until the Haemagglutination-Inhibition (HAI) test was carried out at National Veterinary Institute, Debre Zeit (OIE, 2004).

3.5.5. Haemagglutination-Inhibition (HAI) Test:

HAI test was used to detect antibodies of Newcastle disease. The test was done according to the procedures of Beard (1989) and OIE (2000). The test was carried out by running two fold dilutions of equal volumes (0.025 ml) of phosphate buffered saline (PBS) and test serum (0.025 ml) in a U-bottomed micro titer plates. Four haemagglutinating units (HAU) of virus/antigen were added to each well and the plate were left at room temperature for a minimum of 30 minutes. Finally 0.025 ml of 1% (v/v) chicken RBCs was added to each well and, after gentle mixing, the RBCs were allowed to settle for about 40 minutes at room temperature. The HI titer was read from the highest dilution of serum causing complete inhibition of four HAU of antigen. The agglutination was assessed by tilting the plates. Only those wells in which the RBC titer stream at the same rate as control wells (containing 0.025 ml RBC and 0.05ml PBS only) were considered to show inhibition. A titer greater than or equal to 3(log to base 2) was taken as positive.

3.5.6. Slide Agglutination Test

This test was used to detect the antibodies of fowl typhoid. Fresh blood samples were collecting from the brachial vein of chickens using 5ml disposable syringe. The disposable syringe that contained blood was put in slant position for an hour. Then clear serum was harvested using a clean microscopic slide. A drop of 25µl crystal violate stained antigen was dropped in the center of each slide. Then a drop of 25µlof the harvested serum was added into the antigen which was dropped on the slide. By using a fine glass rod, the drops of antigen and serum were mixed. By using gentle rocking motions the mixed drops were agitated for about 2 minutes. The reaction was judged as positive whenever there was easily visible clumping of the antigen within 2 minutes or negative otherwise (OIE, 2004).

3.6. Statistical analysis

Data collected were entered and stored in Microsoft Excel (2003). Summarization of data by descriptive statistics was done by SPSS (Release 11.5, 2002). The prevalence of the occurrence of individual helminth species in the alimentary canal of chicken was calculated as the percentage of the total sampled chicken (Thrust field, 1995). The GLM procedure of SAS (SAS Institute Inc., Cary, NC, USA) was used to compare prevaelnces and parasitic loads. The association of prevalence to three agro-climatic zones and sex groups was analyzed using Chi-square statistics. Worm burdens were compared using ANOVA.

4. RESULTS

4.1. Socioeconomic and farming system characteristics

4.1.1. Socio-economic characteristics

In the study, the average age of household heads was within the range of 36.6-37.3 years in all the study areas. The average family size was also comparable in the three districts (5.02-5.4 persons). The same trend was observed regarding the average total land holding per household. It ranged from 1.71 ha in Lume District to 2 ha in Boset District. The land use pattern was also the same in the study districts. From 11.76% (Lume) to 15.29% (Boset) of the total land size was used for grazing while the remaining greater proportions were used for crop cultivation (Table 5).

Table 5. Mean and standard errors of age of household head, family size and land holding

Variable	Overall		Gimbichu		Lume		Boset	
	N	Mean (SE)	N	Mean (SE)	N	Mean (SE)	N	Mean (SE)
Age of decision maker	301	37.02±0.50	100	37.13±0.82	101	37.28±0.90	100	36.56±0.91
Family size	301	5.21±0.09	100	5.24±0.15	101	5.34±0.17	100	5.02±0.16
Land holding	301	1.88±0.09	100	1.95±0.14	101	1.71±0.12	100	2.00±0.18
Crop land	301	1.65±0.08	100	1.73±0.12	101	1.53±0.11	100	1.70±0.15
Grazing land	301	0.22±0.02	100	0.22±0.04	101	0.18±0.03	100	0.26±0.03

The sex and educational level of household heads in the study areas are presented in Table 6. In general, most of the households were headed by males (82.39 %) and the majorities were literate at least at basic education level (65.45%). The representation of females as household heads was highest in Lume (22.77%) followed by Boset (17%) and Gimbichu (13%). The level of literacy was also highest in Lume (84.15%) followed by Gimbichu (60%) and Boset (52%).

Table 6. Frequencies and proportions of sex and educational status of sampled households

Variable	Overall		Gimbichu		Lume		Boset	
	N	Proportion (%)	N	Proportion (%)	N	Proportion (%)	N	Proportion (%)
Sex of household head	301		100		101		100	
Male	248	82.4	87	87.0	77	76.23	83	83.0
Female	53	17.6	13	13.0	23	22.77	17	17.0
Educational status	301		100		101		100	
Illiterate	104	34.55	40	40.0	16	15.84	48	48.0
Primary school	135	44.85	42	42.0	53	52.47	40	40.0
Secondary school	62	20.60	18	18.0	32	31.68	12	12.0

N= number of observation, %= proportion of interviewed farmers

4.1.2. Farming system characteristics

About 76.7% of the households in all the study areas were practicing mixed crop-livestock system, while the remaining 23.3% were involved only in livestock production. In more than 65% of the sampled households, the purpose of keeping cattle was mainly for draft purpose, followed by dairy (34%) and beef (1%). The major crops grown in the study area are cereals, pulses and oil crops. Cereal crops covered about 81.93% of the total land allocated for cultivation. Teff, wheat, and barely were cereals cultivated in the highland while teff and wheat were grown in the midland. In the lowland, maize and sorghum were the most common cereals grown. Among the pulses, haricot bean and lentils were grown mainly in the highland and midland areas. From the oil crops, linseed and noug were grown on few hectares of land in the highland and midland areas.

The total livestock herd size per household in each district was comparable. The highest value was found in Gimbichu (12.91 heads). In Gimbichu (37.42%) and Lume (40.58%) Districts, the largest proportion of the livestock herd was contributed by sheep. In Boset District, the livestock herd was dominated by cattle (36.85%). The number of goats and donkey in the three districts was comparable. The number of horses in Lume District (0.71) was about twice those in Gimbichu (0.36) and *Boset* (0.29). In general there was no much difference in cereals, pulses and oil seeds yield per hectare per household. The highest cereals yield per household was found in Gimbichu (2.44 tons/ha) while the highest pulse crops yield was found in Lume (0.54 tons/ha). About 0.4-0.5 tons/hectare of oil seeds were produced in the study districts (Table 7).

