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ASSESSMENT OF URBAN POULTRY PRODUCTION PRACTICES IN ADDIS ABABA WITH EMPHASIS ON EGG PRODUCTION, PRODUCT MARKETING, FEED QUALITY AND WASTE MANAGEMENT

PhD Dissertation

BY

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May, 2016
Bishoftu, Ethiopia

ASSESSMENT OF URBAN POULTRY PRODUCTION PRACTICES IN ADDIS ABABA WITH EMPHASIS ON EGG PRODUCTION, PRODUCT MARKETING, FEED QUALITY AND WASTE MANAGEMENT

A dissertation Submitted to the College of Veterinary Medicine and Agriculture of Addis Ababa University in partial fulfillment of the requirements for the Degree of Doctor of Philosophy in Animal Production

By

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As members of the Examining Board of the final PhD open defense, we certify that we have read and evaluated the Dissertation prepared by Nebiyu Yemane Asfaw titled: 'Assessment of Urban Poultry Production Practices in Addis Ababa with Emphasis on Egg Production, Product Marketing, Feed Quality and Waste Management', and recommend that it be accepted as fulfilling the dissertation requirement for the Doctor of Philosophy in Animal Production.

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BIOGRAPHICAL SKETCH

I, the author of this PhD Dissertation, was born in December 1985 in Addis Ababa, Ethiopia. I attended Elementary, Junior Secondary and High School Education at Africa Andnet No.1 Elementary School, Arbegnoch Junior Secondary School and Medhanialem Comprehensive Secondary school in Addis Ababa, respectively. After a successful completion of my High School Education, I joined Mekelle University and graduated with BSc degree in Animal and Range Sciences in 2004. Soon after graduation, I was employed by the Agricultural Technical and Vocational Educational Training (ATVET) Department of the Ministry of Agriculture and Rural Development to teach at Agarfa ATVET College as Junior Instructor. Then after, I was employed by Bebeka Coffee Plantation Development Enterprise as Beekeeping expert. I then joined the school of graduate studies of College of Veterinary Medicine and Agriculture of Addis Ababa University in 2007 to pursue Master of Science degree and graduated in July 2009 with MSc degree in Tropical Animal Production and Health (Poultry Science). I was then employed by Arba Minch University as an instructor where I am still working.

STATEMENT OF THE AUTHOR

I first, declare that this dissertation is my *bonafide* work and that all sources of materials used for this dissertation have been duly acknowledged. This dissertation has been submitted to the requirements for PhD degree at Addis Ababa University, College of Veterinary Medicine and Agriculture and is deposited at the University's Library to be made available to borrowers under rules of the Library. I solemnly declare that this dissertation is not submitted to any other institution anywhere for the award of any academic degree, diploma, or certificate.

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LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
Ca	Calcium
CF	Crude Fiber
CGIAR	Consultative Group for International Agricultural Research Centers
CP	Crude protein
CSA	Central Statistics Agency
DM	Dry Matter
EE	Ether Extract
FAO	Food and Agricultural Organization of the United Nation
GLM	General Linear Model
HDEP	Hen-Day egg production
HHEP	Hen-Housed Egg Production
HU	Haugh Unit
ILRI	International Livestock Research Institute
IWM	Integrated Waste Management
ME	Metabolizable Energy
MoARD	Ministry of Agriculture and Rural Development
SPSS	Statistical Package for Social Sciences
UA	Urban Agriculture
UNCED	United Nations Conference on Environment and Development
UNCHS	United Nations Centre for Human Settlements
UNDP	United Nations Development Program
USA	United States of America

DEDICATION

This dissertation is dedicated to my mother Ayelech Diresse Allene, for nursing me with affection and love and for her dedicated partnership in the success of my life.

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ASSESSMENT OF URBAN POULTRY PRODUCTION PRACTICES IN ADDIS ABABA WITH EMPHASIS ON EGG PRODUCTION, PRODUCT MARKETING, FEED QUALITY AND WASTE MANAGEMENT

Nebiyu Yemane Asfaw

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ABSTRACT

The study was conducted with the objectives of assessing the existing poultry production systems and constraints in Addis Ababa and identifying potential intervention areas for improving the performance of the enterprise. A two-stage sampling technique was used to select Sub-cities and poultry farmers. A total of 156 poultry farmers were included in the study. For egg quality analysis, a total of 120 eggs were collected from four groups of farms (30 eggs from each group) based on their formulated feed sources. Four major formulated layers feed samples were subjected to nutrient composition analysis. For the marketing survey, 30 local retail shops, 30 collectors and 30 supermarkets were included. For poultry products utilization assessment, 25 restaurants, 25 pastries and 25 snack houses and 105 urban consumers were included. Most of the households (57.1%) were female-headed. The poultry farmers obtained foundation and replacement stock from privately owned large scale poultry farms. Most of the poultry farmers (62.2%) used the floor system of housing while 37.8% used the cage system. None of the poultry farmers did use home-mixed ration due to lack of knowledge (89.1%), unavailability of ingredients (7.7%) and high cost of ingredients (3.2%). The common poultry diseases in the study area were Gumboro, Newcastle, Mareks, Fowl pox, Salmonella, Ecoli, Food cholera, Mycoplasmosis and Coccidiosis. Egg production performance was affected by family size, educational level, housing system and flock size ($p<0.05$). Layer birds kept in cages laid the first egg and attained peak of lay earlier than those kept on floor housing. Percent hen-day (HDEP) and hen-housed egg production (HHEP) increased with increasing flock size. Significantly higher ($p<0.01$) HDEP and HHEP were also recorded in cage compared to the floor system. Birds in cages and larger size flocks laid for a significantly ($P<0.01$) longer period. Mortality rate was higher in flocks of less than 151 birds ($p<0.05$). A higher mortality rate

was also recorded for birds reared on floor than those on cage housing systems. The crude protein, metabolizable energy, crude fiber, ash, ether extract and Ca levels of the formulated layer feeds considered was above the minimum nutrient level recommended for layer birds. Most external and internal egg quality traits were affected by feed sources and housing system ($p<0.05$). The price of eggs and spent layers were significantly varying ($p<0.05$) in different occasions at different market centers while the price of eggs was not significantly different ($p>0.05$) at supermarkets. Currently, the price offered for eggs obtained from exotic chicken has become higher than that of the eggs from local chicken. The restaurants and pastries mainly preferred the exotic chicken egg while the snacks houses preferred the local chicken egg. High price of eggs is one of the main marketing constraints that the restaurants, pastries, and snacks houses faced. Manure was found to be the major waste of poultry farms followed by litter/manure mix and dead birds. The nuisance odour of poultry droppings (1^{st}), lack of convenient dump site (2^{nd}), lack of market for selling the manure/litter (3^{rd}) are the main constraints of waste disposal. The high prices of feed (1^{st}), shortage of land (2^{nd}), unavailability of pullets in time (3^{rd}) are the major constraints of small scale intensive urban poultry production. Flock size was significantly affected by age ($p<0.05$), family size ($p<0.01$), educational level ($p<0.05$) and farming experience ($p<0.001$) of the household heads while sex, sideline business and housing system had no significant effect ($p>0.05$). The increase in demand for table eggs laid by exotic chicken owing to the increase in number of hotels, restaurants and pastries is an opportunity for urban poultry farming. Using cage housing system and having large flock is more advantageous than rearing birds in floor housing system with small flock size in terms of producing dozens of eggs, reducing the chance of bird's mortality and efficient use of land. Formulated feed sources and housing system influenced the quality of the eggs. Only very small number of farmers benefited from sells of manure/litter. The dominant constraint of urban poultry production was high price of feed. Thus, concerned bodies should design a platform for the development of the poultry sub-sector considering the existing urban poultry production practices for its contribution for income generation, job creation and fulfilling the protein demand of the urban dwellers.

***Key words**: Egg production, Laying strains, Small scale system, Marketing, Poultry waste*

1. INTRODUCTION

Urban agriculture is generally characterized by closeness to markets, high competition for land, limited space, use of urban resources such as organic solid wastes and wastewater, low degree of farmer organization, mainly perishable products and high degree of specialization. By supplying perishable products such as vegetables, fresh milk and poultry products, urban agriculture to a large extent complements rural agriculture and increases the efficiency of national food systems (Veenhuizen, 2006). Throughout the developing world, and especially in Africa, animals are an important physical and financial capital for many urban households. Throughout Africa, broiler chicken, milk and eggs come from city farms or the suburbs (Moustier and Danso, 2006). As a regular source of income, they represent a form of savings. They may also generate additional physical capital in the form of manure (Prain, 2006). However, the major problem in most of these less developed countries is lack of recognition of urban agriculture as a major contributor to food self-sufficiency and its many other actual and potential benefits towards sustainable urban development. In most of these countries there is no even base-line data and information on the very activity of the industry (Jacobi *et al.*, 2000).

Poultry production is one of the best available sources for the production of high biological value animal protein in terms of eggs and meat. Commercial hybrids, both broilers and layers, are being disseminated for meat and egg production throughout the world (Yasmeen *et al*., 2008). In egg-producing farms, day-old chicks are purchased from specialized hatcheries that produce egg-producing pullets. These pullets are either raised by the egg producer or a pullet grower until they are ready to start laying eggs, which is usually at 19 weeks of age. Laying hens in egg producing farms are usually of small body frame and body weight compared to broilers. Egg producing chicken breeds have been bred and raised for maximum egg production (up to 300 eggs per year) rather than high meat yield (Beutler, 2007). The productivity of exotic strains intensively reared is high compared with the native hens (Ershad, 2005). The performance of laying hens kept in the tropics is determined to a large extent by the birds' productive adaptability (Yakubu *et al*, 2007). The production

potential of a good layer strain is better assessed based on the number and size of eggs produced during its lifetime and its final as spent-hen (Imouokhome and Ojogho, 2012).

Commercial layer farming is not only a source of employment, income and food but also critical to strong socio-cultural linkage. To meet up the increasing demand, apart from egg production, efficient egg marketing is necessary. It is difficult to run a profitable business without proper and organized marketing system. Therefore, marketing is a very important factor for egg as a commercial product. An efficient marketing system is needed for availability of product supply at a fair price and to encourage higher production (Omar *et al*, 2013). Due to the high population growth in Africa and growing income, the demand for eggs and poultry meat has significantly increased in recent years across large parts of the continent (WHO, 2010). The consumption of poultry and eggs will increase by 200% between 2010 and 2020 for at least some countries in sub-Saharan Africa (USDA, 2013).

The poultry industry produces large amounts of waste that include solid waste and waste water. The solid waste consists of bedding materials, excreta (manure), feed, feathers, hatchery waste (empty shells, infertile eggs, dead embryos and late hatchlings), sludge, abattoir waste (offals, blood, feathers and condemned carcasses) and mortality. Poultry waste is usually a combination of poultry bird faeces, urine, saw dust and remnants of animal feeds, drugs and pesticides (Adedayo 2012). Poultry manure contains high phosphorus which has positive effect on the growth and productivity of crops. It is also effective when combined with mineral phosphorus fertilizer for farm use (Mokwunye 2000). Dead birds and hatchery waste are high in protein and contain substantial amounts of calcium and phosphorus due to high levels of mineral supplements in the diet. The approximate percentages of nutrient intake excreted by poultry are: nitrogen (65.5%), phosphorus (68.5%) and potassium (83.5%), elements for soil fertility and increased crop production (Olumayowa and Abiodun 2011). There are several ways of disposing poultry waste including burial, rendering, incineration, compositing, feed for livestock, fertilizer or source of energy. Other waste disposal methods include conversion of poultry waste to energy and use of poultry waste for treatment of heavy metal contaminated water (Moreki and Chiripasi, 2011).

The poultry sector in Ethiopia can be characterized into three major production systems based on some selected parameters such as breed, flock size, housing, feeding, health, technology and bio-security. These are large scale commercial poultry production system, small-scale commercial poultry production system and village or backyard poultry production system (Bush, 2006). Small-scale commercial production system is characterized by medium level of feed, water and veterinary service inputs and minimal to low bio-security. Alemu (1995) also stated that poultry production systems in Ethiopia show a clear distinction between traditional, low input systems and modern production systems using relatively advanced technology. There is also a third upcoming "small scale" intensive system with small number of birds (from 50 to 500) as an urban and peri-urban household income source using exotic birds and relatively improved feeding, housing and health care (Alemu and Tadelle, 1997). Most small-scale poultry farms obtain their feed and foundation stock from large-scale commercial farms (Nzietchueng, 2008). There are about 7 regional poultry multiplication and distribution centers with a total annual capacity of producing about 1,236,000 day-old chicks and about 486,000 pullets and cocks. There are also about 10 commercial poultry farms with estimated annual production capacity of 1,500,000 chicks. Most farms import day old chicks from abroad (MoARD and FAO, 2006).

