

**ADDIS ABABA UNIVERSITY
FACULTY OF VETERINARY MEDICINE**

**ASSESSMENT OF THE NUTRITIONAL STATUS OF LOCAL SCAVENGING
CHICKEN UNDER FARMER MANAGEMENT CONDITIONS IN ADA'A DISTRICT,
EAST SHOA**

**BY
MULATU DAGNEW**

**JUNE 2008
DEBRE ZEIT, ETHIOPIA**

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

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DEDICATION

This thesis is dedicated to the memory of my grand father Lekatabet Brhanie Nigusie, to my grand mother Emuhay, Tewabech Yigezaw and Tiruworke Engeda.

ACKNOWLEDGMENTS

I express my deep sense of gratitude to Dr.Mekonnen H/Miriam my major advisor; much needed support and friendly treatments critical remarks encouragement and inspiration from problem identification to the final write-up of the thesis. He shared with me his accumulated professional experiences and was cooperative from the beginning of proposal writing to completion of the thesis work with out his help, the success of this work would not have been possible.

I would express my deep sense of gratitude to Dr.Kelay Belihun and Dr.Berhan Tamir my co-advisors much needed support and friendly treatments critical remarks encouragements and inspiration from problem identification to the final write-up of the thesis.

I would express my special thanks to financial support from the Swedish International Development Cooperation Agency, Department for Research Cooperation (SIDA/SAREC) and Amahara regional State of Agricultural and Rural Development Head Office for sponsoring the research component of the post graduate study and also my special thanks goes to Dembech worda Administrative Office for supplying my salary during the study period.

I wish to express my heart felt thanks to Addis Ababa University Faculty of Veterinary Medicine Post Graduate School for giving me this opportunity to join the University Post Graduate Studies and providing full access to different facilities and timely completing the course.

My sincere acknowledgement is due to Ato Adisu Tagele Dembecha District Agricultural and Rural Development Office and special thanks to W/ro Etenu Bezuye and stuff of the District Office of Agriculture for great help they offered me in facilitating the condition to continue my post graduate study.

I also wish to acknowledge the hospitality and dedication of farmers and the development agent workers in the study sites, especially Ato.Guta Assefa, and Berhanu Demessie are highly appreciating for providing me information important for this works.

My thanks are due to my friends Ato. Berhanu Alemu for all the Cooperative .I received during the study and their encouragement and appreciation to my success.

Special thanks is extended to my family Ato Zelalem Berhanie, Mulugeta Eneyew, Shiferaw Dagneu, Melkam Dagneu, W/ro Serkadis Berhanie and Fiker Alemu for their moral and material support for me ,while I was in a study leave at Addis Ababa University.

Finally ,my special heart gratitude and appreciation goes to my wife W/ro Agerie Gete ,who took all responsibilities and encouraging me to cope with what ever problems I encountered in my life and during my study leave at Addis Ababa University.

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LIST OF ABBEREVATIONS

AACMC	Australian Agricultural Consulting and Management Company
AOAC	Association of Official Analytical Chemists
Ca	Calcium
CACC	Central Agricultural Census Commission
CF	Crude Fiber
CI	Confidence Interval
CP	Crude Protein
DM	Dry Matter
DZARC	Debre Zeit Agricultural Research Center
EE	Ether Extract
FAO	Food and Agricultural Organization of the United Nations
Fig	Figure
ha	Hectare
ILCA	International Livestock Center for Africa
ILRI	International Livestock Research Institute
kcal	Kilocalorie
LSD	Least Significant Difference
M OA	Minstry of Agriculture
ME	Metabolisable Energy
NCD	Newcastle Disease
NFE	Nitrogen Free Extract
NRC	National Research Council
P	Phosphorous
p.m	post meridian
q	quintal
SD	Standard Deviation
SE	Standard Error
SFR	Scavenging Feed Resource
SPSS	Stastical Package for Social Science
US \$	United State Dollar

WADU

Wollaita Agricultural Development Unit

ABSTRACT

The study was conducted in Aad'a woreda East Shoa Zone of the Oremia Regional State from mid September 2007 to mid February 2008 with the following objectives. To assess the types and relative abundance of feeds consumed by scavenging local chicken, to determine the nutritive values of the scavenged and common supplement feeds and to determine the seasonal effects on the scavenged feed resources types and relative abundance at smallholder farmers level. A single visit multiple subject questionnaire survey was used to collect data on household demography characteristics, poultry production system, feeding, housing practice. Data were also generated through chicken crop content identification and quantification, supplement feed identification and quantification, laboratory analysis of chicken crop contents and common feed supplements. A total of 210 households from two peasant associations (105 from each) were included in the study. A total of 208 chickens purchased from selected peasant associations were slaughtered and their crops dissected, crops contents were analyzed. The majority (84.3%) of the households were headed by males. The average age of the household heads was 41.28 years; the average family size was 6.55 persons per house hold. All the selected households were engaged in mixed crop-livestock production. Women did most of the poultry production activities. Even in men headed households chicken were owned by women. The average poultry flock size was 12.13 ± 4.46 across the study area. Layers were larger in number compared to other sex and age groups. Eighty five percent of the households were offering one or other type of feed as a supplement to their scavenging chicken. The commonly offered supplements were wheat, wheat threshing leftover, maize, barely, wheat bran, boiled tef, "injera", When the occurrence of the total crop content was significantly ($P < 0.05$) higher in the harvesting than non-harvesting season. The main components of the crop contents were grains, kitchen wastes, green forages, insects (worms) and others. The occurrence of insects and green forages significantly higher ($P < 0.05$) in the crop content of layers than growers. The occurrence of kitchen wastes, insects (worms) and green forage in the chicken crop content was significantly higher ($P < 0.001$) in the non-harvesting than the harvesting season. The occurrence of grains was significantly higher ($P < 0.05$) in the harvesting than non-harvesting season. The occurrence of dry matter and crude fiber in the layer's crop content was significantly higher ($p < 0.001$) in the harvesting season than non-harvesting .Calcium and

phosphorous levels showed the reverse pattern. Grower's crop contents also showed the same pattern. The over all mean chemical composition (in %) of the crop contents were dry matter: 91.78 (0.12); ash: 6.28 (0.22); crude fiber: 5.14 (0.14); crude protein: (14.26); ether extract: 5.73(0.30); nitrogen fiber extract: 66.93 (0.63); calcium: 0.65 (0.04); phosphorous: 0.32 (0.01) and computed metabolisable energy (ME kcal/kg) 3510.14 (31.90). Except metabolisable energy concentration all nutrients were below the standard requirement. For egg production and optimum growth, protein to energy and calcium to phosphorous ratio were too low. In general the chemical analysis of crop contents of scavenging chickens showed that, except metabolisable energy, all other nutrients were below the requirement levels and varied with season and type of bird. Scavenging poultry should be provided with supplementary feed rich in nutrients that were deficient in scavenge able feed resource base. Further studies should focus on the amino acid profiles of crop contents

Key words: Smallholder; scavenging chicken; crop content; season; supplementation.

1. INTRODUCTION

The world poultry population has been estimated to be about 14 billion heads (FAO, 2000). Poultry production in tropical countries is based on the traditional scavenging system. The share of the later to the total poultry population in developing countries (in general and in Africa in particular) is not well documented but estimated to reach 70 to 80 percent (Gueye, 1998; Gueye, 2000). The total poultry population in Ethiopia is estimated to be 65 million heads (FAO, 2000); the country has about 60 percent of the total chicken population of East Africa (Mekonnen *et al.*, 1991).

Poultry production is an important economic activity in Ethiopia. Besides its social and cultural benefits it plays a significant role in family nutrition. Rural smallholder farmers keep more than 95 percent of the poultry population (Taddle and Ogle, 1996a) and contribute about 90 percent and 92 percent of the national egg and poultry meat production, respectively. This is equivalent to an annual output of 72,300 metric tones of meat and 78,000 metric tones of eggs (ILCA, 1993). Poultry production systems in Ethiopia show a clear distinction between traditional (low inputs system) and modern production systems (using relatively advanced technology) (Alemu, 1995). There is also a third up coming “small scale” semi-intensive system with small number of chicken (from 50 to 500) as an urban and pre-urban household income source using exotic chicken and relatively improved feeding, housing and health care (Alemu and Tadelles, 1997). The low productivity of local chicken coupled with the infancy of the commercial sector (only contribute less than 10 percent of the total poultry and poultry products) has resulted in a low supply of poultry meat and eggs to the nation. As a result, the per capita egg and chicken meat consumption is about 57 eggs and 2.5 chickens per annum (Alemu, 1985).

Research studies on some of the indigenous birds have shown that their potential for egg production is very low. A study conducted by the Wolaita Agricultural Development Unit (WADU) Kidane (1980) at Soddo showed that the egg production performance of indigenous chicken to be 84 eggs /chicken /year. According to the study made by the MOA (1980). average annual egg production of indigenous chicken was 30 to 40 eggs under village

conditions and this could be increased to 80 eggs when chicken are provided with an improved feeding, housing and health care. Assela Livestock Farm reported that the average production of local chicken in Arsi was 34 eggs/hen/year, with an average egg weight of 38gm under scavenging conditions (Brannang and pearson, 1990). These results are extremely low when compared with production levels of improved exotic chickens which can produce over 200 eggs/hen/year with an average egg weight of 60 grams. At the Debre Zeit Agricultural Research Center Ethiopia, White Leghorn breeds were observed to produce over 236 eggs/hen/year (DZARC, 1991).

Most poultry improvement programs in developing countries have been directed towards the introduction of specialized exotic breeds, crossbreed and management intensification (Kitalyi, 1998a, b). However, the high mortality rate of introduced breeds, low feed resource base at the village level and lack of understanding the complex biological, cultural and socio-economic relationships involved have limited the success of improved village chicken production in developing countries in general. Therefore, more information on the intake and nutritional status of scavenging chickens is needed in order to introduce efficient supplementation strategies. One possible way of determining the intake and nutritional status of scavenging chickens by conducting crop content analysis. A number of studies on the qualitative and quantitative characteristics of scavenging feed resources (SFR) in village poultry have been carried out in developing countries, such as in Sri Lanka, (Roberts & Gunaratne, 1992; Gunaratne *et al.*, 1993 and Tanzania (Mwalusanya *et al.*, 2002).

Since there is a paucity of information on the nutrient content of feeds scavenged by local chickens, the present study was undertaken with the following objectives:

1. To assess the types and relative abundance of feeds consumed by scavenging local chicken
2. To determine the nutritive values of the scavenged and common supplement feeds.
3. To determine the seasonal effects on the scavenged feed resources types and relative abundance.