Table 7**.** Mean and standard errors of livestock herd composition and annual cereal production

Variable	Overall		Gimbichu		Lume		Boset	
	N	Mean (SE)	N	Mean (SE)	N	Mean (SE)	N	Mean (SE)
Livestock herd size	301	12.18±1.32	100	12.91±1.12	101	12.15±1.28	100	11.48±1.55
Cattle herd size	301	3.51±0.34	100	3.25±0.24	101	3.05±0.32	100	4.23±0.45
Sheep flock size	301	4.22±0.37	100	4.83±0.32	101	4.93±0.53	100	2.90±0.27
Goat flock size	301	1.98±0.47	100	2.04±0.40	101	1.73±0.30	100	2.18±0.71
Donkey	301	2.11±0.09	100	2.08±0.09	101	2.15±0.08	100	2.09±0.09
Horse	301	0.36±0.05	100	0.71±0.07	101	0.29±0.05	100	0.08±0.03
Cereal yield (ton/ha)	301	1.97±0.03	100	2.44±0.01	101	2.07±0.01	100	1.41±0.02
Pulse yield (ton/ha)	301	0.42±0.01	100	0.34±0.01	101	0.54±0.02	100	0.38±0.00
Oil seed yield (ton/ha)	301	0.04±0.01	100	0.05±0.01	101	0.05±0.01	100	0.03±0.00

4.2. Poultry production characteristics

4.2.1. Objective of poultry keeping

The main objectives of keeping chickens were production of chickens for egg and meat purposes. In general, poultry products were used as sources of income (84.4%) and to rear chicks for replacement flock and household consumption (11.6%). A few proportion of the farmers were also keeping poultry for cultural purposes (4%). The same trend was observed in the three districts (Table 8).

Table 8**.** Functions of poultry products in the three districts

Variable	Overall		*Gimbichu*		*Lume*		*Boset*	
	N	Mean (SE)	N	Mean (SE)	N	Mean (SE)	N	Mean (SE)
Source of income	301	254 (84.4%)	100	82(82.0%)	101	89(88.1%)	100	83(83.0%)
Own consumption & replacement	301	35(11.6%)	100	12(12.0%)	101	9(8.9%)	100	14(14.0)
Cultural	301	12(4.0%)	100	6(6.0%)	101	3(2.9%)	100	3(3.0%)

4.2.2. Poultry flock size and composition

The overall average poultry flock size for the study areas was 7.53. The highest flock size was found in Lume (8.12) followed by the values of Boset (8.03) and Gimbichu (6.45). In general, the poultry flock was dominated by chicks (52.19%). This trend was also seen Gimbichu (53.95%), Lume (50.49%) and Boset (52.30%). Hens had the second highest proportion in the poultry flock in all the study areas (35.65-38.61%) (Table 9).

Table 9**.** Mean and standard errors of poultry flock composition in the three agro-ecologies

Poultry flock composition	Overall		Gimbichu		Lume		Boset	
	N	mean±SE	N	mean±SE	N	mean±SE	N	mean±SE
Total flock size	180	7.53±0.31	100	6.45±0.29	101	8.12±0.55	100	8.03±0.66
Hens	180	2.81±012	60	2.30±0.11	60	3.03±0.17	60	3.10±0.29
Cocks	180	0.91±0.04	60	0.82±0.05	60	0.98±0.06	60	0.92±0.09
Chicks	180	3.93±0.21	60	3.48±0.22	60	4.10±0.43	60	4.20±0.39

The study on poultry flock dynamics revealed that a total of 5.18 chickens were added to the flock and 5.48 chickens left the flock in last year (1998 E.C). Most of the additions to the flock were due to hatching (82.05%) and the rest were added by purchasing (17.95%). The major reason for reductions of the flock size was due to sales (44.16%) and chick mortality (42.52%). The remaining 11.31% and 2.0% of the reductions were due to adult chicken mortality and household consumptions, respectively. The same trend was observed in the three agro-ecological zones except the findings that in Gimbichu, here was no chicken consumed by the households.

4.2.3. Poultry housing

The majority of the households had a night shelter for poultry (56.8%) while significant proportions were sharing the family house (34.9%). The remaining 8.3% had separate houses for poultry. Almost the same trend at different proportions was observed in the three districts. The proportion of households having night shelter in Gimbichu, Lume and Boset was 75, 40.6 and 55%, respectively. Poultry houses were sharing the family house in 22, 42.6 and 40% of the households in Gimbichu, Lume and Boset, respectively. Separate house was provided by 3, 16.8 and 5% of the households in Gimbichu, Lume and Boset.

4.2.4. Poultry feeding

The majority of the households (69%) in Gimbichu, about half of the households in Lume (49.5%) and about a quarter of the households in Boset (26%) were providing supplementary feeds to poultry. In Boset, most of the households (74%) were dependent on scavenging feed resource for poultry. The scavenging feed resources in the study areas included household leftovers, green plants, termites, worms and other insects. In the lowland area (Boset), there is scarcity of water, thus, water supply to poultry was unreliable.