Ethiopia, one of the most populous countries in Africa, is a huge market for poultry, despite the high level chicken population. While chicken consumption remained low for so long at less than 1 kg per person per year (Davis, 2014), the market demand is increasing particularly in the Ethiopia capital Addis Ababa and many other major cities. Over the previous three decades or so, however, the subsector has been showing a shift to industrial production with an increase in small- and medium-scale producers that have been established to exploit mainly urban markets. An emerging middle-class urban sector with higher income and more buying power has boosted the demand for poultry products, and this has led directly to expansion of poultry production particularly within urban and peri-urban areas. Large-scale investment is following the boom of the small-scale urban and peri-urban poultry producer (Pagani and Wossene, 2008). The cost of day-old chicks, equipment, feeds, drugs and other inputs are unbearable and for a farmer to succeed in this enterprise, the most productive layer strain must be reared on the farm in order to achieve the desired maximum

profit, repay the loans secured for the business and plan for expansion (Imouokhome and Ojogho, 2012).

It is estimated that the poultry population in Addis Ababa is about 350,000 where most of the chicken are raised on small scale level in the backyards. The poultry population is insignificant as compared to the national poultry population, which is estimated at about 51.35 million (CSA, 2013). The existing chicken's population in the City is estimated to produce about 2,342 tons of eggs and 705 tons of poultry meat. According to the unpublished data of the City Administration's Urban Agriculture Department (2005), the per capita consumption in Addis Ababa was about 2.28 kg of eggs and 2.5 kg of poultry meat. The per capital annual poultry meat and egg consumption has been declining and estimated at the national average of close to 0.12 and 0.14 kg, respectively (USAID, 2010). In the least developed countries, the projected increase in egg consumption between 2005 and 2015 is 26%, compared with only 2.4 percent in the developed countries (Windhorst, 2008).

Like many developing countries, Ethiopia has a high rate of urbanization, averaging about 3.8 % per annum (CIA, 2012). About 30% of this population is concentrated in the capital city, Addis-Ababa. This population growth rate is also accompanied by growing numbers of the urban poor and malnourished, due primarily to the high rate of unemployment. The Addis-Ababa City Government has recognized urban agriculture as one of the important tools to end poverty. To this effect, the City Government has taken the following measures to encourage this sector: Recognized the existence and continuation of urban farming within and around the City; Accepted urban agriculture as an integral component of the City's development Master Plan; and established the Department of Urban Agriculture at both city and sub-city levels (Thomas, 2013). This indicates that the government is giving due attention to urban agriculture particularly for poultry production. As a result, the newly emerging small scale intensive poultry farming is now playing a major role in creating job opportunities and becoming a source of income generator for most of unemployed youth and urban dwellers of Addis Ababa and also satisfying the protein demand of the urban dwellers.

In the past, most researches conducted on poultry production focused on village poultry production and its contribution to the rural poor. The urban poultry farming is under-estimated and given very little attention by researchers even if it has a significant contribution to the socio economic development of the country. Besides, the quality of most of the formulated feeds produced by feed manufacturers and its effect on egg production performance and quality and the poultry waste management practices were not properly addressed. Despite the increase in demand of exotic chicken products in the study area, there is lack of information on the marketing system. Moreover, there is lack of information on the utilization of exotic chicken products by restaurants, pastries and snack houses. Therefore, this indicates that there is a need to undertake a comprehensive scientific study on urban poultry farming practices, its contribution towards income generation, products marketing and utilization, poultry production performance, identification of major constraints of urban poultry farming and existing opportunities, poultry waste management practices and evaluation of the quality of formulated feeds and its effect on egg quality traits. Hence, studying the existing small scale intensive urban poultry farming will help to suggest possible recommendations for further improvement and development of the urban poultry farming practices and to address the problems. Moreover, the information obtained from this study will contribute to policymakers, researchers and institutions as baseline data for further development of the sector in urban areas.

Accordingly, this study was designed with the general objective of assessing the existing poultry production systems and constraints in Addis Ababa and identifying potential intervention areas for improving the performance of the enterprise in the area specified. The specific objectives include:

- assessment of the poultry husbandry practices and factors affecting the performance of poultry farms in terms of egg production;
- evaluation of the performance of exotic layers under small scale intensive urban poultry farming;
- to determine the quality of formulated poultry feeds and egg quality traits under small scale intensive urban poultry farming;

- assessment of exotic poultry products marketing and utilization;
- assessment of waste management practices of small scale intensive urban poultry farming;
- identification of the major constraints, opportunities and socio-economic factors affecting flock size in small scale intensive urban poultry farming.

2. LITERATURE REVIEW

2.1. Urban Agriculture

Urban agriculture can be defined as the production of food (for example, vegetables, fruits, meat, eggs, milk, fish and non-food items such as fuel, herbs, ornamental plants, tree seedlings, flowers) within the urban area and its periphery; for home consumption and/or for the urban market, and related small scale processing and marketing activities (Hovorka *et al*., 2009). It is the practice of producing vegetables, food and fruits within urban environment for household consumption as well as sale to the rapidly growing urban population (Dima *et al*., 2002). Urban agriculture takes place on private, leased or rented land in peri-urban areas, in backyards, on roof tops, on vacant public lands such as industrial parks, school grounds, roadsides, in prisons and other institutions as well as ponds, lakes, and rivers (Salau and Attah, 2012).

The scale of urban food production is generally under estimated. Conservative estimates suggest that, in 1993, between 15 and 20% of the world's food was produced in urban areas. Although numbers are difficult to come by, it is further estimated that as much as 40% of the population in African cities and up to 50% in Latin America are involved in urban agriculture (Mougeot, 1994).

Urban agriculture contributes, in no small measure, to the food security of many major cities, both as an important component of the urban food system and as a means for vulnerable groups to minimize their food-insecurity problems. City case studies indicate a considerable degree of self-sufficiency in fresh vegetable and poultry production as well as other animal byproducts. Dakar produces 60% of its vegetable consumption, whilst poultry production amounts to 65-70% of the national demand (Mbaye and Moustier 2000). The importance of urban agriculture is increasingly being recognized by international organizations like UNCED (Agenda 21), UNCHS (Habitat), Food and Agriculture Organization (FAO), and Consultative Group for International Agricultural Research

(CGIAR). Urban agriculture plays an important role as a source of food, income and creates employment especially for the poor (Waters-Bayers, 2000).

According to Mougeot (2000), crops, horticulture and livestock are important for developing countries with regard to food safety, supply of quality protein, source of cash or even education for urban people. Urban agriculture may function as an important strategy for poverty alleviation and social integration of disadvantaged groups (e.g. HIV/AIDS-affected households, disabled people, female-headed households with children, elderly people without pensions, jobless youth), with the aim to integrate them more strongly into the urban network, provide them with a decent livelihood, and prevent social problems such as drugs and crime (Novo and Murphy, 2000). Urban livestock systems are very diverse and can be classified in various ways, e.g. according to location (urban or peri-urban or on-/off-plot), main production goal (commercial v subsistence), scale of production, husbandry methods (roaming, herding, tethering, stall-feeding), land tenure (private, rent or lease, informal agreement) and animal size and species (Schiere, 2001).

2.2. Socio-economic Characteristics of Urban Farmers

About half of the world population lives in urban areas. It is estimated that, by 2020, the developing countries will account for about 75% of all urban dwellers (Bakker *et al*., 2000). However, while urbanization brings a number of socio-economic benefits, the rapid increase in urban population ushers a number of challenges. Urban authorities find themselves heavily challenged in terms of their capacities to provide adequate services such as housing, infrastructure, facilities and employment. The continued expansion of urban areas into the immediate hinterlands often leads to the conversion of potential agricultural lands into non-agricultural land uses. This takes place at a time when many cities are saddled with the challenge to tackle growing unemployment and poverty (Thomas, 2013).

Some cities have adopted urban agriculture as a strategy to address the increasing urban unemployment, poverty and hunger. This is because urban agriculture supports food security and nutrition, provides employment and generates income for the urban poor in general and

the disadvantaged groups such as women, the disabled, the elderly and the unemployed youth (van Veenhuizen, 2006).

The higher growth of urban areas and urban population is evident worldwide. Half of the world population is already in urban (Prain, 2006). In Africa by 2030 about 50 percent or more of population is expected to live in cities (Parrot *et al*, 2010). UNDP mentioned that about 800 million urban residents were engaged in agricultural production for subsistence and commercial purposes in the mid-1990s. The population engagement in urban agriculture (UA) in Africa increased from 10-25% in the beginning of 1980s to 70% in 1990s (Bryld, 2003).

For a long time now the importance of urban agriculture was overlooked or dismissed as merely the result of traditional habits brought by rural migrants to the city, expected to fade away overtime when these people integrated into the city economy. There was opposition to urban agriculture from public health and urban planning circles, which perceived urban agriculture either as a threat to public health that should be abandoned, or as a low-rent land use that would not be able to compete with other urban land uses. Such perceptions were institutionalized in restrictive bye-laws and regulations at national and city levels, although these have remained largely ineffective (Hovorka *et al.*, 2009). However in 1996 the United Nations Development Programme (UNDP) estimated that 800 million people worldwide were engaged in urban agriculture, 200 million of them were market producers employing about 150 million people full time (UNDP, 1996).

In many countries, rapid urbanization is accompanied by increasing urban poverty, food insecurity and malnutrition. As a result, in many cities the number of people involved in urban agriculture tends to increase with ongoing urbanization. Another factor is the growing urban demand for perishable products, including vegetables, meat, milk, and eggs, coupled with the comparative advantage of producing close to the markets; and the availability of productive resources including urban organic wastes, wastewater and vacant public lands (Hovorka *et al.*, 2009).

Urban farming is also a common feature in Sub-Saharan Africa. It is estimated that over 50% of the urban population in Africa is involved in urban agriculture (Obudho and Foeken, 1999). Evidence presented from the city of Kano in northern Nigeria suggests that urban agriculture is providing farmers with food and employment (Lynch *et al*., 2002). Urban agriculture has a high potential for improving the urban environment by using organic waste-solid wastes and waste water as inputs by improving the micro-climate and by preventing erosion and flooding through replanting bare lands. It also conserves energy and food, because there are fewer foods looses during transport and handling and greater energy savings due to the smaller need for storage, processing and packaging (Salau and Attah, 2012).

2.3. Small Scale Commercial Poultry Production

In recent years there has been growing recognition among the development community of the role of small scale commercial poultry production in accelerating the pace of poverty reduction and reaching out to the poorest of the poor. There is also growing evidence to demonstrate the role of small scale poultry in enhancing the food and nutrition security of the poorest households and in the promotion of gender equality (Dolberg, 2004).

At the same time, the market and production context of poultry production has been changing rapidly over the last two decades. Rapid economic growth and urbanization in developing countries has resulted in fast expansion of industrial large scale, vertically integrated, poultry production units, especially in Asia. Opportunities have also expanded for small scale poultry enterprises due to improved market access infrastructure (Conroy *et al.*, 2005).

Small scale commercial poultry production farms are generally characterized by farmers raising medium sized flocks (ranging from 50 to 500 birds) of local breeds or cross-bred stock. Farmers usually provide housing structures made of local materials, purchase part of their feed, use vaccines and veterinary services whenever available and may even have minimal bio-security systems in place. Such systems are more prevalent in urban and peri-

urban areas with output from these systems usually sold to nearby urban centers with varying degrees of marketing systems in place. While some poultry growers have relatively formal marketing contracts others usually rely on verbal contracts. Such contracts are restricted to sale-purchase agreements and have no effect on the choice of technology, input supplies or any other service support (Vinod and Arindam, 2007).

The cage system of housing laying hens is the most economical method of producing eggs. However, although the productivity and health of birds are better than in other systems, there are serious welfare disadvantages in the cage system. Lack of the freedom of movement, comfort and shelter, suitable flooring and freedom to display most normal patterns of behavior aroused many discussions about the poultry welfare. Since battery cages for poultry were first criticized by the animal welfare organizations and scientists (Wegner, 1990). The aviary, perchery and free-range housing systems incorporate many of the requirements of the domestic hen that are currently not met by battery cage housing: increased physical space, greater environmental complexity, litter, perches, and egg-laying facilities (Folsch *et al*., 1988). It was reported that feed consumption, feed conversion and mortality of hens housed in cage was better than in aviary, perchery and free-range (Mostert *et al*., 1995).

2.4. Egg Production Performance of Exotic Chickens

The hybrid layers usually start egg laying at about 19 weeks of age and peak egg production is attained during the first production cycle. The average production rate of commercial layers usually remains very close to 0.9 eggs per day (Kekeocha, 1985). However, as the age increases, their egg production decreases. This situation is further aggravated during the second production cycle. Appetitive behavior of hens is also affected during the later stage of production age. The climatic conditions have also been known to affect the production behavior of the laying hens (Smith and Leclecq, 1990). In areas where climate is hot and humid, commercial hybrids produce an average of 180-200 eggs per year, while in more temperate climate, birds can produce between 250 and 300 eggs per year. The production cycle of eggs may also be influenced by many other factors such as breed, mortality rate, body weight, laying house lightening schedule, feed and culling (North and Bell, 1990).