2. LITERATURE REVIEW

2.1. Poultry Production systems

Poultry production systems are described under landless mono-gastric production systems (FAO, 1996). They are classified into extensive, semi-intensive and intensive systems (Table 1). The extensive poultry production systems exclusively based on hybrid and high producing exotic breeds and high-energy concentrate feeds were described by Sere *et al.* (1996). The semi-intensive system which is also referred as back yard poultry was developed recently. In rural areas of Africa the intensive poultry production system is rare because farmers are not able to afford the high input requirement of the introduced exotic breed (Safalauh, 1997).

The most dominant production systems are the extensive systems, which are based on the local indigenous type of chickens (*Gallus domesticus*). It is characterized by including small flocks, with nil or minimal inputs, low outputs and periodic devastation of the flocks by disease. Chickens are owned by individual households and are maintained under a scavenging system, with little or no inputs for housing, feeding or health care (Aini 1999; Cumming, 1992; Alemu, 1995; Tadelle and Ogle, 1996a). Typically the flocks are small in number with each flock containing chickens from each age group, with an average of 7-10 mature chickens per household, consisting of 2-4 adult hens, a male chicken and a number of growers of various ages. Tadelle and Ogle (1996a), Gunaratne *et al.* (1992) and Cumming (1992) also described village poultry flocks in Asia as including 10-20 chickens of different ages per household. According to AACMC (1984), in Ethiopia there is an average of six indigenous chickens per household and, according to Sonaiya (1990), the average flock size in Africa ranges from 5-10 chickens. As described by Tadelle and Ogle (1996a), the village poultry production system is characterized by minimum inputs, with chickens scavenging in the backyard, and no investments beyond the cost of the foundation stock, a handful of grain each day and possibly simple night enclosures.

Table 1: Characteristics of poultry production systems

variable	Production systems		
	Extensive/Scavenging	Semi intensive	Intensive
Breed and flock size	Local indigenous type: <50	Specialized and dual-purpose breeds: 50-500	Specialized breeds: 500-5,000
Housing	Specific poultry houses are rare	Varies from modern houses to simple housing made from locally available materials	Modern housing, generally with concrete walls and regulated internal environment
Feed resource	Scavenging and occasional feeding with home grains and household refuse	Commercially compounded, homemade mixtures and scavenging	Commercially compounded feeds
Health program	No regular health program of disease control measures in place	Disease control and health program at varying levels	Standard and regular animal health program
Markets	No formal marketing channels	Input and output distribution is based on existing trading centers	Cold chain system for input-output distribution
Infrastructure	Underdeveloped infrastructure	Modest infrastructure depending on proximity to urban centers	Water, electricity and communication available
Product storage and processing	No refrigeration, sales of live birds and eggs	Minimum refrigeration occasional dressing of birds	Products refrigerated; dressed birds and table eggs refrigerated
Technology/ Information	Local knowledge, with moderate or no extension services	Moderate formal training and extension services	Formal training, extension services available, information disseminated through producer and consumer associations

Source: FAO (1996)

2.2. The rural poultry production system

According to (Alemu, 1995) the village poultry production system in Ethiopia is based on low input-output levels. This system has a unique position in the rural household economy in that it supplies high quality protein to the family, provides small cash income and plays a significant role in the religious and cultural life of the society .Tadelle and Ogle (1996a) showed that poultry rearing is one of the most appropriate activities for rural women, for landless and marginalized farmers that it provides cash income for the poor and at the same time increases the supply of high quality animal protein. Family poultry management is usually the responsibility of women in the country.

The extensive poultry production system is although appearing primitive, can be economically efficient in that the indigenous birds are performing well to a very low input supply which some times is considered as virtually non-existent (Smith,1990 ; Tadelle and Ogle,1996b).The feed resource base for extensive (scavenging) poultry production is obtained by the birds scavenging in and around the homestead, and consist of house hold waste, anything edible found in the immediate environment and small amount of grain supplements provided by the household women. As indicated by Cumming (1992), Tadelle and Ogle (1996b) , Tadelle and Ogle (2000), the scavenging feed resource base for village chickens is very variable and depends on season and rain fall.

2.3. Socio economic aspects of rural poultry production system

Rural poultry represents a significant part of the rural economy. This segment of production in Africa as a whole represents an asset value of US \$ 5.75 billion (Sonaiy, 1990). In addition to their contribution of a high quality animal protein and as a source of easily disposable income for farm households, rural poultry can be integrated very well and in a sustainable way in to other farming activities. This is because they require little labor and initial investment compared to other farm activities (Tadelle and Ogle, 1996a). A number of authors Velum (1987), Sonaiya (1990) and Gunaratne *et al.* (1992) have also reported that rural poultry play a significant role through their contribution to the cultural and social life of rural people. Poultry

keeping in most of the developing countries is the responsibility of women. Tadelles and Ogle (1996a) in a study of three villages found that it is the women that look after the chicken, and the earnings from the sale of eggs and chickens are often their only source of cash income. In another report made by Tadelles and Ogle (1996a), Leulseged (1998), Tadelles and Ogle (2001) indicates that households in rural Ethiopia keep birds for socio-religious functions at home. Tadelles and Ogle (1996a) also reported that the major uses and benefits of poultry and eggs in rural societies in the central highlands of Ethiopia are sale, home consumption, and sacrifice (healing ceremonies) and stock replacement. In some cases farmers give live birds and eggs as a gift to visitors and relatives, as starting capital for youths and newly married women. Chicken also perform a valuable sanitary function in the villages through eating discarded food and cockroaches (Tadelles and Ogle, 2000).

2.4. Production and productivity of extensive poultry production system.

The productivity of village chicken production systems in general and the free-range system in particular is known to be low (Gunaratne *et al.*, 1993). Under village conditions, the annual egg production per hen ranges from 20 to 100 eggs with an average egg weight ranging from about 30 to 50 g (Sonaiya *et al.*, 1999 and Guèye, 2000).

In South East Asia, village chickens reach a market weight of 1.0 to 1.5 kg at the age of 4 to 5 months (Aini, 1999). In Africa, the adult male and female weights range from 1.2 to 3.2 kg and 0.7 to 2.1 kg, respectively. Guèye (2000) and Guèye (1998) indicated that some advantages of village chicken production such as good eggs, meat flavor, hard egg shells and above all low cost high dressing percentage and especially low cost with little special care required for production. Village chicken meat is well appreciated in the developing countries and has a price: two to three fold in Indonesia and a 10 to 20 percent increase in Sri Lanka over the price of product from an intensive farm (Roberts, 1999).

According to Chrysostome *et al.* (1995) the local breeds have a reputation for hardiness and resistance to diseases. Village fowl are maintained with very low levels of input (land, labour

and capital), they can be kept by those in the poorest social strata of rural population (Guèye, 1998).

2.5. Scavenging feed resource

Potential scavenging feed resources (SFR) can be categorized into four main groups:

- (1) Household wastes (including the waste from households which do not keep chickens).
- (2) Materials from the environment, such as, protein sources (worms, snails, termites insects, grasshoppers and frogs), grain products from cultivating, harvesting and processing (rice and maize seeds and their brans) , green leaves and seeds.
- (3) Cultivated and wild fodder materials such as herbs, fodder trees and aquatic plants (Lemma, Azolla, duckweed and water spinach)
- (4) Non -conventional feeds and agro-industrial by-products (brewery and alcohol residues, soybean residues and molasses) (Roberts, 2000).

The scavenging feed resource base (SFR) base is not constant, and the proportion that comes as a supplement and from the environment varies with certain condition such as season, land preparation and sowing, harvesting, and grain availability in the household, and the life cycle of insects and other invertebrates (Tadelle and Ogle, 1996b). Soil fertility, water availability for irrigation, and rainfall are other factors that determine the SFR (Cumming, 1992).

The composition of SFR is illustrated by findings from the few studies and surveys conducted in developing countries using crop content analysis. The nutritional status of scavenging chickens in rural environments was below the nutrient requirements of local and crossbred growers and layers for optimum performance, and varies with season and the type of bird. The SFR are sometimes deficient in protein rather than energy, and therefore, protein supplementation was considered to be more important than energy in the scavenging poultry production systems in Bangladesh (Rashid, 2003). Another study indicated that the scavenging feed resource (SFR) base varied from 200 to 400 kg for each household annually in Sri Lanka

(Roberts, 1992). In Sri Lanka the SFR base was estimated to be 203 kg dry weight per family per year, including 23 kg protein and 609 Mcal of ME (Roberts & Gunaratne, 1992). Another study in Southeast Asia indicated that the SFR base yield in Thailand was found to be 390 kg per family (Janviriyasopak *et al.*, 1990).

2.5.1. Major scavenging feed resource base nutritional input

Scavenging feed resource base can simply be defined as those feed resources available at farm level that consists of household refuse and all the materials available in the immediate environment that the scavenging birds can use as feed. A range of SFR bases and their physical components as given in various literature sources are shown (Table 2).

Table 2: Types and physical components of scavenge able feed resources found in the crop content of eviscerated scavenging birds

Types of feed SFR base	Physical components	Reference
House hold materials		
Grains	Rice, broken rice, maize and wheat	Huque (1999); Mwalusanya <i>et al.</i> (2002) ;Generate <i>et al.</i> (1993); Rashid <i>et al.</i> (2004)
Bran/polishing	Rice bran ,wheat bran and rice	Huque (1999);Mwalusaya <i>et al.</i> (2002 Rashid <i>et al.</i> (2004,2005)
Kitchen wastes	Cooked rice, cooked pulses, egg shells, vegetables trimmings, scales of fish, pieces of bread and Coconut residues	Huque (1999); Mwalusanya <i>et al.</i> (2002) Rashid <i>et al.</i> (2004) Gunaratne <i>et al.</i> (1992) Tadelle and Ogle (1996b)
Environmental material		
Seeds	Grasses and fruit	Tadelle and Ogle (1996b) & Rashid <i>et al.</i> (2004,2005)
Green forages	Green leaves of vegetables, Grasses, plant materials	Mwalusanya <i>et al.</i> (2002) Rashid <i>et al.</i> (2004,2005)
Insects and worms	snails, earthworms Cockroaches, ants, flies	Gunaratne <i>et al.</i> (1992); Huque (1999); Mwalusanya <i>et al.</i> (2002); Gunaratne <i>et al.</i> (1992) ;Tadelleand Ogle (1996b)
Sand and grit	Sand and insoluble grits	Gunaratne <i>et al.</i> (1993); Rashid <i>e t al.</i> (2004)
Miscellaneous materials	Feathers, hair, polythene, Piece of glass and brick paper products and button	Rashid <i>et al.</i> (2004, 2005)
Unidentified materials	Various feed particles	Huque (1999); Rashid <i>et al.</i> (2004)

Under normal conditions the proportion of the SFR base supplied by household materials as determined by the crop contents of scavenging birds usually forms a greater part of the total SFR base consumed per day (Roberts, 1999). In Sri Lanka, Gunaratne *et al.* (1993) found that 72 percent of the crop contents of the 15 hens slaughtered consisted of household materials and the remaining of the crop contents came from the environment. Similar observations have been

reported by Sonaiya (2004) in Nigeria where the household refuse made up 64 percent of the crop content.