4.2.5. Poultry flock management

In all the districts, poultry management was the responsibility of women in general (81.1-91%) and wives in particular (67.3-73%). Women were attending poultry in 70, 67.3 and 73% of the households in Gimbichu, Lume and Boset, respectively. Daughters were involved in poultry management in 16, 13.8 and 18% of the households in Gimbichu, Lume and *Boset*, respectively (Table 10)

Table 10. Labor distribution for poultry production among family members in the three districts

Variable	Overall		Gimbichu		Lume		Boset	
	N	Frequency (%)	N	Frequency (%)	N	Frequency (%)	N	Frequency (%)
Women	301	211(70.1%)	100	70(70.0%)	101	68(67.3%)	100	73(73.0%)
Men	301	27(9.0%)	100	9(9.0%)	101	12(11.9%)	100	6(6.0%)
Daughter	301	48(16.0%)	100	16(16.0%)	101	14(13.8%)	100	18(18.0%)
Son	301	15(5.0%)	100	5(5.0%)	101	7(7.0%)	100	3(3.0%)

4.2.6. Poultry breeding

In the study area, the common breed type was the indigenous chicken, but there were also exotic breeds introduced by Regional Agricultural Office. The community selected female chickens by different selecting characters such as color, egg productivity and body weight. Very close values of hatchability were found in the three agro-ecologies. The highest hatchability was found in the lowland area (Boset) (83.69%). Slightly lower hatchability was found in the highland area (Gimbichu) (82.99%) followed by value in the midland (Lume) (79.24%).

4.2.7. Poultry health problems and disease control

Nearly all the respondents (93.7%) complained that poultry disease problems were severe and fatal during the main rainy season (from late June to end of August). The most common symptoms observed by the households were loss of appetite, watery and yellowish droppings, paralysis and consequently death. There was in general lack of veterinary service in the areas, thus, farmers tended to use traditional medicaments such as feto (*Brassica spp*), garlic, areke (local beverage) and grawa (*Vernonea amygdalon*).

The major causes of mortality mentioned by the selected households were disease, predators, nutritional deficiency and harsh climatic conditions. The most commonly encountered predators were domestic cats, birds of prey like eagles and foxes. The average crude mortality rates found were 74.8% for chicks and 26.9% for adults. Table 11 depicts the results of the comparison of mortality of chicken in the three districts (agro-ecologies). The overall number of mortalities in each household for chicks and adults were 2.33 chicks and 0.62 chickens, respectively. There was significant difference only in adult mortality between the three agro-ecologies. The number of dead adult chicken was higher in the highland (0.98) than in the lowland (0.45) and midland (0.42).

Table 11**.** Comparison of chick and adult mortality in the three agro-ecological zones

Factors	Group	N	Chick mortality	Adult mortality
			LSM (SE)	LSM (SE)
Overall mean		180	2.33 (0.12)	0.62 (0.09)
Agr-ecology			NS	*
	Highland (Gimbichu)	60	2.57±0.18	0.98±021
	Midland (Lume)	60	1.97±021	0.42±0.12
	Lowland (Boset)	60	2.47±0.21	0.45±0.13

N= number of observations, NS=not significant, * $p<0.05$

4.3. Seroprevalence of fowl typhoid and Newcastle disease

4.3.1. Seroprevalence of fowl typhoid

The overall seroprevalence of fowl typhoid in the study areas was 22.87%. Sex had significant effect on the seroprevalence of fowl typhoid ($p<0.05$). The seroprevalence was higher in male (27.61%) than females (18.18%). Although there was no significant effect of agro-ecology ($p>0.05$), the highest prevalence was observed in the lowlands (27.78%). The prevalence rates in the highland (20.95%) and midland (20.0%) were very close. (Table 12).

Table 12. Comparison of Seroprevalence of fowl typhoid by agro-ecology and sex

Factor	Category	N	Number of sero-positives	Seroprevalence (%)
Agro-ecology	Highland	105	22	20.95
	Midland	115	23	20.00
	Lowland	108	30	27.78
	Total	328	75	22.87
		x^2		2.23
		P-value		0.330
Sex	Male	163	45	27.61
	Female	165	30	18.18
	Total	328	75	22.87
				4.13
		P-value		0.042

N= number of observations

4.3.2. Seroprevalence of Newcastle disease

The overall seroprevalence of ND was 23.17%. In this case, there was significant difference in seroprevalence between agro-ecologies ($p<0.05$). On the other hand, there was no significant difference between sexes ($p>0.05$). The highest seroprevalence was recorded in the lowlands (30.56%) followed by midland (24.35%) and lowland (14.29%). (Table 13).

Table 13**.** Comparison of seroprevalence of Newcastle Disease by agro-ecology and sex

Factor	Group	N	Number of seropositive	Seroprevalence (%)
Agro-ecology	Highland	105	15	14.29
	Midland	115	28	24.35
	Lowland	108	33	30.56
	Total	328	76	23.17
		x^2		7.33
		P-value		0.026
Sex	Male	163	42	25.77
	Female	165	34	20.61
	Total	328	76	23.17
				31.23
		P-value		0.268

N= number of observations

4.4. Identification of gastro-intestinal helminthes and ectoparasites

4.4.1. Identification and prevalence of gastro-intestinal helminthes

The results of Chi-square statistics to determine the effects of agro-ecology and sex on the prevalence of single and mixed helminth infections are depicted in Table 14. The overall prevalence of single and multiple infections were 35.98% and 42.68%, respectively. Significant difference was observed only in the prevalence of multiple helminth infections between the three agro-ecologies ($p<0.001$). The highest prevalence of mixed infections was observed in the lowland (59.26%) followed by midland (42.6%) and highland (25.71%).

With regard to the species of helminthes identified, nine different species were found including three nematodes (*Ascaridia galli, Heterakis gallinarum and Subulura brumpti)* and six species of cestodes (*Raillietina echinobotridea*, *Raillietinea tetragona, Rillietinea cesticullus, Cohanotenia* *infundibulum, Daveania proglottinea and Amebotenia sphenoids*). The later two cestodes were found only in the highland agro-ecology (Gimbichu).

Table 14 . Comparison of single and mixed helminth infections by sex and agro-ecology

Factors	Category	N	Non-infected	Single infection (Prevalence)	Mixed infection (Prevalence)
Agro-ecology	Highland	105	31	47 (44.76%)	27 (25.71%)
	Midland	115	26	40 (34.78%)	49 (42. 60%)
	Lowland	108	14	30 (27.78%)	64 (59.26%)
	Total	328	71	117(35.67%)	140(42.68%)
				1.05	24.48
	P-value			0.59	0.001
Sex	Male	163	29	56 (34.36%)	78 (47.85%)
	Female	165	42	61 (37.06%)	62(37.57%)
	Total	328	71	117 (35.67%)	140(42.68%)
				0.78	3.54
	P-value			0.38	0.060

N=number of observations

The average worm burdens in lowland, midland and highland areas of the study area are presented in Table 15. The overall worm burden was 6.72 worms. Significant difference was observed between agro-ecologies ($p<0.05$) and sexes ($p<0.01$). The highest worm burden (7.57 worms) was observed in the lowland areas followed by the value in highland (6.53 worms) and midland areas (5.88 worms). Regarding sex of chicken, the highest worm count was seen in males (7.42 worms) than females (5.9 worms).