After one year of production, layers are culled and used for meat purpose without exploiting their full inherent potential, which can be exploited up to second production cycle (North and Bell, 1990). The factors like diseases and market rates usually reflect a miserable picture of annual flock replacement while rearing new pullets for profitable egg production. Moreover, keeping aged hens as such is uneconomical because of gradual decline in egg production with more erratic clutch cycles and poor feed efficiency in the relatively heavy layers. Therefore, pullets and spent layers must be managed effectively and efficiently in order to get maximum output and profitability (Kekeocha, 1985).

2.5. Egg Quality Traits of Exotic Chickens

Egg weight is one of the important phenotypic traits that influence egg quality and reproductive fitness of the chicken parents (Islam *et al*., 2001). Egg weight influences the weight of components of eggs especially egg albumen and yolk (Aygun and Yetisir, 2010). Anderson (2002) provided detailed information on the differences in egg production and quality between different white and brown egg strains and reported the egg weight from brown hens (61.1g) was more than that of white hens (58.3g). Yolk color is a key factor in any consumer survey relating to egg quality (Okeudo *et al.*, 2003). Consumer preference for yolk colour is highly subjective and varies widely from country to country. The determinant of yolk colour is the xanthophyl (plant pigment) content of the diet consumed (Silverside *et al*., 2006). Ethiopian consumers have a strong preference for eggs with deep yellow yolk colour. Very small sized eggs from the scavenging local chicken with deep yellow yolk colour fetch much higher prices compared to larger eggs of improved strains with pale yolk (Tadelle *et al*., 2003).

The eggshell thickness is an important trait for hatchability. For best result of hatchability egg shell thickness should be between 0.33 and 0.35 mm and few eggs with a shell thickness less than 0.27mm will hatch (Khan *et al*., 2004). The differences in eggshell quality depend on the environmental conditions and the feed quality and also of strain of layers (Zita *et al*., 2009).

It is generally accepted that the higher the Haugh unit value, the better the quality of the egg. Research has shown in UK that there is consumer resistant to purchase eggs which have HU's below 60, the actual HU figure where resistance to the product determined later by market researchers. Some of the large supermarkets chains in the UK set minimum acceptable level of 70 HU on regular documented tests (TSS, 1999).

2.6. Poultry Feeds and Feeding

Feed represents the major cost of poultry production, constituting up to 70 percent of the total. Of total feed cost, about 95 percent is used to meet energy and protein requirements, about 3 to 4 percent for major mineral, trace mineral and vitamin requirements, and 1 to 2 percent for various feed additives. Poultry diets are formulated from a mixture of ingredients, including cereal grains, cereal by-products, fats, plant protein sources, animal byproducts, vitamin and mineral supplements, crystalline amino acids and feed additives. These are assembled on a least-cost basis, taking into consideration their nutrient contents as well as their unit prices (Ravindran, 2012).

2.6.1. Poultry feed resources

The feed resources can be divided into two main categories as conventional and nonconventional feed resources. Conventional feed sources are those traditionally used, whereas, those non-conventional once are not commonly and traditionally used as chicken feeds (Younas and Yaqoob, 2005). However, conventional feed resources are facing a problem of competition with human foods. Gura (2008) also stated that the recent feed price increment may upset many of the plans to further development of industrial livestock/poultry productions.

2.6.2. Poultry feed resources in Ethiopia

The country`s requirement of poultry feed is met through local production. The demand for poultry feed is estimated at 25,749 tons. The demand for the products is projected to reach at

34,453 tons and 41,889 tons by the year 2018 and year 2022, respectively. The principal raw materials required are oil cake, wheat bran, molasses, cereals, limestone, bone - meal (blood - meal), vitamins, minerals and salt. All the raw materials are locally available, except vitamins which have be imported. Proteins, largely of vegetable origin, encourage the normal development of pullets and help them to lay eggs longer. There are about 20 feed mixers in the country. However, only five of them are manufacturing purely for sale. The rest produces primarily for own consumption (ILRI, 2011).

According to Wilson and Beyer (2000) the profit from poultry production can be attained by minimizing feed cost which accounts more than half of the total cost of production. Feed cost accounts 60-70% of the total animal production cost. Any attempt to improve commercial poultry production and increase its efficiency therefore, needs to focus on better utilization of available feed resources. Knowledge of nutritional characteristics of these feeds and its optimal levels of inclusion in rations and optimum combination of ingredients composed locally available materials are very useful (Kamalzadeh *et al*., 2008).

Nevertheless, there is comparatively little information on the actual uses of agro-industrial by products in Ethiopia. In tropical countries like Ethiopia where cereal grains are staple diet of human, the use of agro-industrial by-products as an alternate source of protein, partially or/and fully enables cheaper egg and meat production which in turn decrease consumption of cereal grains by animal (Meseret *et al*., 2012).

The industrial sector in Ethiopia is still playing a minor role in the national economy. Nevertheless, at present, industries especially those depending on agricultural raw materials are undergoing a significant revolution particularly owing to the current free market economic policy. Beverage and food processing industries are flourishing so fast that disposal of end products has become so critical, raising economic and environmental concerns. Hence utilization of such by-products in the livestock industry and particularly in poultry production has become one of the focal areas of research. A variety of oil crops are known to grow in Ethiopia. Among the major oil crops, for instance, about 78,000 metric tons of cotton seed, 58,000 metric tons of Noug (*Guizotia abyssinica*) seed, 22,000 metric

tons of rape seed and 29, 000 metric tons of groundnut seed are produced annually (Solomon,1992) and used mainly by the oil processing industries. Currently, residues of oil extraction industries are providing a large quantity of oil seed cakes and meals to poultry farmers at a relatively low cost. A study conducted in the Eastern part of the country indicated that brewer's dried grain could be included up to 25% in the ration of layers without impairing egg production and other parameters (Adnan, 1988).

2.6.3. Components of poultry feeds

Poultry diets are made primarily from a mixture of several feedstuffs such as cereal grains, soya bean meal, animal by-product meals, fats and vitamin and mineral premixes (Alimon and Hair-Bejo, 1995). A poultry diet is expected to contain three essential nutrients of protein, vitamins, and minerals as well as provides adequate metabolizable energy (ME). The most easily available sources of energy are the carbohydrates contained in common grains, grain by-products and plants generally (Dateh, 2013). The important and basic components of a laying hen diet include energy, carbohydrates, protein and amino acids, fat, and vitamins and minerals. Not only must all of these nutrient sources be present in the diet, but they must also be present in certain amounts (Depersio, 2011).

Most of the carbohydrate in poultry diets is provided by cereal grains. Suitable quantities of fat may be added to increase dietary energy concentrations and palatability. Protein is essential in all animal life. Proteins make up a large part of the muscle, skin, beak, feathers, cartilage and internal organs of animals and are needed for growth, egg production, reproduction, production of antibodies to fight diseases, etc. The dietary requirement for protein is actually a requirement for amino acids. Specific amino acids must be provided in proper amounts and in some definite ratios to others. An under supply of a single essential amino acid will inhibit the responses to those in adequate supply (Fanatico, 2010).

In any protein, the limiting amino acid is the one which is below the standard. For poultry, methionine is usually the first limiting amino acid and lysine the second limiting amino acid. Since protein is not stored in the body to any considerable extent, any protein consumed

above the birds‟ requirement is oxidized for energy. However, since protein sources are expensive and uneconomic for energy provision protein levels are usually stated in precise terms to be closer to the minimum requirement than other nutrients. Protein sources can be of a plant origin such as soya and groundnut cake or of an animal origin, such as fish meal. Some sources of minerals include Oyster shell and limestone which are both rich in calcium (Dateh, 2013). Bone meal is a very good source of both calcium and phosphorus amongst others. Common salt can satisfy the birds' sodium and chloride requirements. However trace mineral requirements are usually met by supplementation via the vitamin/mineral premix (Scheideler, 2009).

2.6.4. Quality of formulated poultry feeds and nutrient requirement of birds

The efficiency of feed utilization in the livestock and poultry birds and the development of feed industry of a country are dependent upon the quality of feeds. The quality of compounded animal feeds is based on the quality of its constituents i.e the raw material (cereals by products, oil seed meals, marine feeds, agro-industrial by products), used to formulate the ratio (Uppal *et al.*, 2008). In Ethiopia, the quality of mixed feed used is generally poor. Most formulations available do not have vitamin/mineral premixes. Ingredients and processed feeds vary in nutritive value and there is no regular quality control mechanism in the country. Unavailability of feed quality legislation and laboratory facilities for chemical analysis also contributes greatly to the poor quality of processed feeds (Taddele *et al*., 2002).

Since a laying hen draws upon the nutrients provided in its diet to produce eggs, the quality and formulation of the diet is of most importance to a producer, especially considering that 65 to 75% of the cost to produce eggs is due to feed costs (Bell and Weaver, 2002). Due to this fact, it has become increasingly important for producers to find a balance between feeding their birds on a least-cost basis as well as feeding the appropriate amounts of nutrients in the diet as the hen needs them throughout her lay cycle (Depersio, 2011).

For maximum growth and good health, intensively reared poultry need a balanced array of nutrients in their diet. The nutrients required by birds vary according to species, age and the purpose of production – whether the birds are kept for meat or egg production. Formulation of balanced diets is fundamental to economical poultry production, and this process depends on knowledge of nutrient requirements of poultry". In essence, there are three main factors that an egg producer must be concerned with and they are; 1) the cost of feed, 2) the amount of egg production and quality of the eggs, and 3) the profit made (NRC, 1994).

Feed is the most important input for poultry production and the availability of low-priced, high quality feeds is critical for the expansion of the poultry industry and quality (FAO, 2003; Ismoyowati and Sumarmono, 2011). Diets for laying hens are formulated to meet the requirements for those indispensable amino acids (AA) that may limit egg production, namely lysine, methionine, tryptophan, and total sulfur amino acids (Perez-Bonilla *et al.*, 2012).

According to NRC (1994), diets based on corn and soybean meal with 15.0% CP can satisfy the amino acids requirements of brown egg-laying hens consuming 110 g of feed per day. However, several commercial guidelines for laying hens (Lohmann, 2010; ISA Brown, 2011) recommend CP levels varying from 17.4 to 18.2% (19.1 to 20.0 g of CP/day per hen) for the first part of the production cycle. The reasons behind this practice are unknown but might be related to the interest to maximize egg size and reduce the possibility of a non-conventional indispensable amino acids (i.e., Arg, Ile, Trp, Val) limiting egg weight and hen production. However, an excess of CP in the diet increases nitrogen load to the environment (Latshaw and Zhao, 2011) and often results in increased feed cost.

According to Perez-Bonilla *et al*. (2011) supplemental fat affects productive performance and egg size of laying hens, but the effects depend on the amount and type of fat used as well as on the linoleic acid content of the diet (Grobas *et al.*, 1999). In addition, supplemental fat might improve the digestibility of other components of the diet as well as egg mass production and feed efficiency (Bouvarel *et al.*, 2010).

Poultry can derive energy from simple carbohydrates, fat and protein. They cannot digest and utilize some complex carbohydrates, such as fibre, so feed formulation should use a system based on available energy. Metabolizable energy (ME) is the conventional measure of the available energy content of feed ingredients and the requirements of poultry. This takes account of energy losses in the faeces and urine. Metabolizable energy requirements of commercial layers depend on environmental temperature; it increases when the environment is cold or hot (Sakomura *et al*., 2005). Therefore, under heat stress situations, increasing energy levels in the diet of commercial layers by the inclusion of oil may compensate the low feed intake and supply the higher energy requirements (Almeida *et al*., 2012).

Minerals are the inorganic parts of feeds or tissues and are divided into macro (major) minerals and micro (minor) minerals. Minerals are required for skeletal formation, as cofactors of enzymes, and for maintenance of osmotic balance within the body. Macro minerals that are required in the diet of a laying hen include calcium, chlorine, magnesium, phosphorus, potassium, and sodium. Two macro minerals that are particularly important in the diet of a laying hen are calcium and phosphorus. The amounts of calcium required in the diet for laying hens, as recommended by the NRC (1994), are 4.06, 3.25, and 2.71% for 80, 100, or 120 grams of feed intake, respectively. Micro minerals required in the diet include copper, iodine, iron, manganese, selenium, and zinc. Fat-soluble vitamins that are essential in the diet of a laying hen include A, D_3, E, and K. Water-soluble requirements include B_{12}, biotin, choline, folacin, niacin, pantothenic acid, pyridoxine, riboflavin, and thiamin. Fats and oils are feed sources high in energy and can be added to a poultry diet to provide energy, and in turn improve productivity and efficiency. This is because oxidation of fats is an efficient way to obtain energy (NRC, 1994).

At the onset of laying, it is desirable to encourage feed consumption and quickly to obtain eggs of marketable size. For this, a feed enriched in fat and incorporating a minimum of insoluble fiber is recommended. After the onset of laying, a slightly lower energy level, richer in cellulose, will allow a good energy efficiency to be obtained (expressed in kcal) and plumage to be maintained (ISA, 2009).