Several authors (Tadelle and Ogle, 1996b; Mwalusanya *et al.*, 2002; Rashid *et al.*, 2004) have indicated the greater proportions of SFR base being supplied by household refuse. However, the size of the household materials in scavenging systems always varies depending on factors such as population density (Roberts, 1999), food crops grown, their processing methods and decomposition due to climatic conditions (Kitalyi, 1998) and the number of scavenging animals by which all may compete with rural poultry (Sonaiya, 2004). As a result, the supply of SFR base in scavenging systems in developing countries is not always constant (Cumming, 1992; Tadelle and Ogle, 1996b).

2.5.2. Factors influencing the scavenging feed resource base

As indicated in table 2, SFR base in the traditional scavenging systems consists of household refuse and environmental feed materials. During the rainy season there is abundant supply of insects, worms and green forage materials while in the dry or harvesting season there is high supply of cereal grains, cereal by-products and low supply of green forage and insects (worms). In Tanzania Mwalusanya *et al.* (2002) reported that during wet season there is less amounts of grains and kitchen wastes with high amount of insects (worms) and green forages.

Studies in Indonesia, Sri Lanka and Tanzania, showed that the amount of the available SFR base varies greatly with season. In addition, the SFR base could vary also with the type of chicken due to their foraging behavior and stage of growth. The proportion of the grains in the layers' crop contents was lower compared to that in growers' crop contents. The higher proportion of green forages, insects (worms) and kitchen wastes in the layer crop contents could be due to their selective feeding behavior which depends upon nutritional requirements of a particular age group of chicken and production stage. Since laying hens have higher requirement for CP and Ca, they are more likely to pick up feedstuffs rich in protein and calcium compared to growers to support egg production (Rashid *et al.*, 2005). Chicken kept on free-range and backyard systems can certainly not find all the nutrients it needs for optimal

production all the year round. These findings are in line with those of other authors (Tadelle and Ogle, 1996b; Huque, 1999; Mwalusanya *et al.*, 2002; Rashid *et al.*, 2005) who observed that in different seasons, SFR base is critically deficient or unbalanced in nutrients.

Flock biomass and managerial factors

Flock biomass is defined as the total live weight or the number in the flock times the mean live weight. Like other feed resources, the availability of SFR base can be determined by the total biomass of scavenging poultry that can be optimally supported by the available feed resources. Roberts (1995) has described this relationship between the availability of SFR base and village flock biomass using a model of the scavenging village chicken production system. The model of Roberts (1995) describes the village community in terms of families, which discard household refuse and which then becomes available to the village chicken flock as SFR base. The remainder of the SFR base usually comes from the environment.

In the absence of disease outbreaks or festival activities which diminish the flock, the biomass of the village flock which is the sum of the flocks of those families in the village which keep chicken, will remain at a level which can be supported by the available SFR base (Roberts, 1995). However, if the village flock biomass exceeds the carrying capacity of the SFR base, then there will be a strong competition pressure among chickens of different sex and ages on the available household refuse and environmental feed. Under this competition, chicks and growers, because they are the weakest members of the village flock, cannot compete with adult chickens for SFR base. In Nigeria Sonaiya *et al.* (2002b) found that the quantity of SFR base available for a chick was 0.996 kg/year whereas a hen had 11.04kg/year.

Social and bird behavioral factors

The availability of SFR base provided by household refuse is directly related to the density of housing (Roberts, 1999). In areas where the density of housing is high there is an abundant supply of house refuses provided that most of the village families do not keep large number of poultry. However, if the village families keep large number of poultry, this would lead into

competition pressure for the household refuse and the poultry will have a limited land area for scavenging. The land area available for scavenging and distance a flock can travel to scavenge will depend on many factors such as flock size, feed availability, population density, agricultural activities and predators (Gunaratne, 1999). In some areas, social factors such as rapid urbanization, development projects and environmental changes are causing restrictions on the availability and accessibility of the SFR base (Roberts, 1999). Similar findings have been reported by Gunaratne (1999) in behavioral studies in Sri Lanka where crossbred chickens released for scavenging environment tended to restrict their scavenging area close to the household compounds.

2.5 3. Determination of scavenging feed resource base

The first attempt to determine quantity of SFR base in the free-range system was done in south-east Asia by Roberts (1992) and Roberts and Gunaratne (1992). This method requires weighing proportion of the household leftovers determined from the crop content of a bird slaughtered after scavenging. However for precise estimates of SFR base, each family should have access to the household refuse and environmental feed. This approach helps to determine the quantity of SFR base required by each family flock per unit time. The contribution of household refuse and environmental feed to the total SFR base can easily be determined by examining the feed components in the chicken crops at different times of the day. This estimate however, does not show the proportion of the SFR base available to each individual bird category in the family flock (Sonaiya *et al.*, 2002a). Because of the variations within the family flocks due to age-group and sex; and because of competition for the SFR base in a communal scavenging condition, estimation of the SFR base on the basis of bird category such as cocks, hens, growers and chicks is more appropriate (Sonaiya *et al.*, 2002a). In this case, any differential access to the SFR base by chicks, growers, hens and cocks in the family flock can be easily assessed.

2.6. Constraints in scavenging chicken production

The New-agriculturist (1998) indicated that the management of village chickens is complicated because of the presence of multi-age individuals in the same group. High chicken losses have been attributed to poor feeding, no housing, and minor health control practices. With no preferential treatment of the small chicks, some starve to death because of high competition for the available scavenging feed resource. Below some of the major constraints are reported in detail.

2.6.1. Low availability of adequate feed resources

The feed resource base for scavenging is limited and varies with seasonal circumstances such as rainfall, cultivation, harvest and crop processing. If the supply of the scavenging feed resource is exceeded by the nutritional requirements of the animals, then the 'biomass' of the village flock is reduced accordingly, production will fall and some chicken may die. Gunaratne *et al.* (1993), Tadelle and Ogle (1996b) also indicated that crude protein, metabolisable energy and calcium intake from scavenging sources appear to have a seasonal nature. In the rainy season, there is an increase of sources of protein (worms, insects) for scavenging birds. In general, farmers try to supplement the diet of village chicken by giving household wastes or grains of cereals (Chrysostome *et al.*, 1995). Mostly birds scavenge during the day for protein (insects, worms, larvae). The study of chemical analysis of village chicken crop contents during the two seasons (harvesting and non-harvesting) of the year in Bangladesh, showed that 10.5 percent of crude protein, 2.1 percent of ether extract, 6.4 percent of crude fiber, 12.5 percent of crude ash, 68.7 percent of nitrogen-free-extract, 0.96 percent of calcium and 0.38 percent of phosphorus. These values are somewhat below the requirement particularly for protein and calcium for high growth or egg production when taking into consideration the recommended level for chicken diets (Kazi, 1990).

2.6.2 Mortality due to diseases

One of the major constraints of village fowl production in Africa is undoubtedly the prevalence of various diseases (Guèye, 1998). According to Chrysostome *et al.* (1995), the local breeds have a reputation for hardiness and for resistance to diseases. Another study indicated that high mortality in rural flocks, ranging from 50% to 80% (Guèye, 1998). Several studies indicate that Newcastle Disease (NCD) is the main cause of this mortality (Guèye, 1998; Chrysostome *et al.*, 1995; Sonaiya *et al.*, 1999). The wild birds are a reservoir of NCD-virus (Guèye, 1998). Other diseases that affect village chickens to a lesser extent 3 percent to 14 percent are fowl pox, pullorum diarrhea, and fowl cholera coccidiosis (Atteh, 1989). Chicks and pullets, the most important one was the pullorum diarrhea, in addition to the diseases mentioned there is a high degree of internal and external parasitism, aerial and terrestrial predators contribute to mortality (Chrysostome *et al.*, 1995; Sonaiya *et al.*, 1999).

2.6.3 Low genetic potential

In the case of village chickens Vanekeren *et al.* (1995) indicated that in various countries, cock exchange programmes have been successfully carried out. The same source suggested that the production of local chickens can be improved by replacing the local cocks with cocks of more productive breeds and to slaughter the non-productive animals. Investigations on village chickens describe the level of performance under village husbandry conditions and they also attempt to establish the potential of indigenous birds to perform under optimal conditions of confinement (Tadelle and Ogle, 2000). The level of performance in optimal conditions is generally low compared to those of an improved breed.

2.6.4 Housing and Harsh environment conditions

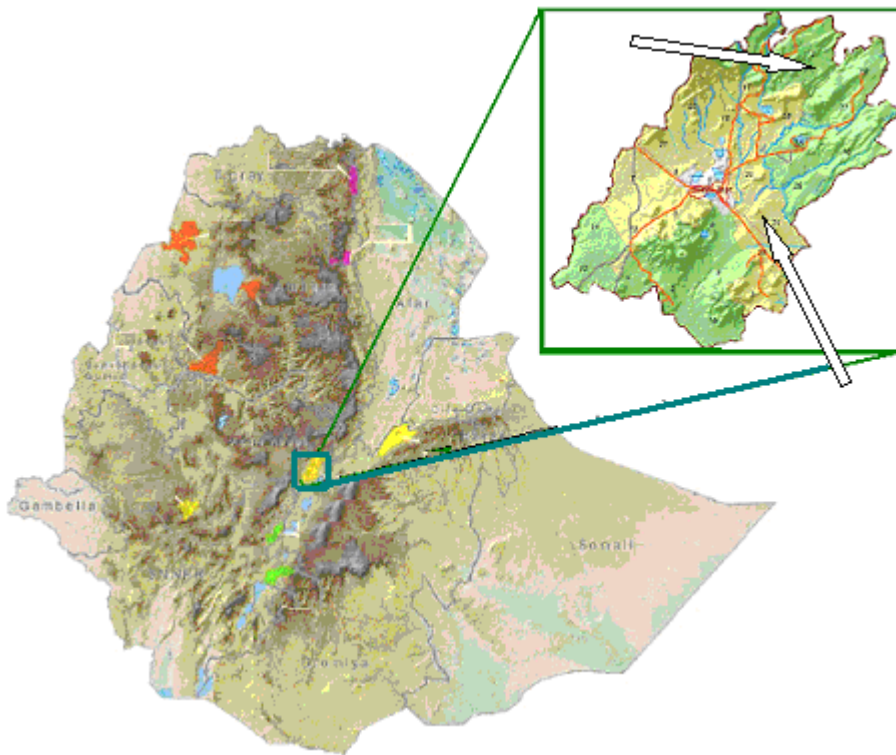
Village chicken production depends on harsh environmental conditions. A high mortality of village chickens is observed due to unfavorable environmental conditions in relation with housing, diseases and predators. Many authors (Guèye, 1998; Sonaiya *et al.*, 1999; Kitanyi, 1999) found out different housing conditions for village chicken. Birds may perch on high

places or shelter in human house or kitchen. Some traditional housing systems have a saddle roof; the housing may be around thatched hut, box or basket. These traditional poultry housing structures are small and have poor hygienic conditions and there is high infestation with external parasites (Kitalyi, 1999).