Table 15. Least squares means (+SE) of helminth burden of chicken by sex and agro-ecology

Factors	Group	N	LSM(SE)	P- value
Overall mean		328	6.72	
Agro-ecology	Highland	105	6.53±0.46a	0.0166
	Midland	115	5.88±0.42b	
	Lowland	108	7.57±0.41c	
Sex	Male	163	7.42±0.34	0.0025
	Female	165	5.90±0.36	

N= number of observations, LSM= least squares mean, means with the same letter suffix do not differ significantly

4.4.2. Identification of ectoparasites

In all three agro-climatic zones and in both sexes, different types of external parasites were identified. These include fleas (*Echidnophaga gallinaceamits*), mite (*Cnemidocoptes mutans*) and lice (*Goniodes dissimilis* and *Menopon* gallinae).

5. DISCUSSION

In this study, the mean value of family size was about 5.21 persons per household. This result was within the range reported by Getnet (1999) (5-7 persons) and lower than the findings of Kelay (2002) (7.54 person) for the central highlands of Ethiopia. Regarding land holding (1.88ha), our finding was relatively less than reports from other parts of the country; Getnet (1999) (3.9ha), Solomon (1996) (5.2ha) and Kelay (2002) (3.8ha), respectively. Most of the land was used for crop cultivation mainly cereals (81.93) in this study. This is in agreement with the value found by Gashaw (1992) (72.59%) for the central highlands. The small land size allocated per household in this study indicates land scarcity in the area mainly due to population growth which is a known phenomenon in the central highlands of Ethiopia. The land scarcity is worse for grazing lands, which is revealed by the very low proportion of land allocated for grazing purposes.

The type of farming system in all the study areas was mixed crop livestock system with the main crops cultivated in the areas being teff, wheat and barley in the highland, teff and wheat in the midland and maize and sorghum in the lowland. In this study area, the cereal crops covered about (81.93%) of the total land allocated for cultivation and this value is similar with that reported by Gashew(1992) (80%) at Selale areas.

The Livestock Production constitutes an important component of farmers ‘economy. These include multi purpose products and uses such as drought power, transportation, manure and fuel, means of income and skin. The livestock herd sizes per house hold found in this study was almost comparable with the area of Adea and Adama *11.44* and 11.64, respectively, and higher than the result recorded in Siraro and Sodo 9.3 and 4.8 respectively. (Hailemariam *et al*., 2006).

The main objectives of poultry production in the three agro-ecological zones in this study was production of egg and meat for income generation (84.4%). This finding is similar to those described by AACMC (1984), Teketel (1986), Alemu (1995) and Tadelle and Ogle (2001) in rural part of Ethiopia and by Van Veluw (1987) in Northern Ghana and Sonaiya and colleagues (1999) in Africa in general. The use of poultry products for income generation purpose is common to most parts of the country where a mixed crop-livestock type of farming system is prevalent.

The average poultry flock size per household found in this study (7.53) is within the ranges reported by Tadelle (1996) (4-10) in the central highlands of Ethiopia and Sonaiya (1990) (5-10) in Africa and comparable to the values reported by AACMC (1984) (6) in Ethiopia and higher than the report by Mocrad (1987) (2-5) in a village in Indonesia. Our finding was lower than the reports of Kitalyi (1998) for Ethiopia (10), Gambia (12) and Zimbabwe (20). The flock size variations could arise due to differences in farming systems and the prevalence of local factors such as diseases and predators.

The finding that the majority of the households had only a night shelter in this study is a common phenomenon in the different parts of Africa (Sonaiya, 1990; Minga *et al*., 1989; Wilson, 1979; Yami, 1995; Yongolo, 1996; Mwalusanya, 2002). Sonaiya (1990) indicated that the poor housing conditions in developing countries predispose the chickens to disease and predators.

In the highland (Gimbichu) and midlands (Lume) quiet a significant proportion of the households (69% and 49.5%, respectively) supplemented their poultry. In the lowland areas, poultry production was based mainly on scavenging feed resources (74%). The finding in the highland and midland areas is encouraging while the situation in the lowland is alarming since supplementing poultry with protein and energy rich feed resources is very much essential to ensure better productivity and health conditions. The low level of supplementation in the lowland area (Boset) could be due to the relatively poorer linkage of the area with output and input markets. The importance of location in determining the availability of supplemental feeds was indicated by Alam (1997).

In this study, it was observed that poultry management was mainly the business of women (81.1-91%) especially wives (67.3-73%) in all the agro-ecologies. Similar findings were noted in Ethiopia, Gambia and Tanzania by FAO (1993) and in rural Sub-Saharan Africa by Gueye (1998) and again in Ethiopia by Tadelle and Ogle (2001). This could be mainly due to the fact that poultry keeping is a backyard activity in the village system to which women are closer.

Indigenous chickens are the predominant type in the study area. This is also the case in village chicken production in different parts of Africa (Spradbrow, 1993). In this study, an overall high value of hatchability ranging from 79.24-83.69% was found. Similar value of hatchability was reported by Mwalusanya *et al*. (2002) (83.6%) in Tanzania and Tadelle and Ogle (2001) (80.9%) in the central highlands of Ethiopia. Hatchability is affected mainly by hygienic and incubation conditions in the nests, egg quality, nutrition of the breeding hen, genetic factors and diseases (Austic *et al*., 1990; Sainsbury, 1992). The variations in hatchability between our finding and previous reports could be explained by most of the above mentioned conditions.