2.7. Urban Poultry Products Marketing and Utilization

According to Adene and Oguntade (2006) in the commercial sector, large-scale operators slaughter and process their birds using in-house facilities. About 90 percent of broilers are processed and sold as frozen chickens, with the remainder sold as live birds. Eggs and fresh and frozen poultry meat are sold directly to consumers at the farm gate and open markets, to commercial distributors, and to supermarkets, fast food companies, and hotels and other hospitality industry operators. Poultry products are mainly transported by road in all types of vehicles, including specially designed vans for day-old chicks, refrigerated trucks for frozen products, and cars, buses, trucks, and motorcycles for live birds. Shipments of day-old chicks are occasionally sent by air. Backyard, semi-commercial producers sell poultry in live bird markets or directly from their homes or shops. They also sell live birds to distributors for re-sale to hotels and restaurants (Obi *et al*., 2008).

Poultry products in most developing countries, especially in Africa, are still expensive. The marketing system is generally informal and poorly developed. Unlike eggs and meat from commercial hybrid birds (derived from imported stock), local consumers generally prefer those from indigenous stocks. As most consumers with greater purchasing power live in and around cities, intensification of poultry production should be initiated in peri-urban areas or, at least, in areas having a good road network (Branckaert *et al*., 2000).

In North West Ethiopia, the price, demand and supply of chicken are highly related to religious festivals, mainly Christian festivals. The egg marketing channel is more or less similar to that of chicken. Eggs are sold at the farm gate to egg collectors, in the open markets to middlemen and consumers and to retail shops, hotels and supermarkets in towns. Eggs pass through a relatively longer chain to reach the consumers than chicken. The main actors in egg marketing are producers, collectors, traders or (wholesalers), local kiosk, shops and supermarkets. Urban markets followed by nearest local market and farm gate are, in order of importance, the preferred outlets for egg marketing by producers (Fisseha *et al*., 2010).

In the last few years, agricultural production has experienced significant development due to an increasing demand for food by the world's population. This demand results particularly from the increase in the global population, as well as in average income and urbanization. The United Nations (UN) estimates that there will be eight billion people on the planet by 2030, whose income will be, on average, 32 per cent higher than in 2006. In addition, meat consumption per person per year will increase by 26 per cent in the same period, and this increase in consumption will be chicken meat, in particular (OECD-FAO, 2010). Poultry products are preferred by consumers that these products provide foods with high-quality protein and a low level of fat with a desirable fatty acid profiles (FAO, 2010).

According to FAO (2009), there is a positive relationship between the level of income and the consumption of animal products. Quality and safety considerations in foods of animal origin provide commercial opportunities for producers, market actors and industry participants of developing countries (ILRI, 2000). According to Pisulewski (2005) consuming poultry and fish products has no risk of cancers. Furthermore, FAO (2003) also reported that the by-products of poultry production are of value if managed and recycled; however, if not managed or recycled properly are of concern. The preference and consumption of chicken meat can be considered as a universal phenomenon and chicken meat is greatly accepted by consumers worldwide as compared to the other meat consumption (Jayaraman *et al*., 2013).

The demand of protein food is progressively growing with the improvements of society's income and population growth that affects trends of chicken production. With an annual human population growth rate of 2.4%, the present 77.4 million Ethiopia's human population will increase to about 149.3 million by the year 2040 (FAO., 2005). With the increasing population of the country, there is an increasing demand for the supply of food. Thus, the demand for animal products is expected to increase substantially. To meet the ever-increasing demand for meat and eggs, introduction of superior/exotic breed has been proposed as one of the plausible option. Under the prevailing management situations, it may be difficult to fulfill these demands in short time. Therefore, intensification and upgrading of the potential of birds will be inevitable to provide surplus products (Haftu, 2016).

According to Daghir (2009) the current growth of poultry production and consumption makes a good case for the need and desire for future growth of the poultry industry. Estimated egg and poultry meat per capital consumption in the mid 1990s was 57 eggs and about 2.85 kg (ILCA, 1993), respectively in Ethiopia. However, the per capital annual poultry meat and egg consumption has been declining and estimated at the national average of close to 0.12 and 0.14 kg, respectively (USAID, 2010). The increase in egg and poultry meat consumption for developing countries is 26 and 2.4%, compared with only 2.4 and 1.6% in the most developed countries (Windhorst, 2008).

2.8. Urban Poultry Waste Management Practices

The poultry industry produces large amounts of waste that include solid waste and waste water. The solid waste consists of bedding materials, excreta (manure), feed, feathers, hatchery waste (empty shells, infertile eggs, dead embryos and late hatchlings), sludge, abattoir waste (offals, blood, feathers and condemned carcasses) and mortality (John and Teto, 2013). In Botswana, ashes which result from the use of coal for chick brooding are also produced as waste in large quantities on broiler operations, especially in medium scale and large-scale operations, and these need to be disposed of (Moreki and Chiripasi, 2011).

The effective movement from the point of collection to either a temporary storage or point of final use is a crucial factor in waste management (Mijinyawa and Dlamini, 2007). Olumayowa and Abiodun (2011) stated that dead birds and hatchery waste are high in protein and contain substantial amounts of calcium and phosphorus due to high levels of mineral supplements in the diet. Waste utilization for agriculture including poultry waste is not a new phenomenon in Africa but a traditional method of providing nutrients for plants, enhancing soil quality and creating livelihood for farmers (Onibokun, 1999). There are several ways of disposing of poultry waste including burial, rendering, incineration, compositing, feed for livestock, fertilizer or source of energy (John and Teto, 2013).

The utilization of waste for urban agriculture has recently become an important phenomenon in developmental research due to its role in curbing urban food and unemployment problems

for the growing urban population. Recent studies have provided evidences of environmental, social and economic contributions of waste utilization for urban food production. However, a major problem to contend with remains how waste (wastewater, municipal waste, cattle waste, poultry waste, etc.) can best be managed for healthy food production with minimal negative health implications (Allison *et al*., 1998). The application of animal manure such as poultry/pig manure and cow dung or human excreta directly to the soil requires an organized composting or co-composting of the animal manure with other forms of solid waste for efficient productivity in urban agriculture (Cofie *et al*., 2005).

The production of poultry results in: hatchery wastes, manure (bird excrement), litter (bedding materials such as sawdust, wood shavings, straw and peanut or rice hulls), and on-farm mortalities. The processing of poultry results in additional waste materials, including offal (feathers, entrails and organs of slaughtered birds), processing waste water and bio solids. Most of these by-products can provide organic and inorganic nutrients that are of value if managed and recycled properly, regardless of flock size. However, they also give rise to potential environmental and human health concerns as the sources of elements, compounds (including veterinary pharmaceuticals), vectors for insects and vermin, and pathogenic microorganisms. With the probable exception of veterinary pharmaceuticals, these factors are also relevant to small flocks, including small family flocks that may be partially housed in containment structures (Williams, 2013). The knowledge of the quantity of poultry manure or litter produced on a farm is essential for the design of effective waste management programme (FAO, 2012).

Moreki and Keaikitse (2013) stated that using manure to fertilize the soil is a good way to dispose of litter or manure because manure and/or litter can add the nutrients that are lacking in the soil. Most poultry manure and litter are applied to land near poultry production farms. With few exceptions, this is the preferred practice in developing countries and elsewhere. Such land management of poultry by-products brings the risk of surface and groundwater contamination from potential pollutants contained in the manure and litter. Its value depends on several factors, including the agronomic potential of the receiving crops to utilize the waste nutrients, the receiving soil type and specific geological conditions of the land being

utilized, the distance to nearby surface and ground waters, the amount of vegetated areas (riparian buffers) adjacent to nearby surface waters, and the climate. Poultry waste reuse poses serious threat to human health. The smell and sight of poultry waste are offensive and often become breeding ground for a variety of pests, rodents and also generate polluted runoff into water ways and to the environment (Zeeuw, 2000). According to Moreki and Chiripasi (2011) and Amanullah *et al*., (2010) application of manure or litter appears to be an ideal method of disposal for soils poor in phosphorus.

2.9. Major Constraints of Urban Poultry Production

The African poultry sector faces high production costs, safety concerns due to lack of sanitary controls, and technical constraints in processing and marketing. Production costs are higher in Africa due to the lack of an integrated and automated industrial poultry sector. Farmers lack reliable access to inputs, including chicks and feed, and face high costs for veterinary services. African livestock markets are also limited by global concerns about product safety. The persistence of animal disease outbreaks continues to limit domestic and export production potential. In addition to biological issues, the lack of breeders, marketing, and processing technology present technical constraints to poultry sector growth (David, 2004). The following are the major constraints of urban poultry farming in Ethiopia:

2.9.1. Feed cost

The price of raw materials varies according to source of supply and region. Little attention is given to the least cost formulation of rations. It is believed that considerable scope exists to reduce the price of feed in some areas without reducing its nutritive value. Transport costs add significantly to the cost of feed in areas distant from the source of supply. The lack of feed mills and dependence on supplies of some ingredients from large cities and its surroundings add to the overall cost of feed in many parts of the country. The absence of bulk deliveries and storage has increased feed costs. In some cases, a lot of wastage occurs due to weevil infestation. The shortage in the supply of protein supplements of animal origin has made the price of abattoir by-products extremely high. In many instances, the cost of

mixed feed does not seem to follow reductions in ingredient cost. Prices of mixed feed remains unduly high even at times when the price of the major component of mixed rations (e.g. corn) fall by more than fifty percentage (Tadelle *et al*., 2002).

2.9.2. Feed availability

Poultry feed and nutrition is one of the most critical constraints to poultry production under both the rural smallholder and large-scale systems in Ethiopia. The problem is mainly associated with lack of processing facilities, inconsistent availability and distribution and sub-standard quality of processed feeds, when available. Regular availability of good quality ingredients and a fully balanced complete feed are essential for efficient poultry production. Grains, cereal by-products, oil seed cakes and meat and bone meal are obtained locally. The shortage in the supply of grains especially corn is improving due to the increase in the production of corn in recent years. The most serious problems arise from the unavailability of suitable micro-nutrient sources: vitamins and minerals (Haftu, 2016).

2.9.3. Feed quality

The quality of mixed feed for commercial poultry production is generally poor in Ethiopia. Most formulations available do not have vitamin/mineral premixes. Ingredients and processed feeds vary in nutritive value and there is no regular quality control mechanism in the country. Unavailability of feed quality legislation and laboratory facilities for chemical analysis also contributes greatly to the poor quality of processed feeds (Tadelle *et al*., 2002).

2.9.4. Shortage of chicks supply

In general, the knowledge on hatching processes is low and management standards at most of the hatcheries are poor. This leads to low hatching percentages on several of the hatcheries in Ethiopia. Hatching results are influenced both by parent stock management as well as the management of the hatchery itself. Managing parent stock is more difficult than managing layers or broilers. The parent stock farms observed clearly lacked good

management: animals were not always uniform, cocks often too fat, dry hens are not culled and many birds suffer from diseases and external parasites. On most of the parent stock farms, there is no candling equipment available to test fertility of the eggs. Furthermore, hatching of both layer and broiler parent stock are often put together in the same batch, which is far from ideal, as layer hatching eggs are more sensitive to disturbances in the hatching process. A structural problem with all the hatcheries in Ethiopia is the altitude on which they are built. All are on higher altitudes (1500 meters or above), where the oxygen concentrations are lower. This leads to higher mortalities between days 15 and 20 of the hatching process, when chicks gradually need more oxygen. The total output of the hatcheries currently is too low to meet the demand. This leads to long waiting lists for poultry keepers and empty, unoccupied houses for periods sometimes up to 7 months or longer. This makes poultry production a risky venture and as a result, many people drop out of poultry keeping and turn to other ways of income (Boere *et al.*, 2015).

2.9.5. Diseases and biosecurity problems

Newcastle disease (ND) is the main cause of economic loss in poultry production in Ethiopia (Nasser *et al*., 2000). The bio-security status in many of the intensive poultry farms is extremely poor (Wossene, 2006). The management and health care practices are generally inadequate to ensure the introduction of highly pathogenic avian influenza (HPAI) is prevented and to control the disease should an outbreak occur. The sale of poultry waste for animal feed, exchange of sacks and the lack of biosecurity and hygienic measures at feed processing plants, inadequate bird slaughtering and packaging facilities in many commercial poultry facilities, and the sourcing, handling and storage of poultry products in supermarkets are some of the bio-security issues that require urgent consideration and policy decisions (Solomon, 2008).

Day old chickens are imported from countries like Egypt, UK, Germany, Kenya and Holland as a parent stock by ELFORA, Genesis Farms and Alema farm. Information obtained from the federal MoARD indicates that the OIE recommendations are followed during importation of birds into the country. Critics of the importation regulations indicate that

although certifications that testify freedom from major diseases are used as criteria for importation, follow up quarantine and inspection activities are not in place either at the Federal or at the importing farm level (Wossene, 2006).