3. MATERIALS AND METHODS

3.1 Description of the study area

The study was conducted in Aad'a District of East Shoa Administrative Zone of the Oromia Regional State from mid September 2007 to mid February 2008. The area lies between $8^{\circ} 44' N$ and $35^{\circ} 58' 47$ km of East Addis Ababa. (Astatke *et al.*, 1995).



Source: ILRI (2005)

Figure 1: Map of Aad'a District showing the location of selected peasant association where the study was done (arrows).

Ada'a is one of the district found in the East Shoa Zone located in the Great Rift Valley, It is bordered on the south by Dugda Bora, on the west by the West Shoa, on the northwest by Akaki, on the northeast by Gimbichu, and on the east by Lume. The administrative center is Bishoftu. The district has an altitude ranging from 1500-2250 meters above sea level. Based on

figures published by the Central Statistical Agency in 2005, this district has an estimated total population of 355,343, of whom 175,788 were males and 179,555 were females; 142,866 or 40.21% of its population are urban dwellers (Motram *et al.*, 2005).

The agro-ecology of the study area is best suited for diverse agricultural production. There are a number of rivers and creator lakes that are being used for irrigated agriculture, particularly for horticultural crops production. The study area nationally known for its best quality “teff” (*Eragrostis tef*) production, which dominates the agricultural production system and wheat, is also grown in sizeable quantity. Pulse, especially chickpea, is grown in the bottomlands and on residual moisture in selected areas (ILRI, 2005).

Livestock production is an integral part of the production system. The district’s livestock population is estimated to be cattle 160,697, sheep 22,181, goat 37,510, horses and asses, 1,660 and poultry, 191,380 is a very common practice (CACC, 2003).

Mean monthly minimum air temperature ranged from 11.2 to 13.5⁰C, while the maximum mean monthly air temperature varied from 21.6 to 31.5 ⁰C. Monthly total rainfall varied from 2.1 mm (January 2006) to 239.5 mm (July 2006). Two rainy periods, the minor one extending roughly from February to April and the major one between June and September, appreciable quantities of rainfall were recorded throughout from February to August, 2006 including September, 2005, and peaking in July. The annual mean rainfall about 877.2 mm. (DZARC, 2006).

3.2 Study population

The smallholder farmer raising local chicken under extensive production systems represent the study population.

3.3. Design of the study

Cross-sectional type of study was carried out to collect data on nutritional status of local scavenging chicken under farmer management conditions. The study has two components. The first part focused on studying household characteristics of smallholders, poultry management and assessing common supplement feed resources bases of scavenging chicken. The second part evaluated the chicken crop content of scavenged feed resource and common supplements of chicken feed nutritional value.

3.4. Sample size determination and sampling method

The sampling procedure followed was the one recommended by Arsham (2005) as follows:

$$N = 0.25/SE^2$$

Where N = sample size,

For a SE of 5% the computed sample size for each peasant association was 100. However, during random selection of households from “Denkaka” and “Keteba” peasant associations, 105 households from each peasant association were selected.

3.5. Data collection

Semi-structured questionnaire was prepared, tested and used for the survey. A single visit interview was carried out to collect data from a total of 210 households (105 households from each peasant association). The questionnaire was focusing on socioeconomic characteristics of farmers, chicken management practices and commonly used supplements to scavenging chicken.

3.5.1. Categorization and quantification of chicken crop contents

Sampling was done two periods; the non-harvesting period (mid September to mid November 2007) and the harvesting period (mid November 2007 to mid February 2008) were considered for chicken crop content identification and quantification of a total of 208 hens

and growers of an equal number for each were used. From each smallholder, layer or grower (based on availability) were purchased. The hens were at the age of having completed at least one laying cycle (one clutch), while growers were mixed sex, 3 to 5 months of age. 104 layers and 104 growers were collected from the households in the evening between 5.00 p.m to 6 p.m in two seasons when they were at the end of the day of scavenging. They were immediately brought to the Faculty of Veterinary Medicine and slaughtered at Faculty's laboratory. Slaughtering was done by cutting at the cervical region. They were eviscerated and crop content of individual bird was collected. The latter was visually identified, separated in to different categories and weighed by using balance (the weighing balance). After weighing, each chickens' crop content was put into a polythene plastic bag and kept in a freezer at a temperature of -20°C until further processing (Mwalusanya *et al.*, 2002).

3.5.2. Common supplement scavenging chicken feed sample collection

Commonly used chicken feed supplements were collected from smallholders and identified prior to chemical analysis.

3.6. Sample preparation and chemical analysis of chicken crop contents and common feed supplements

The laboratory chemical analyses were done at the National Veterinary Institute in animal nutrition laboratory. Chicken crop contents were taken out from polythene plastic bags and sun dried. They were then ground in a cyclone mill to pass a one-millimeter screen. The individually ground crop contents and common supplemented feedstuffs were analyzed for their proximate composition of dry matter (DM), crude protein (CP), ether extract (EE), crude fiber (CF) , Nitrogen Free Extract (NFE) and ash, according to AOAC (1990) procedures. Metabolizable energy (ME kca/kg) levels were determined by an indirect method using the following equation: True ME (kcal/kg dry matter) = $351 + 54.4 \text{ EE} - 88.7 \text{ CF} - 40.8 \text{ ash}$ (Wiseman, 1987).

3.7. Data storage and 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). Data were subjected to analysis of variance using General Linear Model procedures. The least square means were computed and compared using least significant difference (LSD) performed using mean and standard error for each outcome variable.

The statistical model as follows:

$$Y_{ijk} = \mu + S_i + T_j + E_{ijk}$$

μ = Overall mean

S_i = The effect due to i^{th} season

T_j = The effect due to j^{th} type of bird

E_{ijk} = Random effect

Where Y_{ijk} is an observation for a given variable in the general mean common to all observation; S_i is the effect due to i^{th} season ($i=1, 2$); T_j is the effect due to j^{th} type of bird ($j=1, 2$); $(ST)_{ij}$ stands for interaction effects between the i^{th} season and the j^{th} bird type; E_{ijk} represents random effects peculiar to each observation. A 5% significant level was used.

4. RESULTS

4.1 Household Demographic Characteristics

Tables 3 and 4 show demographic characteristics of households that participated in the present study. The majority (84.3%) of the households were headed by males. The average age of the household heads was 41.28 years; the average family size was 6.55 ± 2.63 persons per household. Most of the household heads (62.9 %) have attained basic and primary levels of education. On the average, each family owned 2.05 ± 0.97 ha of land, 12.47 ± 5.11 animals and 12.13 ± 4.46 chickens.

Table 3: Demographic characteristics of households in Aad'a District (N=210 household)

Variable	mean \pm SD	95 % CI
Age of household	41.28 \pm 11.13	39.77-42.80
Family size	6.55 \pm 2.63	6.19-6.91
Total land holding(ha)	2.05 \pm 0.97	1.92-2.12
Crop land (ha)	1.87 \pm 0.90	1.74-1.98
Crop production(q/ha)	16.36 \pm 9.48	15.06-17.65
Grazing land(ha)	0.17 \pm 0.23	0.14-0.21
Livestock herd size	12.47 \pm 5.11	11.77-13.16
Cattle herd size	6.10 \pm 2.91	5.70-6.50
Sheep flock size	2.67 \pm 2.09	2.39-2.96
Goat flock size	1.78 \pm 1.48	1.57-1.98
Equine	1.92 \pm 1.01	1.78-2.06
Total poultry flock size	12.13 \pm 4.46	11.52-12.74
Layer	3.98 \pm 1.85	3.72-4.23
Cock	1.00 \pm 0.58	0.93-1.08
Pullet and	2.48 \pm 1.66	2.25-2.70
Cockerel	1.46 \pm 1.52	1.25-1.67
Chick	3.21 \pm 2.81	2.83-3.60

SD: Standard Deviation

CI=Confidence Interval

Table 4: Demographic characteristics presented in categorical values Of household in Aad'a District
(N=210 households)

Category of variable	Frequency	Percentage
Sex		
Male	177	84.3
Female	33	15.7
Age (year)		
<30	39	18.57
30- 40	74	35.23
> 41	97	46.2
Educational status		
Illiterate	60	28.57
Basic and primary	132	62.85
Junior and above	18	8.58
Landholding(ha)		
≤ 1.5	78	37.14
1.5 – 3	84	40
≥ 3	48	22.86
Farm experience (years of local chicken rearing experience)		
≤ 10	110	52.38
11 – 20	71	33.8
21-30	26	12.38
31-40	3	1.44

All the selected households were engaged in mixed crop-livestock system. In addition to cultivated annual crops, each household keeps one or more types of livestock for various economic and social reasons (Table 3).

Experiences in raising chicken, in nearly half of the households, exceed 10 years. The average poultry flock size was about 12.13 ± 4.46 across the study area (Table 3). Layers were larger in number compared to other sex and age groups.

4.2. Purpose of raising chicken in the study area

Poultry were the most important components of the mixed farming systems in the study area. As per the responses of the participant farmers the first reasons of raising poultry was source of income. Own home consumption and flock replacement were rated in the second position (Table.5).

Table 5: Purpose of keeping poultry in the study area in Aad'a District
(N=210 households, Rank 1, the most important and Rank 3, the least important)

Variable	Rank		
	1	2	3
Source of income	174	36	
Human Consumption and flock replacement	36	63	
Cultural		1	10

Values in the Table show number of household ranking.