In this study, nearly all the respondents (93.7%) complained that poultry disease problems were severe and fatal during the main rainy season. This has been also reported by Tadelle and Ogle (2001) for the central highlands of Ethiopia. The overall number of mortalities in each household for chicks and adults were 2.33 chicks (which is about 59.29% of the current number of chicks in a flock) and 0.62 chickens, respectively. The chick mortality was found in this study is lower than the report of Tadelle and Ogle (2001) (6) for 8 weeks old chicks. Our finding is higher than the chick mortality rate reported by Mwalusanya *et al*. (2002) (40%). The large number of mortalities is the reflections of poor veterinary services available in the study areas and also lack of hygienic practices in poultry housing and feeding.

An overall seroprevalence of 22.87% was found for fowl typhoid in this study and the prevalence was significantly higher in male chickens (27.61) than females. A much higher prevalence rate was reported by Ashenafi (2000) (64.2%) in backyard chickens. In commercial farms based on exotic birds, fowl typhoid was indicated as important by different authors. Alamargot (1987) and Meles (1991) reported 5-20% and 16.05% incidences in different farms in Ethiopia, respectively. Bhattacharya and Majumder, (2001) reported 37.76 and 68.84% seropostivity in two broiler parent-stock flocks in Bangladesh. This indicates that fowl typhoid is an important disease in both smallholder and commercial farms.

An average overall seroprevalence rate of 23.17% was found for Newcastle disease in this study. Significantly higher prevalence was found in the lowland area (30.56%). Much higher prevalence rate was reported by Eskoli (1984) (72%) in traditionally managed non-vaccinated village chickens in Nigeria. Lower value was reported by Japiot *et al*. (1990) (14%) in non-vaccinated village chickens in Niger. A very wide range of seroprevalence was found by Yongolo (1996) (25-81.5%) in different localities in Tanzania. In Ethiopia, a higher seroprevalence (43.68 %) was found by Ashenafi (2000) in the central highlands while a lower prevalence (19.78%) was reported in the Rift Valley areas Aschalew *et* al. (2005).

About 78.35 % of the chickens included in this study were infected either by single (35.67%) or multiple (42.68%) types of endoparasites. This finding is in consistent with previous reports from different regions of Ethiopia (Teshome, 1991; Gedion, 991 and Abebe *et al*. 1997 and Ashanafi and Eshetu., 2000) and also reports from tropical and subtropical regions (Fabiyi, 1972; Ayeni,1973;Senyonga, 1982; Msanga and Tungaraza, 1985; Fatihu *et al*., 1991; Yadav and Tandon, 1991; Mpoame and Agbede, 1995; Hassan, 1966; Permin *et al*., 1997; Poulsen *et al*., 2000; Magwisha *et al*., 2002; Permin *et al*., 2002). The high prevalence observed in free range (village) chickens might be due to the type of production system, which exposes animals to continuous contact with different stages of parasites and intermediate hosts (Magwisha *et al*., 2002).

In the present investigation, nine species of helminth parasites were found, which is in close agreement with the reports of Gedion (1991) (7 species) in Dire Dawa, Bersabeh (1999) (10 species) in Addis Ababa, and Permin *et al*. (1995) (13 species) in Debre Zeit but higher than the finding of Eshetu *et al* (2001) (2-6species) in Amhara region. In other countries too, multiple helminth infection is a common phenomenon in rural free ranging chickens (Ssenyonga, 1982; Samad, *et al*., 1985; Msanga and Tungaraza, 1985; Hug, 1986; Akhtar, 1987; Poulsen *et al*., 2000; Magwisha *et al*., 2002).

In this study, the identified external parasites included fleas (*E. gallinaceamits*), mites (*C. mutans*) and lices (*G. dissimilis and M. gallinae*). Similar results were recorded by Gedion (1991); Bersabeh (1999) and Ashanafi (2000) in different parts of Ethiopia. The presence of scaly leg mite (*C. mutans*) in old village chickens was reported from Zimbabwe (Permin *et al*., 2002). The presence of *M. gallinae* was identified in many reports in different areas (Torres *et al*., 1974; Lunkashu, 1974; Adene, 1975; Manuel, 1981; Manuel and Anceno, 1981; Umeche and Eno, 1987; SangvarAnond, 1993; Orkursoy and Yilmaz, 2002). The presence of these ectoparasites in general indicates lack of cleaning and hygienic practices in poultry housing, which is very common under village conditions.

6. CONCLUSION AND RECOMMENDATIONS

Poultry production was practiced in the study areas mainly as a source of income. Poultry were housed in night shelters and supplied mainly with scavenging feed resource in the lowland areas. In the highland and midland, supplemental feeds (mainly wheat and barley) played a significant role in poultry feeding. In all the agro-ecologies, poultry keeping was the business of mainly women. Indigenous breeds were the most common type of chicken found in the study areas and had high hatchability rate. The poultry health problems were severe during the wet seasons and the chick mortality was considerable. The level of adult chicken mortality was higher in the highland agro-ecology than the others.

The seroprevalence rates of fowl typhoid and Newcastle disease was moderate. The seroprevalence of fowl typhoid was significantly higher in male chickens and it was not significantly different among the three agro-ecologies. On the other hand, the sero-prevalence of Newcastle disease was significantly higher in the lowland than midland and highland areas. The seroprevalence of Newcastle disease was not significantly different among the two sexes.

A total of nine helminth parasite species were identified in the study areas including three nematodes (*Ascaridia galli,Heterakis gallinarum and Subulura brumpti)* and six species of cestodes (*Raillietina echinobotridea*, *Raillietinea tetragona, Rillietinea cesticullus, Cohanotenia infundibulum, Daveania proglottinea and Amebotenia sphenoids*). All the parasites were identified in the three agro-ecologies except *Daveania proglottinea and Amebotenia sphenoids* which were found only in the highland agro-ecology (Gimbichu). The prevalence of single helminth infection was significantly higher in the lowland area. Significantly higher adult parasite load was found in the lowland agro-ecology and male chicken.

The ectoparasites identified in selected chicken were fleas (*Echidnophaga gallinaceamits*), mites *Cnemidocoptes mutans*) and lices (*Goniodes dissimilis* and *Menopon* gallinae).