The health measures at the government owned poultry multiplication and distribution centers were extremely poor. The basic bio-security and hygienic practices are often disregarded and husbandry know-how is generally lacking. Footbath application, if practiced at all, was only when people enter the poultry houses but not when they leave poultry houses. With the exception of Bonga and Bedelle, all the centers were devastated by the outbreak of Infectious Bursal Disease i.e. Gumboro disease (Yilma, 2007). Infectious Bursal Disease (IBD) has become a problem during the past few years and it is assumed that it was introduced to the country through the importation of infected poultry, poultry products or poultry equipment. IBD is a disease of economic importance; especially to the government operated breeding and rearing centers and commercial poultry sector (Solomon, 2008).

3. MATERIALS AND METHODS

3.1. Study Area

The study was conducted in Addis Ababa, the capital Ethiopia. Administratively, the City is having three layers of government: City government, Sub-city administrations, and District (Woreda) administrations. The City is divided into 10 sub-city administrations (Figure. 1). Addis Ababa is situated at a latitude of 9^0 3' North and 38^0 43' East and an altitude of 2408 meters above sea level. The average minimum and maximum annual temperature are 9.4 and 23.2^0C, respectively, and the mean annual rainfall is 1201 mm. The pattern of rainfall is bimodal, in which the long and heavy rainfall is received during the months of June to September, while the short and small shower is received during February to April. The total area of the city is about 527 km^2 and the total human population was estimated to be 3,273,000 (CSA, 2013).

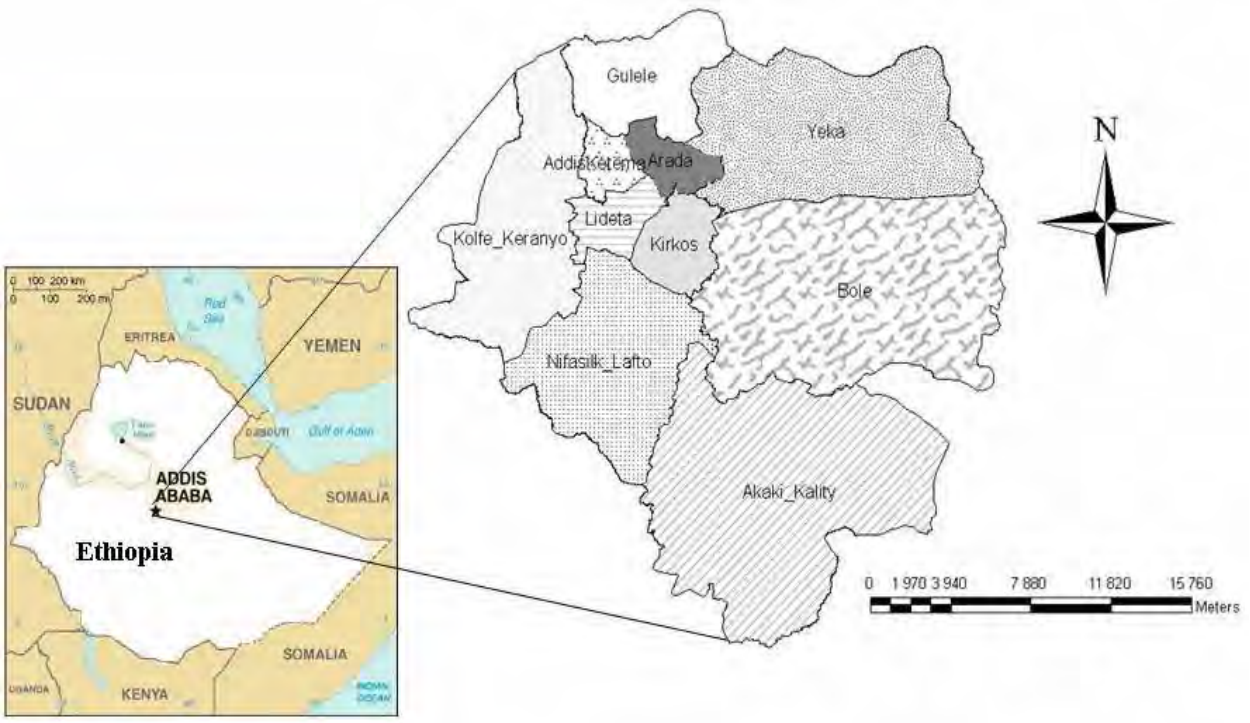

Figure 1. Map of the study area

3.2. Study Population and Design

Small scale intensive urban poultry farmers and chicken kept by the poultry farmers represented the study population. Cross-sectional and retrospective types of studies were conducted to collect data using questionnaires. On farm observations and laboratory analysis were also employed to collect relevant data.

3.3. Study Methodology

3.3.1. Sample size determination

The sampling units were small scale intensive urban poultry farmers. The sample size required for the study was determined by the formula recommended by Arsham (2007) for survey studies.

$$N = 0.25/SE^2$$

Where:

N: number of sample

SE: standard error

With the assumption of 4% SE, 156 households were sampled.

3.3.2. Sampling procedure

Sub-cities and small scale intensive urban poultry farmers were selected using a two-stage sampling technique. The first stage involved purposive selection of five Sub-cities out of the ten Sub-cities based on the practice and the availability of small scale intensive poultry farms in those areas. Thus, Gullele, Bole, Nifasilk-lafto, Akaki-kality and Yeka Sub-cities were selected for the study. In the second stage, small scale intensive urban poultry farmers were selected randomly from the list of urban poultry farmers from each selected Sub-city. Thus, 33, 27, 34, 37 and 25 small scale intensive urban poultry farmers were selected randomly from Gullele, Bole, Nifasilk-lafto, Akaki-kality and Yeka Sub-cities, respectively. The sample size for each sub-city was based on proportional sampling (Table 1). Therefore,

a sample size of 156 small scale intensive urban poultry farmers was used for the survey study.

Table 1. Sample size distribution among selected Sub-cities of the study area

Sub-city	Small scale poultry farmers (N)	Proportion to total	Actual sample size
Gullele	124	0.21	33
Bole	102	0.17	27
Nifasilk-Lafto	130	0.22	34
Akaki-Kality	140	0.24	37
Yeka	98	0.16	25
Total	594		156

For poultry products marketing and utilization assessment, a purposive sampling technique was employed based on their participation in exotic poultry products marketing and utilization; therefore, purposively selected 30 local retail shops, 30 collectors, 30 supermarkets, 25 restaurants, 25 pastries and 25 snacks houses were interviewed. For assessing urban consumers' poultry products preference and frequency of consumption, an accidental sampling technique was employed to select a total of 105 urban consumers at the restaurants and snacks houses were contacted. For identifying the constraints faced by urban agricultural offices, key informants working on poultry production in each Sub-city were interviewed.

For evaluating the egg quality traits, a total of 24 small scale intensive poultry farms having similar age group of layer birds and management were identified and grouped into four groups each consisting of six farms (3 cages and 3 floor housing) based on their feed sources. Thus, a total of 30 eggs were collected from each of the four groups of farms so as to have a total of 120 eggs.

To evaluate the quality of the formulated feed samples, all of the 24 farms from where the eggs were collected were grouped into four groups each consisting of six farms based on

their feed sources. From the six farms in each groups, a feed samples were collected and mixed together to form four composite feed samples that represented each of the four major formulated feed samples.

3.3.3. Data collection methods

The methods employed for collecting data in line with the objectives of the study involved were questionnaire survey, key informants interview, on farm observations and laboratory analysis.

Questionnaire survey

Primary data were collected through interviews using a structured questionnaire. The interview mainly focused on the socio-economic characteristics of the respondents, flock size, source of pullets and finance, housing systems, feeding and watering system, diseases and biosecurity measures, institutional support and extension services, record keeping and egg production performance parameters such as number of eggs produced per day, number of eggs at peak of lay, number of birds available at peak of lay, number of hens housed at the beginning of laying, number of birds available in the flock and length of lay, marketing of exotic chicken products and consumption, waste management practices, the major constraints and opportunities of small scale intensive urban poultry farming, barriers for future expansion of poultry farming, threats to small scale intensive urban poultry farming. Information on the challenges faced by Sub-city urban agricultural offices working on poultry production was collected by interviewing the key informants in each Sub-city. Since the survey was based on a one visit interview, it was not possible to record the egg production performance parameters throughout the egg laying period rather poultry farmers were asked on the performance parameters and their previous records maintained at the farms. Based on the information gathered the hen-day egg production (HDEP) and hen-housed egg production (HHEP) were calculated using the following formula given by North (1984);

$$HDEP\ (\%) = \frac{\text{Total number of eggs produced on a day}}{\text{Number of birds available in the flock on that day}}\ x\ 100\%$$

$$HHEP\ (\%) = \frac{\text{Total number of eggs produced on a day}}{\text{Number of birds housed at the beginning of laying}}\ x\ 100\%$$

Where, HDEP= hen-day egg production, HHEP= hen-housed egg production

A separate structured questionnaire was used to assess the poultry products marketing by interviewing collectors, supermarkets and local retail shops. A separate structured questionnaire was also used to collect information in the restaurants, pastries and snacks houses about the places of purchase of the poultry products, advantage of using exotic poultry products over local chicken products, frequency of purchases of exotic poultry products and amount purchased, main chicken meat and egg dishes prepared, consumers preference relative to other livestock products and marketing constraints in purchasing of poultry products. The urban consumers met at the restaurants and snacks houses were also interviewed on their preference of exotic over local chicken products and frequency of chicken meat and egg consumption.

Key informants interview

Primary Data were also collected by interviewing key informants in each sub-city about extension and technical supports by urban agricultural offices, contribution of small and micro finance institutions, government support to the urban poultry farmers and its future perspective, challenges faced by the urban poultry farmers in the process of production and marketing of the products, challenges faced by the government offices working on urban poultry production and its future sustainability.

Egg quality traits analysis

A total of 120 freshly laid eggs (5 eggs from each of the 24 farms) were collected from the small scale intensive poultry farms of the five Sub-cities having similar age group of layer birds, management practices and based on their formulated feed sources. The egg weight

was measured using digital balance (g) and egg length and egg width using an electronic Digital Caliper (Mitutoyo, Japan). The egg shell thickness was measured at the middle, big size and small size of the shell by using electronic Digital Caliper and the average of the three was used. To determine the internal egg quality characteristics, eggs were broken onto a flat surface. The thick albumen height (AH) and Yolk height (YH) was measured using Tripod Micrometer (TSS, England). The thick albumen height was measured at its widest part at a position half way between the yolk and the outer margin. The yolks were carefully separated from the albumen. Albumen and yolk weight were determined by weighing with electronic sensitive balance separately. The yolk color was determined using the Roche Colour Fan (Printed in Switzerland); a standard colorimetric system ranged 1-15. Individual Haugh Units (HU) were calculated from the two parameters; height of albumen (AH) and egg weight (EW) (Haugh, 1937, as cited by Desalew, 2012), using the formula:

$$HU=100\log (AH–1.7\ EW^{0.37} + 7.6)$$

Where, HU = Haugh Unit

AH= Albumen height in millimeters

EW= Egg weight in grams.

Some of the egg quality traits were estimated using the following formula:

Shape index (%) = (Width of egg / Length of egg) x 100

Albumen (%) = (Albumen weight / Egg weight) x 100

Yolk (%) = (Yolk weight / Egg weight) x 100

Shell weight = Egg weight – (Albumen weight + Yolk weight)

Shell (%) = (Shell weight / Egg weight) x 100

Feed samples laboratory analysis

For evaluating the quality of the formulated poultry feeds, four of the composite formulated feed samples were taken to NVI (National Veterinary Institute) feed laboratory for their nutrient compositions analysis and subjected to chemical analysis for dry matter (DM), ash, crude protein (CP), ether extract (EE), crude fiber (CF) according to AOAC (1990) and the

mineral composition of the feeds in particular the mineral Ca was determined by Talapatra method (precipitation, filtration and titration) according to Mudgal (2012). Metabolizable energy (ME) values of each formulated feed sample were determined by indirect method according to the formula recommended by Wiseman (1987) as follows:

$$ME\ (kcal/kgDM) = 3951 + 54.4EE - 88.7CF - 40.8Ash$$

Where, ME = Metabolizable energy, kcal= kilo calorie, kg= kilogram, DM = Dry matter
EE = Ether extract, CF= Crude fiber

3.4. Data Analysis

All the collected data were coded and entered into a data base using statistical package for social sciences (SPSS). Descriptive statistics such as mean, standard error, percentiles, frequencies and GLM (general linear model), ANOVA (analysis of variance) and Pearson correlation and chi-square test of the SPSS statistical software were used to analyze the data (SPSS for windows, release 20, 2011). The following models were used to analyze the factors affecting farm performance in terms of egg production and the flock size of the farms; the effect of housing system and flock size on percent mortality; the effect of housing system and feed sources and their interaction on the external and internal egg quality traits.