4.3. Poultry housing in Aad'a District (N=210)

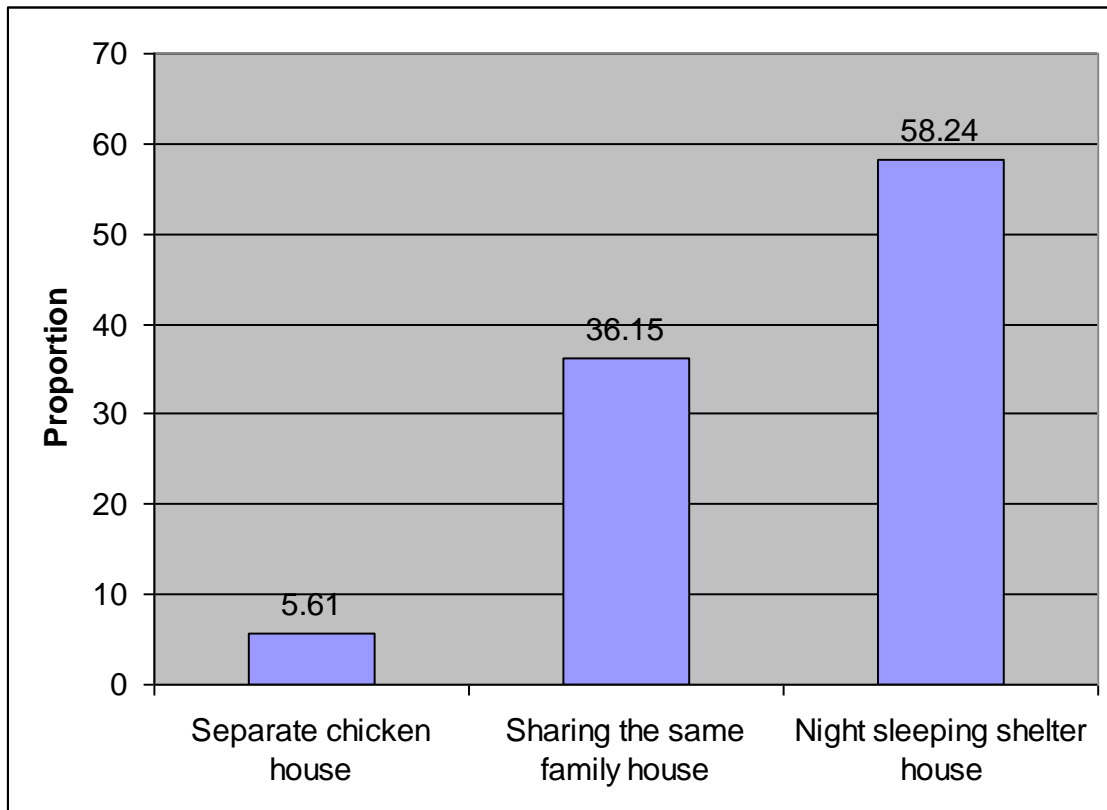


Figure 2: Housing patterns of chicken (proportion show percent of respondents)

By the majority of households, usually there was no special housing provided for the chickens in the study area. About 58.5 percent of the poultry owners kept the chicken roosted in side the family dwelling at night. The roistering made of two or three raised planks of wood placed in parallel while significant proportion 36.2 percent were sharing the family dwelling house and the rest of the households 5.6 percent had constructed small enclosure out side the household dwelling (Fig.2). The purpose of housing in the study area was to protect from predators, theft and extreme weather

4.4. Common supplement feeds supplied to scavenging local chicken

Eighty five percent of the households were offering one or other type of feed as a supplement to their scavenging chicken. The commonly mentioned supplement feed items were wheat, grain (wheat threshing leftover), maize, barely, wheat bran, boiled“teef (*Eragrostis*)”, “injera”, etc. The supplements were offered, in general, in the morning hours before the chicken leave for scavenging. Chicks are supplemented with broken “injera” and boiled “tef (*Eragrostistef*)” while adults and growers were given wheat, grain (wheat threshing leftover), maize, barely and wheat bran in that order of preference depending on the availability (Table 6).

Table 6: Supplemented feeds offered to scavenging local chicken in Aad’a District (N=210 households)

Types of feed	Category of chicken					
	Adult and grower chicken			Chicks		
	Rank			Rank		
	1	2	3	1	2	3
Wheat	143	4				
Maize	34	75				
Wheat bran	1	9	13			
Barely	1	3	1			
Cooked “teff”				72	82	
Broken “injera”				120	38	
Broken wheat				11	11	36
Wheat bran				7	10	8

Values in the Table show number of farmers ranking



Figure 3: Local chickens ready to scavenge the supplement feed in Aad'a District.



Figure 4: Supplemented feeds offered to scavenging local chicken in Aad'a District

4.5. Poultry flock management in Aad'a District (N=210).

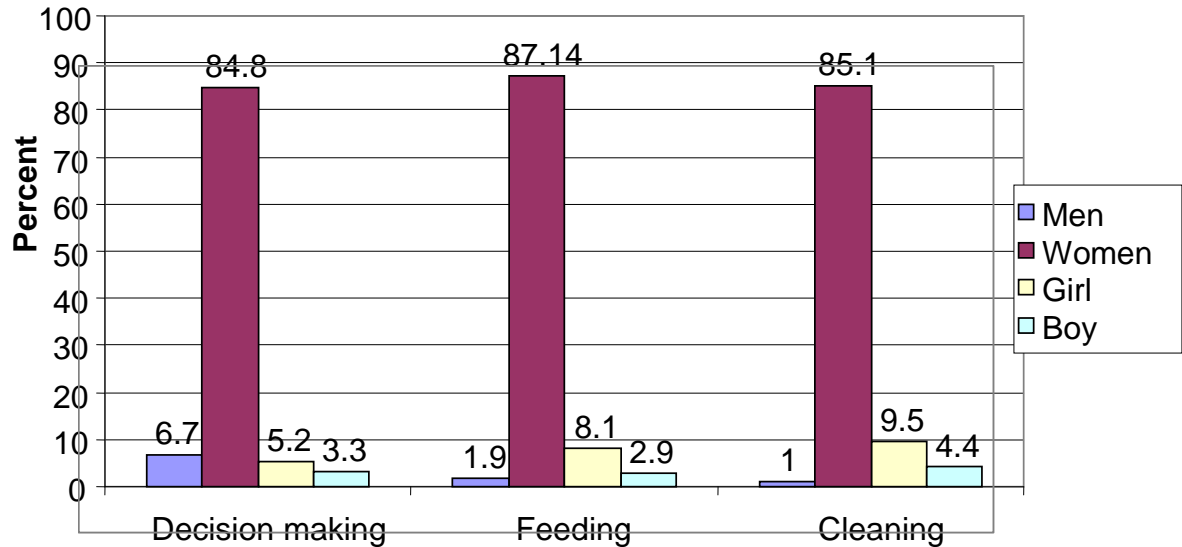


Figure 5: Labour distribution among family members in poultry production (percent of respondent).

The results on participation of different family groups in a household were shown in (Fig.5). Every household member had a role to play in village chicken production, although women did the bulk of the management aspects in most households. Women, even in those households headed by men, were responsible for most of the decision-making on chicken production. Girls had more participation in chicken management than boys.

4.6. Major factors for loss of chickens in Aad'a District. (N=210 household)

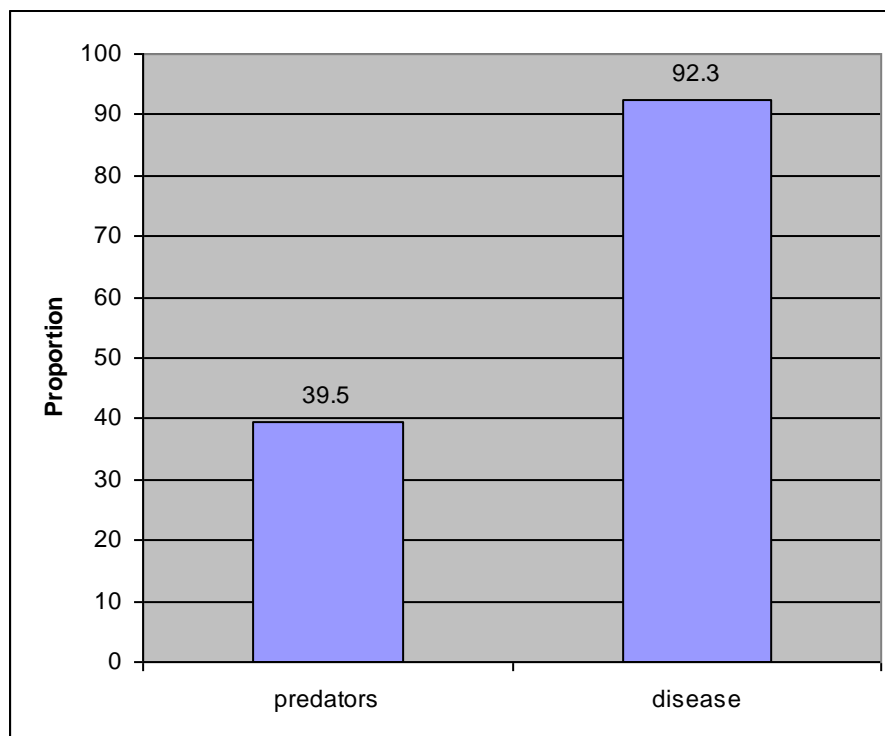


Figure 6: Major factors for loss of chickens (proportion show percent of respondents).

Nearly all respondents (92.3%) complained that poultry disease problems were severe and fatal during the beginning and end of rainy season. The most common symptoms observed by the households were loss of appetite, watery and yellowish droppings, paralysis and consequently death. The symptoms which the disease describes the local name “Fengel” (New castle disease). There was in general lack of veterinary service in study areas. Thus farmers use control the disease use of indigenous knowledge such as herbs “feto” (*Brassica spp*), “grawa” (*Vernonia amygdalina*) and “neem” leaves (*Azadirachta indica*). Predators were also mentioned by nearly 40% of the households as serious problem (Fig.6).

4.7. Average live weight of layers and growers before slaughter

The average live weight before slaughter at the end of scavenging time, of layers were 1.3 ± 0.16 ranging from 1.0 to 1.7 kg and 0.99 ± 0.22 kg for growers before ranging from 0.5 to 1.2 kg.