Based on these conclusions the following points are recommended:

- In the lowland areas, awareness should be created about the importance of supplemental feeding and efforts are required to create market linkages. One solution could be creation of cooperatives for acquisition of feed and disposal of products;
- Awareness should be created among farmers in all the study area about the significance of proper poultry housing in disease prevention and avoiding the impact of predators;
- The veterinary services in the area should be upgraded and special emphasis should be given to vaccination of chicken against major diseases;
- Special attention should be given to chick management to reduce mortalities associated with management factors. One solution could be provision of training in improved management and introduction of hay-box for brooding chicken under village conditions;
- Further research is recommended in the areas of ethno-veterinary practices and the nutrient value of locally available feed stuffs.

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8. ANNEXES

Annex 1. Survey of local chicken Performance in Some Selected Agro-Ecological Zone of East Shoa, Ethiopia

I. Socioeconomic and farming system characteristics

1. FARMERS NAME --
   NAME OF INTERVIEWEE --------------------------------------
   ZONE --
   DATE OF INTERVIEW --
   WOREDA --- Altitude ---------------------
   PEASANT ASSOCIATION --------------------------
   FARMER NUMBER-----------------------------------
2. Level of Education of Respondent -------------------
3. Age group of Respondent -----------------------------
   (a) Less than 20 (b) 20-30 (c) 31-40
   (d) 41-50 (e) 51-60 (f) Above 60)
4. Sex of the respondent: (a) Male (b) female
5. Farm size & household structure
   - 5.1. Farm size
     Total farm size ha____ Cultivated land_____ Grazing land ____Others in ha____
   - 5.2. Household structure
     Household head Name______ Sex --------M / F Age---------

6. Type of farming 1/ Crop-Livestock 2/ Livestock Only 3. Crop

7. Main crop and livestock products:

Crop products	Livestock products

8. Type and number of livestock kept (Year 2006)

Species	Number
Cattle	
Sheep	
Goat	
Donkey	
Horses	
Mules	
Chicken	

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

Species	Increasing*	Stable*	Decreasing*	Reason
Cattle				
Sheep				
Goat				
Equines				
Poultry				

10. How long has poultry been kept in the household?

11. What is your source of foundation stock?

12. What is the source of replacement stock?

13. What is the objective of keeping chicken?

14. What is the source of money for your poultry business?

15. What are the inputs you incur on the poultry business?

a) Stock of chicken b) Poultry feeds

c) Veterinary inputs (medicaments, vaccines and services)

d) Others (specify)

16. Is there any problem in getting the above mentioned inputs? If so, specify the problem

17. Do you have the plan to expand your poultry business? Reason out in both cases.

a) Yes (b) No

18. Is there any taboo /regulation concerning the rising of a special type of birds?

(a) Yes (b) No

17. If yes, state precisely the taboo/ regulation, and to which type of birds and category of People it applies. --

II. Poultry flock characteristics and management

1. Chicken flock composition

Chicken type	Number of chicken		
	Exotic	Hybrids	Indigenous
Cocks			
Hens			
Chicks			

2. Chicken flock dynamics

	Births	Purchases	Mortalities	Sells	Household consumptions
Cocks					
Hens					
Chicks					
Total					

3. Poultry Management system

1) Intensive (Confined all the time + feeding based totally on improved feeds)

2) Semi-intensive (Partly confined + feeding based mainly on scavenging)

3) Extensive (Kept outdoor and confined only at night + feeding total based on scavenging)

9. Who is primarily responsible for managing poultry in the household?

10. What is the role of each member of the household in poultry keeping

Family members/hired labour	Responsibility
Husband	
Wife	
Daughters	
Sons	

11. How much time (approx.) do you spend each day on poultry keeping?

a/ half a day b/ a quarter of a day

c/ hours in a day (specify)

12. How do you house chickens?

a). share the same room with the family b). Have a different shelter for night enclosure

c). separate house constructed entirely for poultry d). Others

14. What are the materials the house is made of?

15. Do you clean the chicken house? a) Yes b)/No

16. If yes, how frequently do you clean the chicken house?

a). Daily b). Weekly C). Monthly d). Less than once per month

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

18. If yes, reasons for culling

19. What do you do with the culled birds?

III. Feed resources & feeding strategy

1. How do poultry get their feed?

a) Scavenging b) Supplementation c) Both

2. If your birds are scavenging, what are the items the birds scavenge on?

3. If you provide supplemental feeds, specify the types and amounts provided per day/chicken.

4. How frequent do you feed birds per day?

5. How do you feed your birds?

a) On feeding troughs b) Throw on the ground for collective feeding

c) Others (Precise)

6. Is your feeding regime different between the different seasons? If so, how is it different?

a) Yes b) No

7. Have you ever faced seasonal shortage of feed? If so, how was it?

a) Yes b) No

8. Do you perceive any advantage due to extra/supplementary feeding of your birds? If yes, what do you think is (are) the advantages

a) Yes b). No

9. Do you provide water for your birds regularly?

a) Yes b). No

10. What is the source of water?

a). Bore whole b). River c. Other ______________

11. Is there any seasonal difference of feed availability? If yes, how is the difference?

a) Yes b) No

III. Breeds/breeding

1. Do you practice selection within your flock? a) Yes b) No

2. On which sex do you practice selection?

3. For which character(s) do you select?

a) Color b). Egg productivity c). Weight (live body weight)

d). others -----------------------

4. What type of breeding do you practice to obtain the characteristic you selected for?

a) Pure breeding b) Cross breeding

5. Which breeds of chicken have you ever crossed and for what purpose (for which characteristics?)

6. Are you interested to have exotic birds? a) Yes b). No

7. If you are given the opportunity to buy exotic chickens, which breed do you like to have? Why?

a) White leghorn b). Rhode Island Red 3. Both 4. Other

8. Do you limit the number of males running with females? a) Yes b). No

9. If yes, would you mention the ratio of male: female you normally have in your farm? ----

10. How many chickens can you afford to manage under your condition? ______

11. How do you incubate eggs destined for hatching and what is the age the egg to be incubated? What is the source of the egg to be incubated?