Model 1: Factors affecting farm performance in-terms of egg production.

$$Y_{ijklmnopq} = \mu + S_i + A_j + F_k + E_l + S_m + E_n + H_o + F_p + F_q + e_{ijklmnopq}$$

Where, $Y_{ijklmnopq}$ = Egg production performance (HDEP%, HHEP%, peak percent lay, length of lay, age at first egg and age at peak of lay), μ = Overall mean, Si= effect of i^{th} sex, $A_{j=}$ effect of j^{th} age, F_k = effect of k^{th} family size, E_l = effect of l^{th} educational level, S_m= effect of m^{th} sideline business, E_n = effect of n^{th} experience, H_o = effect of o^{th} housing system, F_p= effect of p^{th} feed source, F_q= effect of q^{th} flock size, $e_{ijklmnopq}$= random error normally and independently distributed with mean zero and variance (σ^2) i.e. NID (0, σ^2).

Model 2: Effect of housing system and flock size on percent mortality

$$Y_{ij} = \mu + H_i + F_j + + e_{ij}$$

Where, Y_{ij} = Mortality (During growing and laying stage), μ = Overall mean, H_i= effect of i^{th} housing system, F_j= effect of j^{th} flock size, e_{ij}= random error normally and independently distributed with mean zero and variance (σ^2) i.e. NID (0, σ^2).

Model 3: Socio-economic factors affecting flock size

$$Y_{ijklmno} = \mu + S_i + A_j + F_k + E_l + S_m + E_n + H_o + e_{ijklmno}$$

Where, $Y_{ijklmno}$ = flock size, μ = Overall mean, S_i= effect of i^{th} sex, $A_{j=}$ effect of j^{th} age, F_k = effect of k^{th} family size, E_l = effect of l^{th} educational level, S_m= effect of m^{th} sideline business, E_n = effect of n^{th} experience, H_o = effect of o^{th} housing system, $e_{ijklmno}$= random error normally and independently distributed with mean zero and variance(σ^2) i.e. NID (0, σ^2).

Model 4: Effect of housing system and feed sources on external and internal egg quality traits

$$Y_{ijk} = \mu + H_i + F_j + (HxF)_k + e_{ijk}$$

Where, Y_{ijk} = external and internal egg quality traits

μ = Overall mean

H_i = effect of i^{th} housing system

F_j = effect of j^{th} feed source

$(HF)_k$ = effect of the interaction between i^{th} housing system and j^{th} feed sources.

e_{ijk}= random error normally and independently distributed with mean zero and variance (σ^2) i.e. NID (0, σ^2).

Correlation between internal and external egg quality traits were analyzed using Pearson moment correlation coefficient model

$$r = \frac{\Sigma xy}{(\Sigma x^2 \Sigma y^2)^{0.5}}$$

Where r = correlation coefficient

Σx^2, Σy^2 and Σxy = sum of variables

Indices were calculated to provide ranking of the constraints in small scale intensive urban poultry farming, constraints of waste disposal, the constraints in marketing of poultry farm inputs and outputs and also the constraints that the restaurants, pastries and snacks houses faced in purchasing of poultry products according to the formula:

Index = Sum (n x number of HHs ranked first) + (n-1) x number of HHs ranked second + (n-2) x number of HHs ranked third +…+ 1 x number of HHs ranked last) for one factor divided by the sum of (n x number of HHs ranked first+ (n-1) x number of HHs ranked second+…. +1x number of HHs ranked last) for all factors, and where n= value given for the least ranked factor. The variable with the highest index value is the highest economically important (Kosgey, 2004).

4. RESULTS

4.1. Socio-economic Characteristics

The socio-economic characteristics of the small scale intensive poultry farmers of the study area are presented in Table 2. The present study revealed that 57.1% of the poultry farms were female owned and 42.9% of them were male owned. Larger percentages (55.8%) of the poultry farmers were married, 33.3% were single and only 10.9% were widows. Highest number (36.5%) of the poultry farmers attended secondary education (9-12), 21.8% attended primary education (1-8), 17.3% attended tertiary education and 24.4% had no formal education. Most (41.7%) of the poultry farmers had no sideline business, about 37.2% had small businesses like shopping and waving and 21.2% were civil servants. The average age of the poultry farmers was 38.7 years, ranging from 26 to 64 years. The average family size was 5.3 persons which ranged from 2 to 12 persons per household. The average farming experience was 3.2 years which ranged from 2 to 7 years. The flock size per farm ranged from 56 to 415 layers with a mean of 141.6 layers.

Table 2. Socio-economic characteristics of the small scale intensive poultry farmers

Variable	Number of respondents	%
Sex		
Male	67	42.9
Female	89	57.1
Age (yrs.)		
Up to 35	67	42.9
36-50	75	48.1
51yrs and above	14	9.0
Marital status		
Married	87	55.8
Single	52	33.3
Widows	17	10.9
Educational level		
No formal education	38	24.4
Primary education	34	21.8
Secondary education	57	36.5
Tertiary education	27	17.3
Farming experience (yrs.)		
1-3	45	28.8
3-5	94	60.3
>5	17	10.9
Sideline business		
Civil servants	33	21.2
Small business	58	37.2
None	65	41.7
Family size		
1-5	96	61.5
6-10	41	26.3
>10	19	12.2
Flock size		
50-100	54	34.6
101-150	47	30.1
151-200	21	13.5
>200	34	21.8

4.2. Household Labor Allocation for Poultry Farm Activities

The study revealed that all of the poultry farmers used family labor for the farm operation. As shown in Table 3, the major activities of the farms like feeding, cleaning, egg collection, selling and purchasing of inputs and other related farming activities were mainly done by household wives and young daughters. The household wives shared the largest responsibility

for feeding (42.7%), cleaning (37.7%), egg collection (44.3%), selling (55.9%) and purchasing of inputs (59.0%). The responsibilities of husbands were very less in feeding, cleaning, collection, selling and purchasing of inputs compared with the other family members. In 20.2% of the small scale poultry farms, house maids were responsible for cleaning of the poultry farm wastes but none of them was involved in selling and purchasing of farm products and inputs. The role of husbands was very small (0.3%) in cleaning of the poultry farm. Young daughters and sons were also involved in most of the farm operation activities.

Table 3. Household labour allocation for poultry farm activities

Activities	Husband		Wife		Young daughters		Young sons		Household maids	
	N	%	N	%	N	%	N	%	N	%
Feeding	5	3.8	67	42.7	41	26.1	33	21.2	10	6.2
Cleaning	1	0.3	59	37.7	36	23.0	29	18.6	31	20.2
Egg collection	3	2.0	69	44.3	42	26.6	32	20.4	10	6.3
Egg selling	2	1.5	87	55.9	34	21.7	33	20.9	0	0.0
Purchasing	7	4.5	92	59.0	27	17.5	30	19.1	0	0.0

4.3. Purpose of Rearing, Source of Pullets and Finance

The main purpose of rearing poultry in urban areas of Addis Ababa was mainly for income generation through selling of the eggs and spent layers at the end of the production cycle. None of the poultry farmers in the study area reared exotic birds only for home consumption.

The entire poultry farmers included in the present study kept Bovans Brown layer breed. The layer breeds kept by the poultry farmers varied at different times depending on the availability of the birds in the supplier farms. The purchase of the required layers is determined by the supplier. The poultry farmers of the study area obtained initial flock and replacement stock of pullets from privately owned large scale poultry farms. About 53.8%, 40.4%, and 5.8% of the poultry farmers obtained the layer breeds from Friendship agro-industry, Alema agro-industry and Genesis farms, respectively. They mainly purchased three months old pullets which actually depended on the supplier interest and availability of the different age groups of birds at the supplier farms on time of request. Due to the unavailability of replacement layer breeds on time of request, the time period between layer batches in urban small scale intensive poultry farms can reach up to 8 months and above.

The main source of money to finance the poultry faming was from micro finance institution (54.5%), family (34.0%), personal saving (7.7%) and religious organization like Kale-hiwot church (3.8%) (Table 4). These all played a great role by lending money to start the poultry farming and financing it in the process of rearing.

Table 4. Source of finance and pullets

Variable	Number of respondents	%
Source of finance		
Micro-finance institutions	85	54.5
Family/friends	53	34.0
Personal saving	12	7.7
Religious organizations	6	3.8
Source of pullets		
Friendship agro industry	84	53.8
Alema farms	63	40.4
Genesis farms	9	5.8

4.4. Poultry Housing System

About 62.2% of the poultry farmers used the floor housing system of production while the remaining 37.8% used the cage system. All poultry farmers constructed a separate poultry house from the main residence and constructed within the living fences of the poultry farmers. Almost all the houses were not constructed according to recommended poultry housing design. Poultry farmers using the floor system of housing provided litter material in the poultry house like Teff straw (*Eragrostis teff*) (70.1%) and wood shavings (29.9%).

The present study revealed that 84% of the poultry farmers did use lighting for the poultry house whereas the reaming 16% did not use lighting (Table 5). According to the poultry farmers the main reason for not using proper lighting schedule was due to the high cost incurred for lighting (52%), unaware of the advantage of using lighting (28%) and due to frequent power interruption in their residence (20%). It was observed that most of the houses were not conducive for rearing of birds based on poultry housing standard. They were poorly constructed in terms of housing orientation and ventilation. The estimated cost of construction for the floor system ranged from 1500-8000 Birr whereas for the cage housing from 5000-15000 Birr including the cost of the cage and the house construction.

During the study period, there emerged a new regulation by the City administration office that prohibited the construction and modification of poultry houses. This regulation was imposed to prevent the illegal practices of changing poultry houses into living houses for renting after getting a license for construction of a poultry house. Only those poultry farmers who built the houses before the regulation were able to rear the birds on the already constructed houses. A new poultry housing design is now being in the process of distribution and implementation to be used by the poultry farmers. However, the new poultry housing design is only being functional for urban dwellers that have a legalized land ownership certificate. This new poultry housing was designed for individually managed farms of floor and cage housing system for 60, 90 and 120 flock sizes.

Table 5. Housing systems and lighting schedule

Variables	Number of respondents	%
Housing system		
Floor	97	62.2
Cage	59	37.8
Litter material		
Teff straw (*Eragrostis teff*)	68	70.1
Wood shavings	29	29.9
Light usage in poultry house		
Yes	131	84
No	25	16
Length of lighting (hour)		
2	3	2.3
4	56	42.7
6	28	21.4
12	44	33.6
Reasons for not using lighting		
High cost incurred	13	52.0
Unaware of the advantage	7	28.0
Frequent power interruption	5	20.0

4.5. Feeding and Watering Systems

The study revealed that all the poultry farmers of the study area purchased formulated feed for feeding the birds. None of them could mix the feed at home due to lack of knowledge (89.1%), unavailability of ingredients (7.7%) and cost of ingredients (3.2%) (Table 6). The main source of formulated poultry feed was private feed manufacturer. Four private feed sources were commonly used by poultry farmers in the egg production industry in Addis Ababa. They are Alema farm, Genesis farms, Kality feed processing industry and Friendship agro-industry. From the feed supplier's Friend's agro industry, Kality feed processing,

Alema poultry farm and Genesis farms accounted for 50%, 22.4%, 14.7% and 12.8% of the formulated poultry feed supply in the study area, respectively.

Table 6. Feeding and watering systems in small scale intensive poultry farms

Variable	Number of respondents	%
Feed supplier		
Friendship agro industry	78	50
Kality feed processing	35	22.4
Alema poultry farm	23	14.7
Genesis farms	20	12.8
Problem of purchased feed		
Price of feed	77	49.4
Quality of feed	55	35.3
Unavailability in nearby area	24	15.4
Problem of preparing at home		
Lack of knowledge	139	89.1
Unavailability of ingredient	12	7.7
Cost of ingredient	5	3.2
Provision of green feed		
Yes	152	97.4
No	4	2.6
Frequency of feed provision		
Three times a day	96	61.5
Two times a day	60	38.5
Source of water		
Tap water	144	92.3
Hole water	12	7.7
Frequency of watering		
Free access	134	85.9
Two times a day	14	9
Three times a day	8	5.1

The cost of formulated poultry feeds ranged from 630 to 900 Birr which depended on supplier's price and cost of ingredients. According to the poultry farmers, the main problems of purchased formulated feed were its price (49.4%), quality (35.3%) and unavailability (15.4%) of feed suppliers in the nearby area incurred them for high transportation cost. Out of the surveyed poultry farmers, 97.4% of them provided green feed like cabbage, lettuce, alfalfa and 2.6% of them did not provide green feed due to unaware of its use. The main sources of water in the study area were tap water (92.3%) and well water (7.7%).

4.6. Disease and Biosecurity Measures

According to the respondents whenever sick birds were observed in their farm, they called Vet doctor (82.7%) and treat by themselves (17.3%). The common type of traditional medicines used for treating sick birds was *Allium sativum* ("Nech shinkurit"), *Ruta chalepensis* ("Tena adam"), *Vernonia amygdalina* ("Girawa") and *Justitia schimperana* ("Sensel") which were administrated with drinking water. All (100%) of the households practiced regular vaccination program against the common diseases like Newcastle, Marek's, Gumboro following the instruction given by the supplier of birds and Sub-city veterinary health services.