4.8. Physical composition and laboratory analysis of chicken crop content

4.8.1. Physical composition of chicken crop contents

The main components of the crop contents were categorized visually into cereal grains, kitchen wastes, green forages, insects (worms) and others (Table 7). Depending on the types of birds, the occurrence of insects and green forages of crop content of layers significantly higher ($P < 0.05$) than growers. Other crop contents didn't show any significant difference between layers and growers. Proportions of grains in layers crops' were slightly higher than that of growers' crop contents (Table 7).

Table 7: Chicken crop contents in different chicken types in Aad'a District.

Physical compo net (g)	Types of bird		
	Layer (n=104) mean (SE)	Grower (n=104) mean (SE)	p-value
Grains ¹ (g)	13.10 (0.65)	12.86 (0.65)	0.801
Kitchen wastes ² (g)	8.23 (0.53)	6.93 (0.53)	0.081
Insect (worms) ³ (g)	0.56 (0.07)	0.33 (0.07)	0.022
Green forage ⁴ (g)	1.90 (0.13)	1.49 (0.13)	0.033
Others ⁵ (g)	4.83 (0.40)	4.57 (0.40)	0.650
Total sum crop content ⁶ (g)	28.21 (1.02)	26.22 (1.02)	0.167

n=number of chicken

SE=Standard Error

g=gram

¹, Tef (*Eragrostis*) wheat, maize, barely, Field peas, Lentils, Chickpea and seeds of grasses and fruits;

², Cooked, wheat, maize, crumpled (pieces of bread and injera) vegetable trimmings and stump, eggs

hell, cooked pulse crop (chickpea, beans, field peas, lentils) and wheat polishing; ³, Small snail, earthworm, ants, flies and cockroach; ⁴, Grasses, green leaves of vegetable, herbs plant materials; ⁵, Feathers, human hair, polythene, paper products, piece of brick, button, sand, pieces of bones and un identified ingredients; ⁶, Total sum of grain, kitchen waste, insects and worm, green forage and others.

Season had also significant influence on types and quantity of crop contents (Table 8). The occurrence of kitchen wastes, insects (worms) and green forage during non-harvesting season was significantly higher ($P < 0.001$) than that of the harvesting season. The occurrence of crop content of grains was significantly higher ($P < 0.05$) in the harvesting season than non-harvesting. Wheat and maize were a major grains in the crops of chickens during non harvesting and harvesting season, while wheat was a predominant grain in the chicken crops; maize was commonly observed in the crop of chickens, “tef” (*Eragrostis tef*) grain, broken and boiled wheat and maize, chickpea, peas, and, lentils were observed in the chicken crops both the non-harvesting and harvesting season. When the total crop content was considered, the amount was significantly ($P < 0.05$) higher in the harvesting than non-harvesting season.

Table 8: Physical composition of chicken crop content in harvesting and non-harvesting periods in Aad’a District.

Physical compo net (g)	Season		P-value
	Non harvesting (n=104) mean (SE)	Harvesting (n=104) mean (SE)	
Grains (g)	7.54 (0.64)	18.52 (0.65)	0.000
Kitchen wastes (g)	9.14 (0.52)	5.98 (0.53)	0.000
Insect (worms) (g)	0.81 (0.06)	0.07 (0.07)	0.000
Green forage (g)	2.45 (0.13)	0.93 (0.13)	0.000
Others (g)	5.03 (0.39)	4.37 (0.40)	0.242
Total sum crop content (g)	24.72 (1.01)	29.76 (1.02)	0.05

n=number of chicken SE=Standard Error g=gram

Table 9 illustrates season and chicken type effects on crop content. The occurrence of kitchen wastes in the crop content of growers was significantly higher ($P<0.001$) in non-harvesting than harvesting season on the other hand the occurrence of grain in the chicken crop contents was significantly higher ($P<0.001$) harvesting than non-harvesting season. The occurrence of green forage and insect (worm) in crop content of growers was significantly higher ($P<0.05$) in non-harvesting than harvesting season while, the total crop content of growers crop contents was significantly higher ($P<0.05$) in the harvesting than non-harvesting season. The occurrence of green forage and insects (worms) in the crop content of layers was significantly higher ($P<0.001$) in the non-harvesting than harvesting season while, the occurrence of grain in the layers crop content was significantly higher ($P<0.001$) in the harvesting than non-harvesting season and the occurrence of total amount of crop content of layers was significantly higher ($P<0.05$) in the harvesting than non-harvesting season. The rest of the layer crop contents was not any significant difference between two seasons (Table.9).

Table 9: Season and chicken type influences on physical composition of crop content in Aad'a District.

Component	Layer			Grower		
	Non-harvesting (n=52) mean (SE)	Harvesting (n=52) mean (SE)	P-value	Non-harvesting (n=52) mean (SE)	Harvesting (n=52) mean (SE)	P-value
Grains (g)	8.05 (0.91)	18.24 (0.92)	0.000	7.04(0.91)	18.79 (0.92)	0.000
Kitchen wastes (g)	9.08 (0.74)	7.37 (0.75)	0.132	9.22(0.74)	4.60 (0.75)	0.000
Insect(worms) (g)	1.07 (0.09)	0.032 (0.1)	0.000	0.555(0.09)	0.12 (0.1)	0.006
Green forage (g)	3.08 (0.19)	0.71 (0.19)	0.000	1.82(0.19)	1.16 (0.19)	0.016
Others (g)	5.38 (0.56)	4.28 (0.57)	0.186	4.68(0.56)	4.56 (0.57)	0.769
Total sum crop content (g)	25.39 (1.43)	31.09 (1.45)	0.009	24.05(1.43)	28.43 (1.45)	0.025

n=number of chicken SE=Standard Error g=gram

4.8.2. Chemical composition of chicken crop content

Season had also a significant influence on types and amounts of nutrients found in the crop content of chicken. The occurrence of DM and CF in the chicken crop contents was significantly higher ($P<0.001$) in the harvesting than non harvesting season on the other hand CP and ash a significantly higher ($P<0.05$) in the non-harvesting than harvesting season while, Ca and P significantly higher ($P<0.001$) in the non-harvesting than harvesting season (Table10).

Table 10: Effect of season on chemical composition (dry matter basis) of chickens' crop content in Aad'a District.

Chemical component (%)	Season		P-value
	Non-harvesting(n=36) mean (SE)	Harvesting (n=36) mean (SE)	
Dry Matter (DM) %	91.28 (0.15)	92.22 (0.15)	0.000
Crude Protein (CP) %	14.91 (0.26)	13.59 (0.25)	0.002
Ether Extract (EE) %	5.57 (0.43)	5.89 (0.42)	0.622
Crude Fibre (CF) (%)	4.33 (0.24)	6.48 (0.42)	0.000
Ash (%)	7.10 (0.31)	5.43 (0.30)	0.001.
Nitrogen Free Extractive(NFE) %	66.48 (0.90)	67.37 (0.88)	0.585
Calcium (Ca) (%)	0.81(0.50)	0.49 (0.04)	0.000
Phosphorous(P)%	0.37 (0.01)	0.26 (0.04)	0.000
ME, kcal/kg (%)	3503.17 (44.25)	3517.11 (43.47)	0.856

n=number of chicken SE=Standard Error

Depending of the type of chicken, the occurrence of CP in the layer crop contents was significantly higher ($P<0.001$) than growers, the occurrence of Ca in layer crop content significantly higher ($P<0.05$) than growers on the other hand CF in the grower crop content

significantly higher ($P<0.001$) than layer crop content and other nutrients didn't show any significant difference between layers and growers (Table11).

Table 11: Effect of chemical composition (dry matter basis) of crop content on chicken type in Aad'a District.

Chemical component (%)	Type of bird		
	Layer (n=36) mean (SE)	Grower (n=36) mean (SE)	P-value
DM (%)	91.64 (0.14)	91.88 (0.15)	0.527
CP (%)	15.01 (0.25)	13.37 (0.27)	0.000
EE (%)	5.82 (0.41)	5.62 (0.44)	0.705
CF (%)	5.04 (0.23)	6.66 (0.25)	0.000
Ash (%)	6.63 (0.29)	5.33 (0.32)	0.120
NFE (%)	66.56 (0.85)	67.36 (0.93)	0.562
Ca (%)	0.75 (0.04)	0.54 (0.05)	0.011
P (%)	0.32 (0.31)	0.31 (0.31)	0.686
ME kcal/kg (%)	3549.33 (42.00)	3464.03 (45.64)	0.174

n=number of chicken SE=Standard Error

Table 12 illustrates season and chicken type effects on crop content. The occurrence DM, and CF in crop content of growers was significantly higher ($P<0.001$) in the harvesting than non-harvesting season. On the other hand the occurrence of Ca and P were a significantly higher ($P<0.05$) in the non-harvesting than harvesting and other nutrients didn't show any significant between two seasons.

The occurrence CP and P in the crop content of layers was highly significantly higher ($P<0.001$) in the non-harvesting than harvesting and also Ca and P also a significantly higher ($P<0.05$) in the non-harvesting than harvesting while the other nutrients didn't any significant difference between two seasons (Table12).

Table 12: Effect of season on chemical composition of chicken crop content on chicken type in Aad'a District.

Component of nutrient (%)	Layer			Grower		
	Non-harvesting (n=18) mean (SE)	Harvesting (n=18) mean (SE)	P-value	Non-Harvesting (n=18) mean (SE)	Harvesting (n=18) Mean (SE)	P-value
Dry matter	91.4(0.19)	91.90(0.21)	0.132	91.07(0.23)	92.53(0.20)	0.00
Crude protein	15.5(0.33)	14.34(0.36)	0.015	13.99(0.40)	12.88(0.35)	0.06
Crude fibre	4.17(0.30)	5.86(0.36)	0.000	4.57(0.37)	7.07(0.33)	0.00
Ether extract	5.42(0.55)	6.31(0.60)	0.256	4.57(0.66)	5.49(0.59)	0.76
Ash	7.39(0.39)	5.76(0.43)	0.012	6.65(0.48)	5.12(0.42)	0.760
Nitrogen free extract	65.6(1.15)	67.71(1.27)	0.283	67.75(1.39)	67.05(1.24)	0.66
Calcium	0.90(0.06)	0.55(0.07)	0.004	0.66(0.07)	0.43((0.06)	0.002
Phosphorus	0.38(0.01)	0.24(0.02)	0.000	0.35(0.02)	0.28(0.02)	0.006
ME, kcal/kg	3478.29(56.35)	3636.16(62.30)	0.111	3539.66(68.24)	3404.3(60.64)	0.068

n=number of chicken SE=Standard Error ME=Metaboliseable energy

4.8.3 Chemical composition of commonly available chicken supplement feeds

Farmers were practice to offer either wheat or both wheat and maize for adult and grower birds and water soaked “injera” (broken “injera”) or boiled “tef”(*Eragrostis tef*) for chicks as common supplement in the study area.