12. How is the broodiness of the indigenous, hybrid and exotic chicken?

13. What is the setting material?

a) Clay pot & straw bedding b) clay pot only without bedding

c) Others, specify

14. If you use a bedding material along with the setting material what do you prefer?

a) Teff straw b) wheat straw c) other

15. Do you select eggs for incubation? a) Yes b) No

16. If yes, which ones are selected in terms of size and colour?

17. Do you make any special treatments to eggs before setting? a) Yes b) No

18. If yes, how?

19. How do you position the eggs while setting?

20. Do you see any difference in the hatchability of eggs due to size of broody hen/

a) Yes b) No If yes, how is the difference?

Size* of broody hen	Eggs from local hens (range)		Eggs from RIR hens (range)		Eggs from crosses/other breeds(range)	
	No. set	No. hatched	No. set	No. hatched	No. set	No. hatched
Small						
Medium						
Large						

* Size determined subjectively by the farmers

21. Do you have any other criteria for selecting broody hens? --------------------------------

22. Is there seasonal variation in hatchability?

Season	Eggs from local hens (range)		Eggs from RIR hens (range)		Eggs from crosses/other breeds(range)	
	No. set	No. hatched	No. set	No. hatched	No. set	No. hatched

23. Management of broody hens

a). Offered additional feed & water

b). No special care than usual

c). other______________________

24. Did you try to avoid broody behaviour of hens? If yes, how?

25. How do you store eggs?

26. Is there any preference by either local, hybrid or exotic birds to their mating partner? If yes, how?

IV. Poultry products and marketing

1. Poultry productivity

Poultry productivity	Values		
	Indigenous	Exotic	Hybrid
Egg per clutch (clutch size) (number)			
Number of clutches per year			
Average No. of eggs incubated/brooded			
Hatchability of clutches (%)			
Approx. age of sexual maturity, wk. (Male)			
Approx. age of sexual maturity, wk.(Female)			
No of chicks surviving to adulthood			
Weaning age of chicks (in weeks)			
Length of reproductive life (years), Female			
Length of reproductive life (years), Male			

2. Use pattern of poultry products:

Product	Use	Proportion
Eggs		
Chicks		
Adult male		
Adult female		

3. State the unit price of any of the following products that you sell:

Season			Prices in birr per unit of product			
	Mature male	Mature female	Pullets	Growers	Chicks	Egg
Ordinary days						
Religious holidays*						
Traditional festivals						
Any other situation						

4. For what purpose do you use the money from sell of poultry or eggs?

5. Where do you sell chickens and eggs?

a) Local markets b) Regional markets

How long (in terms of time) do you travel to sell your poultry products?

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

7. To whom are you selling your poultry products?

a) Private consumers b). Retailers c). Hotels 4. Others --------------

8. Do you gather information on poultry price before you go to market?

A. Yes b. No

9. If yes, how do you obtain price information?

10. How often do you get price information from these markets?

11. Which of the above consumers provide the best price for each product?

Type of product	Difference in price
Mature male	
Mature female	
Pullets	
Growers	
Chicks	
Egg	

12.. What are the constraints of marketing poultry products?

V. Poultry health

1. Do you practice vaccination of your chicken? a) Yes b) No if yes, specify

2. Do you apply any modern drugs and medicaments? a) Yes b) No if yes, specify

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

Disease (Local name)	Major symptoms	Season of occurrence	Ages mostly affected	Local treatments

4. Do you keep different age group together? a) Yes b) No

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

a). Chicks b). Pullets c). Growers d). Adults

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

7. How do you dispose dead birds?

8. Whenever birds recover from previous diseases would you keep them for further production ?

a) Yes b) No

9. If yes don't you expect that keeping these birds would create any problem?

10. Do you normally slaughter sick birds for domestic consumption? a) Yes b)No

11. Do you experience serious disease outbreaks?

12. What do you do when birds fall sick?

a. Treat them myself c. Kill them immediately e. Nothing

b. Call in the vet. Doctor d. sell them immediately f. Traditional healer

13. If you use a traditional healer, what types of medicaments are applied by the healer?

14. In which season do you lose most of your chickens?

a. Rainy season

b. Dry season

c. Both seasons

15. What was the source of infection?

a. Own flock

b. Incoming chicken

c. Neighboring household

d. Neighbouring village

e. Unknown

16. Do you purchase any medicaments?

a. Yes b.No

17. If yes what type of medicaments did you purchase & from where did you purchase the medicaments?

VI Extension service to poultry production

1. Do you have access to extension services? a) Yes b) No

2. If yes, what are the extension services you get?

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

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

5. When did you receive these chickens? Year --------------------

6. How many chicken you have received ------ Female -------- Male ------------

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

a). Yes b). No

8. Do you discuss your poultry production problems with extension agents ?

(a) Yes (b) No

9. If no, state the reasons:

a) Have not heard of them b) Can not easily reach them

c) There is no need d) other reason(s)

10. If you, how long does it take you to reach to the extension agent?

11. How frequently do you see the agent?

VII Constraints

1. What are the constraints of poultry production in the area?

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

THANK YOU VERY MUCH FOR YOUR SINCERE COOPERATION!!

Annex 2. Serological procedures to test for ND

Preparation of 1% RBCs

- Blood was collected from two chickens older than 4 months and serologically, Negative to ND.
- Bleeding was done with a syringe containing Alsever'anticoagulant solution (equal volume) after gentle mixing, the blood was transferd to a large conical centrifuge for washing.
- The red blood cells were washed three times by gentle centrifugation in physiological saline (1500g revolutions per minute for five minutes), and by pouring of the supernatant and by adding 20 to30 volumes of physiological saline to packed cells.
- This procedure was repeated once or twice until the supernatant was clean.
- The final suspension was stored at 2-80c if not used immediately. then 1 % erythrocyte working suspension was made in PBs by mixing 1 ml of the packed cells with 99mlPBS

Titration for haemagglutinating activity of the antigen

- 50µl antigen was added in well one and 25µl PBs in the subsequent wells 2 to 12 Dilution in two-fold dilution steps was done by transferring 25 µl of the antigen from well 1 to the other wells of the first row and by thoroughly mixing each dilution step approximately, 10 times between each transfer.
- Finally 25 µl from the last well was discarded. Then 25 µl PBswas dispensed into each well (1-12) and lastly 50 µl of the 1%erythrocyte suspension was added to each well.
- Two or more wells were selected as erythrocyte controls which only contained 50 µl PBs and 50 µl 1% erythrocyte suspension, but not antigen. The plate was kept in refrigerator for 30 minutes and was read 3-5 minutes after the plate was taken from the refrigerator and left standing at room temperature.