According to the poultry farmers, the common signs of disease frequently occurred in their flock was greenish waterish diarrhea, head hangs down, closing of eyes, loss of appetite, bloody diarrhea, dropping of wings, sneezing or coughing and nasal discharge. Based on the information obtained from the Sub-city veterinary officers and the symptoms observed by the poultry farmers, the common viral diseases that occurred in the small scale intensive poultry farms were Gumboro, Newcastle, Mareks and Fowl pox. Among the bacterial diseases, salmonella, Ecoli, Food cholera and Mycoplasmosis; from the parasitic diseases Coccidiosis is mostly occurred and responsible for the death of birds.

Most (98.1%) of the poultry farmers used dedicated boots and cloths like overall when they are entering into the poultry house as one of a biosecurity measure against diseases. It was observed that only 19.2% of the poultry farmers used foot dips at the entrance of the poultry house whereas the rest (80.8%) did not use foot dips. The common foot dips used by the poultry farmers were detergents like 'Berekina" which is not actually known in its effectiveness. All of the poultry farmers of the study area practiced a disinfection program before another batch arriving at the poultry house as they were using an all-in-all-out system of poultry rearing. According to the poultry farmers, death due to diseases mainly occurred at young age and at the end of the production cycle.

4.7. Institutional Support and Extension Services

According to the present study, most (75.6%) of the poultry farmers had access to extension services while 24.4% had no access to extension services. Institutional supports like training, extension and veterinary services was provided by the Sub-city urban agricultural offices and credit services also provided by the micro finance of the Sub-city. Most (76.9%) of the households received a credit service at the time of starting the poultry farming. All of the poultry farmers got a commercial poultry rearing training before starting the business. The length of training provided to the households was for few weeks (65.4%) and few days (34.6%). The training was provided by the collaboration of the Sub-city urban agricultural offices, micro and small scale enterprises and technical and vocational training colleges situated in the Sub-city. Young birds suppliers like Friends agro-industry also provided training and technical support in particular to those customers who bought the young birds from their farm. In each Sub-city there is provision of governmental veterinary services with a minimum price for the poultry farmers.

4.8. Factors Affecting Farm Performance in terms of Egg Production

Hen-day egg production was significantly affected by family size ($p<0.001$), educational level ($p<0.001$), housing system ($p<0.01$) and flock size ($p<0.05$) (Table 7). However, sex, age, sideline business, farming experience and feed source did not affect the HDEP% ($P>0.05$). Hen-housed egg production was also affected by family size ($p<0.01$), educational level ($p<0.001$), housing system ($p<0.01$) and flock size ($p<0.001$) while sex, age, sideline business, farming experience and feed source did not affect the HHEP% ($p>0.05$). Peak percent lay was affected by educational level ($p<0.01$), housing system ($p<0.001$) and flock size ($p<0.05$). However sex, age, family size, sideline business, farming experience and feed source did not affect the peak percent lay ($p>0.05$). Length of lay was affected ($p<0.001$) by housing system and flock size while sex, age, family size, educational level, sideline business, farming experience and feed source had no significant effect ($p>0.05$) on length of lay.

Table 7. Analysis of variance for factors affecting egg production performance

Source of variation	Degrees of freedom	Mean squares			
		HDEP (%)	HHEP (%)	Peak percent lay	Length of lay
Sex	1	0.18	0.57	2.28	0.05
Age	2	11.98	9.39	0.99	3.87
Family size	2	162.99***	149.09**	0.77	2.35
Educational level	3	202.73***	170.99***	6.57**	3.67
Sideline business	2	25.79	18.41	0.03	1.23
Farming experience	2	2.37	1.68	1.03	8.11
Housing system	1	187.48**	210.89**	58.06***	45.48***
Feed source	3	30.29	17.52	1.98	3.45
Flock size	3	63.46*	189.73***	4.01*	30.97***
Error	136	20.07	20.68	1.22	2.91
R^2		0.66	0.69	0.56	0.37

HDEP= hen-day egg production, HHEP= hen-housed egg production,

*= P< 0.05, **= P< 0.01, ***= P<0.001

The least significance differences test for factors affecting egg production is presented in Table 8. The HDEP and HHEP were increased with the increment of family size. Poultry farmers that have a larger family size had a better farm performance in terms of HDEP and HHEP. The HDEP, HHEP and peak percent lay increased with the increment of level of education. The results also showed that poultry farmers using cage system of housing had a better egg production performance than those using floor systems of housing. The performance of the farms in terms of egg production also increased with the increase in flock size kept by the poultry farmers.

Table 8. Least significance difference test for factors affecting egg production performance

Source of variation	N	Mean (SE)			
		HDEP (%)	HHEP (%)	Peak per cent lay (%)	Length of lay (weeks)
Sex					
Male	67	69.7(0.93)	66.2(0.98)	90.7(0.19)	50.0(0.25)
Female	89	69.8(0.74)	66.0(0.81)	90.4(0.17)	50.0(0.21)
Age(yrs)					
up to 35	67	72.7(0.87)	69.5(0.91)	90.9(0.19)	50.2(0.25)
36-50	75	67.8(0.76)	63.8(0.82)	90.2(0.17)	49.9(0.23)
51& above	14	66.0(1.60)	61.8(1.58)	90.0(0.30)	49.7(0.55)
Family size(p)		***	***		
1 -5	96	66.7(0.57)[a]	62.8(0.61)[a]	90.2(0.16)	49.8(0.20)
6-10	41	74.1(1.08)[b]	70.7(1.12)[b]	91.0(0.25)	50.2(0.32)
11 and above	19	75.9(1.52)[b]	72.4(1.83)[b]	90.8(0.28)	50.5(0.46)
Educational level		***	***	**	
No formal education	38	63.2(0.54)[a]	59.3(0.58)[a]	89.4(0.19)[a]	49.4(0.31)
Primary education	34	65.9(0.89)[b]	62.0(0.96)[b]	89.8(0.23)[a]	49.8(0.35)
Secondary education	57	72.8(0.75)[c]	69.2(0.86)[c]	91.2(0.20)[b]	50.1(0.27)
Tertiary education	27	77.3(1.05)[d]	74.2(1.06)[d]	91.3(0.22)[b]	51.0(0.34)
Sideline business					
Civil servants	33	69.5(1.32)	65.1(1.29)	90.6(0.25)	49.7(0.35)
Small business	58	70.3(0.98)	66.9(1.06)	90.3(0.21)	50.1(0.27)
None	65	69.4(0.85)	65.8(0.95)	90.6(0.19)	50.1(0.25)
Farming experience(yrs)					
1-3	45	67.1(0.92)	63.0(0.99)	90.4(0.21)	50.0(0.30)
3-5	94	70.2(0.75)	66.5(0.81)	90.5(0.17)	50.0(0.21)
5yrs and above	17	74.1(1.78)	71.7(1.59)	90.8(0.37)	50.1(0.50)
Housing system		**	**	***	***
Floor	97	67.6(0.69)[a]	63.7(0.74)[a]	89.8(0.12)[a]	49.4(0.20)[a]
Cage	59	73.3(0.84)[b]	69.9(0.91)[b]	91.7(0.18)[b]	51.0(0.23)[b]
Feed sources					
Formulated feed I	23	74.0(1.47)	70.3(1.45)	91.0(0.35)	49.9(0.43)
Formulated feed II	78	68.2(0.75)	64.4(0.81)	90.3(0.19)	50.0(0.23)
Formulated feed III	35	69.3(1.28)	65.9(1.42)	90.8(0.21)	49.9(0.34)
Formulated feed IV	20	71.7(1.54)	67.9(1.79)	90.1(0.26)	50.4(0.45)
Flock size(n)		*	***	*	***
50-100	54	65.4(0.77)[a]	60.5(0.77)[a]	90.1(0.17)[a]	49.5(0.27)[ab]
101-150	47	68.4(0.70)[b]	64.7(0.69)[b]	90.0(0.23)[a]	49.4(0.28)[a]
151-200	21	74.6(1.65)[c]	71.7(1.46)[c]	90.9(0.37)[b]	50.3(0.44)[b]
> 200	34	75.5(1.13)[c]	73.3(1.14)[c]	91.5(0.23)[c]	51.5(0.22)[c]

N= number of observations, n= number of birds, p= person, HDEP= hen-day egg production, HHEP= hen-housed egg production *= P<0.05, **= P<0.01, ***= P<0.001, means with the same letter of superscript in the same column did not differ significantly.

4.9. Production Performance

4.9.1. Age at first egg and peak-of-lay

The mean age at first egg and peak of lay were 138 days and 204 days, respectively (Table 9). Housing system had a significant effect ($p<0.05$) on age at first egg and peak of lay. Layer birds kept in cages laid the first egg and attained peak of lay earlier than those kept on floor housing (Table 10).

Table 9. Performance traits of Bovans Brown under small scale intensive system

Variables	Mean±SE
Age at first egg (days)	138.2±0.43
Age at peak of lay (days)	204.1± 0.63
HDEP (%)	69.7± 0.58
HHEP (%)	66.1± 0.62
Peak percent lay	90.5± 0.12
Length of lay (weeks)	50.0±0.16
Mortality (%)	8.3± 0.31

HDEP= hen-day egg production, HHEP= hen-housed egg production, SE= Standard error

4.9.2. Hen-day and hen-housed egg production

Percent HDEP and HHEP was affected by flock size and housing system ($p<0.01$). Percent HDEP and HHEP increased with increasing flock size. Significantly higher ($p<0.01$) HDEP and HHEP were also recorded in cage compared to the floor system (Table 10).

Table 10. Performance traits of Bovans Brown as affected by housing system

Variables	Cage	Floor
Age at first egg (days)	136.4±0.64[a]	139.2±0.55[b]
Age at peak of lay (days)	199.8±0.70[a]	206.8+0.81[b]
HDEP (%)	73.3± 0.84[b]	67.6± 0.69[a]
HHEP (%)	69.9±0.91[b]	63.7± 0.74[a]
Peak percent lay	91.7± 0.18[b]	89.8± 0.15[a]
Length of lay (wks)	51.0±0.23[b]	49.4±0.195[a]

HDEP= hen-day egg production, HHEP= hen-housed egg production, means with different letter of superscript in the same row differ significantly.

Hen-day and hen-housed egg production percentage was negatively and non-significantly correlated with age at first egg (r=-0.050 and r=-0.086, respectively) and peak of lay (r=-0.096 and r=-0.131) while positively and significantly correlated with length of lay (r=0.314 and r=0.342, respectively) (Table 12).

Table 11. Performance traits of Bovans Brown as affected by flock size

Variables	Flock size			
	50-100	101-150	151-200	> 200
Age at first egg (days)	138.3±0.74	138.4±0.88	139.0±1.11	137.1±0.79
Age at peak of lay (days)	204.9± 1.13	203.3±1.08	204.3±1.72	203.8±1.38
HDEP (%)	65.4±0.77[a]	68.4±0.70[b]	74.6±1.65[c]	75.5±1.13[c]
HHEP (%)	60.5±0.77[a]	64.7±0.69[b]	71.7±1.46[c]	73.3±1.14[c]
Peak per cent lay	90.1±0.17[a]	90.0±0.23[a]	90.9±0.37[b]	91.5±0.23[c]
Length of lay (wks.)	49.5±0.27[ab]	49.4±0.28[a]	50.3±0.44[b]	51.5±0.22[c]

HDEP= hen-day egg production, HHEP= hen-housed egg production, means with different letter of superscript in the same row differ significantly.

4.9.3. Peak percent lay

Peak percent lay was significantly affected by flock size and housing system ($p<0.05$). Peak percent lay increased with increasing flock size. Significantly higher peak percent lay was

recorded in cage housing compared to floor system ($p<0.05$). Peak percent lay was found negatively and significantly correlated with age at peak of lay (r=-0.289) and age at first egg (r=-0.189) (Table 12).

4.9.4. Length of lay

Flock size and housing system had significant effect ($p<0.001$) on the length of lay. Birds in cages and larger size flocks laid for a significantly ($P<0.01$) longer period. Length of lay was found to be negatively and non-significantly correlated with age at first lay (r=-0.008) and peak of lay (r=-0.154) (Table 12).