Common feed supplements obtained from farmers in the study area were maize, wheat, boiled “tef” (*Eragrostis tef*) and broken “injera” (water soaked injera).The chemical composition of common feed supplements obtained from farmers in the study area was shown in (Table13).

Table 13: Chemical composition of available feeds commonly supplemented in Aad’a District.

Feed items	DM (%)	CP (%)	EE (%)	CF (%)	Ash (%)	NFE (%)	Ca (%)	P (%)	ME, kcal/kg
Maize	87.8	8.9	4.6	1.9	1.3	83.3	0.1	0.3	3973
Wheat	91.2	11.52	5.27	3.76	3.09	76.3	0.12	0.36	3778.10
Boiled Tef	88.62	13.1	3.27	2.09	4.83	76.6	0.11	0.34	3746.44
Broken “Injera”	89.86	11.69	3.89	2.04	2.94	79.4	0.11	0.34	3861.71

DM=Dry Matter, CP=Crude Protein, EE=Ether Extract, CF=Crude Fiber, NFE=Nitrogen Free Extract, Ca=Calcium, P=Phosphorous, ME=Metaboliseable energy

5. DISCUSSION

The mean value of family size, 6.52 persons per household, obtained in the present study was slightly less than what was reported by Kelay (2002), 7.54 persons per household, for the central high lands of Ethiopia. The average land holding of 2.02 ha per household in the study area was also quite lower than the average land holding of 3.28 ha (Kelay, 2002) for the central highland of Ethiopia to which the study area belongs.

The livestock herd size of 12.47 ± 5.11 per household in this study was comparable to what was reported for Adama (livestock size 11.64) but greater than those of Siraro and Sodo; 9.3 and 4.8 respectively (Hailemariam *et al.*, 2006). Siraro and Sodo are places found far away from the study area and with relatively different agro-ecological setups. In the study area livestock production constituted an important component. Among the important economic contributions are draught power, milk and meat, transportation, manure for fertilizer and fuel, means of income and skin.

The average flock size of 12.13 ± 4.46 chicken per household found in the present study was higher than what was reported by Taddelle and Ogle (1996a) for the central highlands of Ethiopia (4-10 chicken per household) and Kitalyi (1998) for the country as a whole (10 chicken per household). Considering differences in study periods, the flock size difference might reflect the progressive increase in bird population in the country.

Before slaughter the over all mean live weight of the local chickens were 1.3 ± 0.16 and 0.99 ± 0.22 kg for layers and growers respectively. This is an agreement with report of Aini (1999). The later indicated that village chicken reach a market weight of 1.0 to 1.5 kg at the age of 4 to 5 month. Gueye (2000) reported 0.7 to 2.1 kg live weight for adult female in Africa.

The relative importance of chickens as a means of income generation in the study area was in agreement with other studies (AACMC, 1984; Teketel, 1986; Alemu, 1995; Taddelle and Ogle, 2001; Vanveluw, 1987; Sonaiya, 1999). The use of poultry products for income generation purpose is common in most parts of the country where there is a mixed crop livestock farming

system. Gueye (1998) and Pedersen (2002) emphasized the importance of chicken as a means for food security rather than for income generation.

The housing of chickens in almost all of the households was a simple night shelter. This housing condition corroborates with the study results for Tanzania and other African countries (Mingia *et al.*, 1989; Sonaiya, 1990; Alemu, 1995). The poor housing condition is generally one of the factors that predispose chickens to diseases and predators (Sonaiya, 1990). As pointed out by Sonaiya (1990) the small size of the shelters and keeping chicken in kitchen or human sleeping quarters might limit the number of chickens because of limited space.

In this finding the scavenging chicken were supplemented with some grain and grain leftovers (threshing leftover) and kitchen leftovers. Other findings also reported occasional supplementation of scavenging chicken with kitchen leftovers, cereal bran, and small amount of cereal grains during the harvesting season (Mwalusanya *et al.*, 2002). The provision of supplementary feeding was indiscriminate and all age groups had to compete for the supplement; weaker groups might not get their share. (Gunaratne, 1993).

As per the result of this study, every household member had a role to play in village chicken production. Women were however the ones who do the bulk of the work. Women also tend to be more interested in the non-income generating roles of chicken than men (Anderson, 2001).

Crop contents analysis showed that the scavenged feed type was dependent on the surrounding environment including the household refuse availability. From the surrounding environment chickens obtain green forages, insects and worms, household refuses and unidentified materials. The occurrence of kitchen wastes, green forages and insects was highly significant ($P < 0.001$) in the non-harvesting than during harvesting season. The higher proportion of green forage during non-harvesting season could be attributed to the large consumption of young sprouting shoots, which were more abundant and palatable to the birds than during the harvesting season (Gunaratne *et al.*, 1993). Gunaratne *et al.* (1993) and Tadelles Ogle (1996b) reported that planting or harvesting time influenced crop contents of scavenging birds. Kitchen food wastes comprised of cooked wheat, maize, crumpled (pieces of bread and

“injera”), vegetable trimmings and stump, eggshell and cooked pulse crops (chickpea, beans, lentils).

The occurrence of grain in chicken crop contents was highly significant ($P < 0.001$) during harvesting season than non-harvesting season. Higher proportion of whole wheat, maize and other grains were observed. Mwalusanya *et al.* (2002) reported similar result for planting (harvesting) time. Gunarantene *et al.* (1993) reported that availability of grains was higher in long rainy season (in which harvesting most likely takes place) than short rainy season.

Scavenging feed resource base is not constant through out the year (Cumming, 1992). Such feed resource tends to vary with planting or harvesting time. They influence crop content of scavenging chickens. Factors such as seasonal conditions, farming activity, life cycle of insects and other invertebrates are among conditions that influence crop content (Robert, 1995; Tadelle and Ogle, 1996b; Sonaiya, 2004).

The higher proportion of green forages, insects (worms) and kitchen wastes in the layer crop contents could be due to their selective feeding behavior which depends up on nutritional requirement of a particular age group of chickens and production stage. Since egg production is associated with higher requirement for CP and Ca, they are more likely to pick up feedstuff rich in protein and calcium compared to growers to support egg production. Similar results have been reported by Rashid *et al.* (2005) who pointed out that SFR base could vary with the type of birds due to their foraging behavior and stage of growth.

The DM content of the chicken crop contents was highly significant ($P < 0.001$) during harvesting season than non-harvesting season. This might be due to the higher proportion of cereal grains in chicken crops during the harvesting season. According to Tadelle and Ogle (2000) the proportion of grain in the crop contents was higher during the short rainy season because of the increased availability of cereal grains which had just been harvested and frequently given to the birds. Another factor was the relative amount of available plant materials was lower during the short rainy season.

The CP content in the crop samples during the non-harvesting was significantly higher ($P < 0.05$) than the harvesting season. This could be probably because of the higher proportion of worms and young plants found in the non-harvesting season and household refuse waste especially cooked pulses crops (chickpea) found in the chicken crops both non-harvesting and harvesting seasons. Legumes containing two or three times greater than the amount of protein in cereals offer the most practical means of eradicating protein malnutrition of the cereal based diet of the population of Mediterranean (Bahl, 1988).

Similar results showed that the greater consumption of insects (worms) during the short rainy season than long rainy season, Diambra (1990) observed that the CP contents of insects (termites) were 459 g/ kg and that of worms was 341g/kg. Similar findings have been reported by Mwalusanya *et al.* (2002) in Tanzania. The study revealed that heaps of cattle dung used as media for earth worms, maggot larvae and cut worm production and they provide an excellent source of protein rich diets for the rural poultry in Africa. Insects, maggot, larvae and earth worms are the most important portion source for scavenging chickens (Smith, 1990; Sonaiya1995).

The higher CP content in the summer season might be due to the greater availability of insects compared with the other two seasons of the year This result is in agreement with the findings of Savory *et al.* (1978) who found that the diet of scavenging chicks contained about 56% of invertebrate food during the summer period which declined late. The CP content of the crops during the non-harvesting and harvesting season in the study area was greater than the results reported by Rashid *et al.* (2005) 102 and 109 g/kg DM non-harvesting and harvesting respectively. Mwalusanya *et al.* (2002) reported 123 and 85.7 g/kg DM CP during the short rains and long rains respectively.

On other hand layers crop content analysis indicated significantly ($P < 0.001$) higher CP content in the than in the growers. The higher CP in layer could be the higher intake of layers in order to meet their nutritional requirement for egg production. Since egg production demands higher CP and Ca they were more likely to pick up feedstuff rich in protein and calcium compared to growers to support egg production. Similar results found by Rashid *et al.* (2005) showed that

the SFR base could vary also with the type of birds due to their foraging behavior and stage of growth.

The Ca, P and other mineral components of the crop sample were significantly ($P < 0.001$) higher during the non- harvesting season than in harvesting season. This might have been due to the greater intake of green forage in the non-harvesting season. Green forages had been reported to have higher values of Ca and p other minerals than cereals (Ali, 1995).

The higher Ca level in the crop contents of the hens is difficult to explain but dependent upon the Ca requirement of hens for egg shell formation. Therefore, given a free choice feeding in scavenging chickens, hens more likely pick Ca rich feedstuffs than growers.(Leeson and Summers, 1997).

The calcium and phosphorous contents in the scavengeabe feed recourses were also low compared to the recommended level of these minerals for growers and laying hens, indicating the need for supplementation of Ca and P for scavenging birds. The recommended optimal ratio of these two mineral in poultry was with the range of 1:1 to 2:1. Nevertheless in laying hens the proportion of calcium in the diets is much higher since they require a large amount of Ca and P element for egg shell formation (McDonald *et al.*, 2002)

The crude fiber contents in the scavenging feeds were reported to range between 54 to 102 g/kg DM. Similar results indicated that the CF content of 47.1g/kg DM and 81.3 g/kg DM in non-harvesting and harvesting season respectively (Rashid *et al.*, 2005). Fiber fraction is composed of cellulose, lignin and hemicellulose that couldn't be digested efficiently by mono-gastric endogenous enzymes. The higher fiber content observed in the crop feed might have a significant effect on the feed digestibility and nutrient intake in scavenging chickens. Tadlele and Ogle (1996b) indicated 103 g/kg DM and 99 g/kg DM CF in the short rainy and long rainy season respectively, Huque (1999) found 94.4 and 90.9 g/kg DM CF in rainy and winter respectively which greater than 43.3 g/kg DM and 64.8g/kg DM observed in this study during non harvesting and harvesting seasons respectively. According to Felt well and Fox (1987) the normal maximum CF content is 5% in commercial layer ration, as digestibility of the diet is

progressively reduced as fiber level increase above this level and this inturn also limit the scope in the choice of supplements.