Interpretation

- The plates were tilted and the erythrocytes left to flow,
- Sedimented erythrocytes flow to the bottom of the wells edge forming a “nose” with a cross bar
- Haemagglutinated erythrocytes do not flow.
- The HA titer is the reciprocal of the last antigen dilution with complete haemagglutination.

Titration of haemagglutination inhibition

- 50µl of test serum was added to row $A_{1,}$ column 1-11, of a micro titer plate with U-shaped bottom.
- Row A_1, column 12, received 50µl working haemagglutinin.
- Wells 12 G/H remained free for red blood cells controls.
- Using a multi channel pipette 25µl PBs was added into all wells of rows B-H.using a micropipette. 25µl was transferred from each serum or haemagglutinin dilution, respectively, from top to bottom, leaving 12G and 12H wells for red blood cell controls.
- 25µl diluted serum and haemagglutinin was discarded from the last well of each dilution.
- 25µl working haemagglutinin was added to column 1 and 25 µl PBs instead of working haemagglutinating antigen in column 2.
- The plate were shaken by hand and air bubbles at the well bottom were removed by stilette, then they were incubated at room temperature for 10 minutes and 50µl of PBs was added to the red blood cells controls in wells 12G and 12 H.
- Finally, 50µl of the red blood cell suspension was added to each well including 12 G and 12 H known positive and negative control sera were included .Then the microplate was incubated for 30 minutes in a Refrigerator.

Interpretation

The plates were tilted the erythrocytes were left to flow and the flow of sedimented erythrocytes (i.e. no haemagglutinated) to the bottom of the well's edge forming a "nose"with a cross bar was observed. The HI titer was the reciprocal of the serum dilution that completely prevented haemagglutination.The test was read within 5-10 minutes after removal of the plate from the refrigerator.

The test was not interpretable if the following conditions were not met:

- Total sedimentation of control RBCs
- No alteration of the images or RBC agglutination with control serum
- The negative control serum had a titer of <1/8
- The known positive control serum showed a titre near to the already registerd titre.

Annex 3. A slide agglutination test procedure for serology of fowl typhoid

- Fresh blood samples are collecting from the brachial vein of chickens using 5ml disposable syringe.
- The disposable syringe which contains the blood is put in slant position for an hour.
- Then clear serum is harvested using a clean white marked into square of about 3x3cm or a clean microscopic slide.
- Placing one (1) drop of 25µl crystal violate stained antigen in the center of each square or the slide.then adding of one (1) drop of 25µlof the harvested serum into the antigen which is dropped on the slide.
- By using a fine glass rod mix the drops of the antigen and serum then again wiped clean a glass rod between the samples.
- By using gentle rocking motions to keep the drops of agitated for up to 2 minutes. The drops shouldn't be allowed to dry out during this time in very warm condition. Larger drops may be required to avoid drying out.
- Positive reaction is indicated by easily visible clumping of the antigen within these 2 minutes.
- Negative reaction is indicated by absence of clumping of the antigen with in these two (2) minutes.

Annex 4 . Village chicken and parasitic infection

9. CURRICULUM VITAE

A. Biographical Data:

Name	Dagnachew Beyene
Date of birth	September 22, 1965
Place of birth	Addis Ababa, Ethiopia
Marital status	Married, two children
Nationality	Ethiopian
Profession	Veterinarian
Occupation	Agricultural and Rural development Office

B. Educational background

1971- 1976	Ras Seyoum Elementary school, Addis Ababa
1976 -1981	Teferi Mekkonen High school, Addis Ababa
1981 -1987	Zooveterinary Inistitute, Kharkov, USSR, DVM

C. Work Experience

January 2005 to August 2005, Team leader of Agricultural and Rural Development Office.
September 2002 to December 2004, Head, Zonal Rural and Agricultural Development office of East Shoa zone Ethiopia.
October 2001 to August 2002, Head, Zonal Agricultural Development Departement, East shoa zone, Oromia Zone.
December1999 to September 2001, Deputy Head, Regulatory Division, Zonal, Zonal Agricultural Development Departement, East shoa

July 1997to November 1999, Team leader, Animal Health team East shoa zone Agricultural Development Department, Oromia Region

January 1993to July 1997, Senior Veterinarinarian, in East shoa zone Agricultural office

February 1990 to January1993 Veterinarian, in the Bale Zone Agricultural Development Departement, Oromia region

September 1988 to February 1990, Junior Veterinarian, Bale Zone Administration, Elkere Awraja mainly dealing with field veterinary Activities

D. Research output/Technical paper

Prevalence of cocisidiosis in Lozobenka poultry farm. (DVM Thesis) presented to Harkov Zoovetrinary Institutes in the Name of Borisenko, USSR, 1987).

E. Membership to professional societies

Member of Ethiopian Veterinary Association.

F. Language

Amharic	Writing and speaking
Affan Oromo	Writing and speaking
English	Writing and speaking
Russian Language	Writing and speaking

G. Computer Skill

MS Dose, MS Word, MS Excel

10. SIGNED STATEMENT OF DECLERATION

The thesis, 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 Dagnache Beyene Debela

Signature ____________________

Date of submission 25/06/2007

This thesis has been submitted for examination with my approval as University advisor.

Dr. Kely Belihu (DVM, PhD. Asst. Prof.) _____________________________

Dr. Fikre Lobago (DVM, PhD Candidate, Asst. Prof.) ___________________________