Birds kept on backyard systems can certainly not find all the nutrients it needs for optimal production of non-harvesting and harvesting season. These findings are in line with those of other authors (Huque *et al.*, 1994; Huque, 1995; Mwalusanya *et al.*, 20002; Sonaiyia *et al.*, 2002) who observed that in different seasons SFR base was critically deficient or unbalanced in nutrient.

The present results showed that the SFR base was deficient in CP, Ca and P when taking the recommended level of chicken diets by (NRC, 1994) into consideration .The metabolizable energy of crop contents analysis was greater than NRC (1994) recommended level for both layers and growers (2900 kcal and 2850 kcal respectively). Payne (1990) and NRC (1994) recommended CP,16%, Ca, 3.5% and P, 0.5% for layers and CP, 14.5%, Ca,1.0% and P 0.5% for growers was a bit higher than the result of the present study. Harvesting season expectedly increase the amount of ME rather than non-harvesting season but the CP, Ca, and P were greater in non-harvesting than the harvesting season.

6. CONCLUSIONS AND RECOMMENDATIONS

The present study showed that poultry play an important role in supplying the local people with additional income and high quality protein food. Women were the ones more involved in small scale chicken production. Poultry disease, lack of veterinary services and predators were among the major constraints mentioned by smallholders.

Scavenging was a dominant husbandry system and provided most of the SFR base for scavenging poultry. However, the availability of SFR base varied with season, farming activities and bird behavior. Moreover it is indicated that SFR base contain on average low amounts of protein, minerals such as Ca and P.

The dietary status of local chickens as assessed from the crop contents indicated that the CP, P, and Ca from scavenging feed were below the requirements for optimum egg production and growth and has seasonal fluctuation, so supplementary feeds rich in these nutrients would probably result in increased egg production and optimum growth.

Scavenging feed resource base is only sufficient for their maintenance requirement, but for increased production additional input is needed. From the chicken crop contents analysis results, the non-harvesting season was relatively better position as compared to harvesting season with in CP, Ca and P but for EE the reverse was true. Most of the nutrients were critical, and the result indicated that energy was excess even in the two seasons.

Based on the above findings, the following points are recommended.

- ❖ Awareness should be created among farmers about the significance of proper poultry housing, disease prevention and protection from predators.
- ❖ Scavenging poultry should be provided with supplementary feed.
- ❖ Further studies should focus on the amino acid profiles of scavenging chicken crop contents
- ❖ Additional study on the nutritive content of crop contents and individual ingredients should be carried out.

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8. APPENDICES

Appendix 1: Proportion of physical composition of non-harvesting and harvesting of chicken crop content (Layers and Growers).

Component of crop content	Non-harvesting (%)	Harvesting (%)
Grain	31.79	58.53
Kitchen waste	35.78	22.38
Insect(worm)	3.8	0.26
Green forage	9.2	1.15
Others	19.64	17.58
Total	100	100

Appendix 2: Questionnaire to assess the nutritional status of scavenging indigenous chicken under farmer management condition in Aad'a District E. Showa.

I. Socioeconomic and farming system characteristics

Instruction: -

The questionnaire should be filled after you have introduced your self and discussed all the points with the selected farmers.

For closed questions circle the letter(s)

For open questions, write farmers' responses clearly and shortly

Use only pencil

Questionnaire Number _____ Date of Interview _____

1. Households name _____ PA _____ Village _____
Sex _____ Age _____

1.1. Family age group of household (write in No)

1.1.1. Males < 15 yrs _____ Females < 15 yrs. _____

1.1.2. Males ≥15 yrs _____ Females ≥ 15 yrs _____

1.2. Level of education of household (write in no.)

a) Illiterate ___ b) Basic and primary education _____ c) Junior and above

2. Land use pattern (ha): a) total land size_____ b) cultivated land_____ c) private grazing land_____ d) fallow land_____
3. What is your main farming activity? a) Crop, b) livestock, c) integrated d) other
4. What is the main source of income (rank 1-3, one being most important and 3 least important)
a) Livestock & livestock product sale_____ b) Crop production sale_____ c) Off-farming activity_____
5. Types of crops produced in (1999\2000 E.C)

Types of crop produced	Area(ha)	Quantity produced in quintals(q)

6. Do you have livestock on your farm at present? 1/ Y 2/ N. If yes, what kind and how many of each?

Types of species.	No.
Cattle	
Sheep	
Goat	
Equines	

7. For what purpose and objective do you raise poultry? (Write in No)

Chicken type	Chicken type		Sale		Ceremonies	Gift	Others (specify)
	Meat	Egg	Live	Egg			
Cocks							
Cockerels							
Pullets							
Hens							
Chicks							

8. How long has poultry been kept in the household? a) less than 2 years b) 2-5 years c) 5-10 years d) over 10 years
9. What is your source of chickens: a) hatched, b) purchased from local market, c) packages, d) gifts, e) others
10. What is the role of family labor in the local chicken production (rank 1-4, one being most important and 4 least important)?

Activity	Husband	Wife	Children	Others
Owner of chicken				
Feeding				
Preparing and cleaning nests and roosts				
Decision taking to use within family, sell, buy, give to friends, etc.)				
Taking to market place and selling				
Owning the money from the sale				

11. Is there any cultural or religious taboo prohibiting the raising and or consumption of any chicken type a) Yes b) No

II. Poultry flock characteristics and management

1. Chicken flock composition (write in No)

Chicken type	Number of chicken		
	Exotic	Hybrids	Indigenous
Cocks			
Cockerels			
Pullets			
Hens			
Chicks			

2. Chicken flock dynamics for the year 1999(Write in No)

	Births	Purchases	Mortalities	Sells	Household Consumptions
Cocks					
Hens					
Cockerels					
Pullets					
Chicks					
Total					

3. Where do your birds rest at night?

- a). Share the same room with the family b). Night sleeping shelter house
 c). Separate house constructed entirely for poultry d). Others

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

- a) Made of mud of blocks and grass rough b). Iron-sheet roofs and wood c). Others
 specify

5. Do you clean the chicken droppings? a) Yes b)/No

6. If yes, how frequently do you clean?

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

III. Feed resources & feeding strategy

1. How do poultry get their feed? a/ birds feeding for self - scavenging b) Supplementation c)
 Both

2. Do you provide/ supplement extra feed to scavenging chickens? a/ Yes b/ No

2.1. If yes, what are the common supplements?

3. What is the basis of your offering supplements? a/ egg yields b/ Meat yields c/ Broodiness
 (during incubation)

4. Priority of supplementation of the different classes (rank from 1 to 5)

Class	Rank
Chicks	
Layers	
Pullets	
Cocks/cockerels	
Broody hens	

5. How do you feed your birds?

- a) On feeding troughs _____ b) Just spread on the ground for collective feeding

6. Do you make water available to your birds?

- a) Yes _____ b) No _____

6.1. If yes how frequently?

- a) Once a day _____ b). Twice a day _____ c). available at all times
d) Water is not provided _____

IV. Poultry productivity and marketing

1. What is the function of poultry products?

- a) Source of income b) Own consumption & replacement c) Cultural

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

3. Where do you sell chickens and eggs? a) Local markets b) Regional markets

V. Poultry health Management

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	Species	Major symptoms	Season of occurrence	Severity Death	Ages Mostly affected(which type survive	Local treatments

4. Do you keep different age group together? a) Yes b) No
5. Which age group has the highest mortality? (Rank1_3) 1 being highest mortality and 3 being the lowest mortality
a). Chicks b). Adults c). Grower
6. Do you use a traditional healer? a) Yes b) No, If yes specify
7. Do you lose most of your chickens?
a). Rainy season b) .Dry season c). Both seasons
8. What was the source of infection a). Own flock b).Incoming chicken c).Neighboring household d).Neighboring village e).Unknown
9. Do you purchase any medicaments? a.) Yes b).No
10. If yes what type of medicaments did you purchase & from where did you purchase the medicaments?
11. Did your chickens get vaccination? Is that both local and exotic or e
12. Is predator loss a serious problem? If yes specify the type and traditional means to overcome the problem

<u>Class</u>	Type of predator	Traditional means to overcome the problem
Chicks		
Adult		

Appendix 3 : Photo of, Scavenging chicken, and chicken crop content sample Preparation. in the study site.



Figure 1: Local chicken scavenging green forage in non-harvesting season in keteba peasant association Aad'a District.

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Figure 2: Scavenging local chicken scavenging green forage in harvesting season in Den kaka peasant association. Aad'a District



Figure 6: The owner of the household offered common supplement feed (wheat) to local chicken.



Figure 3: Layers and Growers at the day end of scavenging collected from Keteba peasant association Aad'a District.



Growers at the day end of scavenging collected from Den kaka peasant association Aad'a District.



Figure 6: The scavenging chicken scavenging scavenged feed resource around homestead.



Figure 9: Dissected chicken crop content samples at the Faculty of Veterinary Medicine Micro Biology laboratory

9. CURRICULUM VITAE

PERSONAL DATA

Name: Mulatu Dagnew Ayalew

Date of Birth: Dec.5, 1974

Place of Birth: East Gojjam, Ethiopia

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Maternal Status: Married

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EDUCATIONAL BACK GROUND AND QULIFICATION

- B.Sc. degree in a field of Animal Science from Alemaya University of Agriculture(1991-1995)
- Achieved Senior Secondary School Certificate at Motta High Scool,East Gojjam (1987-1988)
- Achieved Junior Secondary School Certificate at Motta Senior Secondary School (1985-1986)
- Achieved Primary Secondary School Certificate at Motta Primary Scool Certificate at Motta Primary School (1980-1986)

SPECIAL COURSES AND TRAINING

Certificate, Basic Computer Course, PC Training April 15 -June 20, 2002.

WORK EXPERIENCE

2000-2004 Amhara Regional State Agricultural and Rural Development Bureau,
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10. SIGNED DECLARATION SHEET

I, the under Signed declare that this thesis is my original work and has not been presented for a degree in any university and that all source of material used for the thesis have been duly acknowledged.

Name: Mulatu Dagneu _____

Date of submission June 25, 2008

This thesis has been submitted for examination with our approval as university advisors.

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