Table 12. Pearson's correlation between some egg production performance indices of Bovan Brown layer strain

Variables	Age at first egg	Age at peak lay	Length of lay	HDEP	HHEP	Peak percent lay	Mortality during growing	Mortality during laying	Overall mortality
Age at first egg	1	0.635**	-0.008	-0.050	-0.086	-0.189*	0.038	0.166*	0.140
Age at peak lay		1	-0.154	-0.096	-0.131	-0.289**	0.173*	0.189*	0.237**
Length of lay			1	0.314**	0.342**	0.317**	-0.191*	-0.259**	-0.298**
HDEP				1	0.974**	0.401**	-0.240**	-0.360**	-0.397**
HHEP					1	0.402**	-0.258**	-0.562**	-0.548**
Peak percent lay						1	-0.201*	-0.188*	-0.255**
Mortality during growing							1	0.179*	0.731**
Mortality during laying								1	0.802**

**. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed), HDEP= hen-day egg production, HHEP= hen-housed egg production

4.9.5. Mortality of birds during growing and laying stage

Mortality of birds during laying period was negatively and significantly correlated with hen-day (r=-0.360) and hen-housed (r=-0.562) egg production percentage, peak per cent lay (r=-0.188), length of lay (r=-0.259) and flock size (r=-0.588) while, positively and significantly correlated with age at first egg (r=0.166) and peak of lay (r=0.189) (Table 12). Mortality rate was higher in flocks less than 151 birds ($p<0.05$) and on floor than cage housing systems. There was no ($p>0.05$) difference found in mortality of birds between farms that had a flock size of 50-100 and 101 to 150 during growing period and between 151-200 birds and more than 200 birds during growing and laying period (Table 13).

Table 13. Effects of flock size and housing system on per cent mortality

Variable	N	Mortality (%)		
		Growing period	Laying period	Overall mean
Housing system		*	*	*
Floor	97	3.5 ± 0.26^{b}	5.8 ± 0.28^{b}	9.1 ± 0.38^{b}
Cage	59	2.6 ± 0.31^{a}	4.7 ± 0.34^{a}	7.1 ± 0.50^{a}
Flock size		***	***	***
50-100	54	4.0 ± 0.43^{b}	7.5 ± 0.39^{c}	11.2 ± 0.55^{c}
101-150	47	3.7 ± 0.30^{b}	5.4 ± 0.29^{b}	8.9 ± 0.34^{b}
151-200	21	2.2 ± 0.25^{a}	3.8 ± 0.35^{a}	5.9 ± 0.37^{a}
>200	34	1.5 ± 0.18^{a}	3.0 ± 0.13^{a}	4.4 ± 0.17^{a}

*= P<0.05, ***= P<0.001, means with different letter of superscript in the same column differ significantly.

4.10. Quality of Formulated Feeds and Egg Quality Traits

4.10.1. Quality of formulated feeds

The crude protein (CP), metabolizable energy (ME), crude fiber (CF), ether extract(EE), ash and calcium (Ca) content of all of the formulated feed samples considered were above the minimum required level recommended for layer birds (Table 14). Highest CP level was

observed in feed III while feed I had the recommended CP level which is around 18%. The dry matter percentage of all formulated feed samples was also above the minimum dry matter percentage recommended for formulated layers feed except for formulated feed sample II which is a bit below the minimum dry matter percentage recommended in layers feed.

Table 14. The nutrient composition of major formulated layers feed used in the study area

Formulated feeds	DM%	Ash%	CF%	CP%	EE%	Ca%	ME(kcal/kg/DM)
Formulated Feed I	91.707	16.404	9.759	18.935	4.94	4.725	2684.83
Formulated Feed II	88.357	15.09	7.809	27.077	5.482	4.716	2940.89
Formulated Feed III	91.517	20.6	7.703	32.466	4.635	5.463	2679.41
Formulated Feed IV	91.613	22.373	6.527	27.799	5.912	6.913	2780.85
*Recommended Standard							
Min (%)	89		6.5	18	4	3	2600
Max (%)		15	8				

*Recommended standard based on Uppal *et al*. (2008)

4.10.2. External and internal egg quality traits

The mean external and internal egg quality traits are presented in Table 15. The egg weight in the present study categorized into a medium size egg which is in between 53 - 63g. The Haugh unit (83.3) value determined in the present study falls into a firm (AA quality) which is a Haugh unit value of 72 and above. The shape index value in the present study (78.1) falls into a round egg category which is above 76.

Table 15**.** External and internal egg quality traits of Bovans brown layer strain

Quality parameters	Mean±SE
External parameters	
Egg weight (g)	61.6±0.31
Egg length (mm)	56.4±0.16
Egg width (mm)	44.1±0.10
Shape index (%)	78.1±0.22
Shell thickness (mm)	0.37±0.001
Internal parameters	
Yolk height (mm)	16.2±0.06
Albumen height (mm)	7.1±0.08
Yolk weight (g)	16.7±0.10
Albumen weight (g)	36.1±0.16
Yolk color	3.3±0.37
Haugh unit	83.3±0.45
Albumen %	58.7±0.15
Yolk %	27.2±0.11

4.10.3. Correlation between external egg quality traits

There was a statistical significant (P<0.01) positive correlation between egg weight and the external egg quality traits such as egg length (0.571), egg width (0.785), shell thickness (2.88) and shell percentage (0.498) while a non-significant but positive correlation with shape index (0.066) (Table 16). A significant but negative correlation value (-0.663) was found between egg length and shape index. On the other hand a significant and positive correlation value (0.390) was found between egg width and shape index of the external egg quality traits. A non-significant but positive correlation value of 0.16 and 0.013, respectively, was found between the shell thickness and shape index with shell percentage of the external egg quality traits.

Table 16. Correlation between external egg quality traits

Parameters	Egg weight	Egg length	Egg width	Shell thickness	Shape index	Shell percentage
Egg weight	1	.571**	.785**	.288**	.066	.498**
Egg length		1	.430**	.047	-.663**	.220*
Egg width			1	.250**	.390**	.292**
Shell thickness				1	.157	.013
Shape index					1	.016

**. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed)

4.10.4. Correlation between internal egg quality traits

Statistically significant positive correlation was found between yolk height and albumen height (0.379), yolk weight (0.398), albumen weight (0.477), yolk colour (0.225) and Haugh unit (0.301) (Table 17). It was determined that a significant negative correlation between yolk height and albumen% (-0.257) and non-significant but negative correlation between yolk height and yolk%. A significantly negative correlation was found between Albumen% and albumen height (-0.280), yolk weight (-0.448) and Haugh unit (-0.205), whereas a non-significant but negative correlation between albumen% and albumen weight (-0.049).

Table 17. Correlation between internal egg quality traits

Parameters	Yolk height	Albumen height	Yolk weight	Albumen weight	Yolk colour	Haugh unit	Albumen %	Yolk %
Yolk height	1	.379**	.398**	.477**	.225*	.301**	-.257**	-.067
Albumen height		1	.323**	.415**	.108	.984**	-.280**	-.137
Yolk weight			1	.577**	.013	.200*	-.448**	.392**
Albumen weight				1	.115	.291**	-.049	-.109
Yolk colour					1	.080	-.146	-.185*
Haugh unit						1	-.205*	-.131
Albumen %							1	-.112

**. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed)

4.10.5. Correlation between internal and external egg quality traits

As presented in Table 18, a statistically significant positive correlation was found between the egg weight and some of the internal quality traits like yolk height (0.546), albumen height (0.499), yolk weight (0.742), albumen weight (0.818) and Haugh unit (0.347). There was a significant negative correlation found between egg weight and albumen % (-0.507) while non-significant negative correlation between egg weight and yolk % (-0.101). A significant positive correlation value of 0.304 and 0.303, respectively, was found between the shell thickness and yolk weight and albumen weight of the internal egg quality traits.

Table 18. Correlation between external and internal egg quality of traits

	External egg quality traits					
Internal egg quality traits	Egg weight	Egg length	Egg width	Shell thickness	Shape index	Shell %
Yolk height	.546**	.428**	.403**	.129	-.106	.266**
Albumen height	.499**	.246**	.323**	.070	.013	.328**
Yolk weight	.742**	.417**	.652**	.304**	.112	.139
Albumen weight	.818**	.515**	.640**	.303**	.005	.115
Yolk color	.169	.171	.076	-.053	-.110	.240**
Haugh unit	.347**	.154	.199*	.028	.004	.260**
Albumen %	-.507**	-.210*	-.358**	-.058	-.081	-.781**
Yolk %	-.101	-.062	.026	.055	.083	-.533**

**. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed)

4.10.6. Effect of housing and feed source on external egg quality traits

The present study revealed that housing system had a significant ($p<0.001$) effect on the external egg quality traits such as egg weight, egg length, egg width and shell percentage while had no effect ($P>0.05$) on shape index and shell thickness (Table 19). Significantly higher egg weight, egg length, egg width and shell percentage were determined in eggs obtained from cage than floor system housing. The formulated feed sources had also a significant ($p<0.05$) effect on egg weight, egg length, shape index and shell%, while had no effect on egg width and shell thickness ($p>0.05$). A significantly lower egg weight was

found for eggs of farms that used formulated feed source II. Significantly higher egg length and egg widths were found in eggs obtained from farms that used formulated feed source III. There was no significant ($p>0.05$) interaction of housing system and feed source for egg weight, shell thickness and shell percentage while a significant ($p<0.05$) interaction were determined for egg length, egg width and shape index.

Table 19. Effect of housing system and feed sources on external egg quality traits

Effects	Egg weight	Egg length	Egg width	Shape index	Shell thickness	Shell %
Housing						
Cage	62.8±0.42^{b}	57.0±0.26^{b}	44.6±0.13^{b}	78.3±0.35	0.37±0.001	14.6±0.24^{b}
Floor	60.3±0.40^{a}	55.9±0.17^{a}	43.5±0.13^{a}	77.9±0.27	0.36±0.001	13.6±0.26^{a}
Feed source						
Formulated feed I	62.3±0.57^{b}	56.9±0.27^{b}	44.1±0.17^{ab}	77.6±0.49^{ab}	0.36±0.002	14.9±0.25^{b}
Formulated feed II	59.7±0.57^{a}	55.6±0.24^{a}	43.9±0.20^{a}	79.0±0.39^{c}	0.36±0.002	13.0±0.39^{a}
Formulated feed III	62.4±0.67^{b}	57.6±0.38^{c}	44.4±0.24^{b}	77.1±0.41^{b}	0.37±0.001	13.7±0.36^{a}
Formulated feed IV	61.9±0.56^{b}	55.6±0.25^{a}	43.8±0.18^{a}	78.7±0.39^{ac}	0.37±0.002	14.8±0.33^{b}
Significance						
Housing	0.000	0.000	0.000	0.330	0.455	0.003
Feed source	0.002	0.000	0.050	0.004	0.519	0.000
Housing x feed source	0.342	0.000	0.032	0.030	0.438	0.850

^{abc}Means along the same column with different superscripts at each housing system and feed source are significantly different ($p<0.05$).

4.10.7. Effect of housing and feed source on internal egg quality traits

According to the present study, housing system had no significant ($p>0.05$) effect on most of the internal egg quality traits such as yolk height, albumen height, albumen weight, Haugh unit and yolk% (Table 20). A significant ($p<0.05$) effect of housing was found for yolk weight, yolk color, and albumen%. Significantly higher yolk weight and yolk color were found for eggs obtained from cage than floor housing system while significantly higher albumen% was found for eggs obtained in floor than cage. The formulated feed sources had a significant effect on yolk height, albumen height, albumen weight, yolk color, Haugh unit

and albumen% while had no effect on yolk weight and yolk% ($p>0.05$). Significantly higher deep yellowish yolk color was found in eggs obtained from farms that used the formulated feed source I. Significantly lower Haugh unit value was obtained for eggs in farms using formulated feed source II. There was no significant ($p>0.05$) interaction determined between housing and feed source for yolk height, albumen height, yolk weight, Haugh unit, albumen% and yolk% while there was a significant interaction for albumen weight ($p<0.05$) and yolk color ($p<0.001$).

Table 20. Effect of housing system and feed sources on internal egg quality traits

Effects	Yolk height	Albumen height	Yolk weight	Albumen weight	Yolk color	Haugh unit	Albumen %	Yolk %
Housing								
Cage	16.3±0.09	7.0±0.10	17.0±0.14^{b}	36.4±0.24	3.5±0.57^{b}	82.9±0.58	58.3±0.16^{a}	27.1±0.16
Floor	16.2±0.09	7.1±0.12	16.5±0.15^{a}	35.9±0.20	3.0±0.48^{a}	83.8±0.69	59.2±0.25^{b}	27.3±0.16
Feed source								
Formulated feed I	16.5±0.14^{b}	7.2±0.15^{b}	16.7±0.20^{ab}	36.3±0.35^{ab}	10.1±0.34^{b}	83.9±0.89^{b}	58.4±0.23^{a}	26.8±0.18^{a}
Formulated feed II	16.0±0.12^{a}	6.5±0.14^{a}	16.4±0.20^{a}	35.5±0.25^{a}	1.0±0.00^{a}	80.4±0.88^{a}	59.6±0.30^{b}	27.5±0.28^{b}
Formulated feed III	16.3±0.12^{ab}	7.3±0.15^{b}	16.9±0.21^{ab}	36.9±0.31^{b}	1.0±0.00^{a}	84.4±0.84^{b}	59.3±0.30^{b}	27.0±0.15^{ab}
Formulated feed IV	16.2±0.11^{ab}	7.3±0.14^{b}	17.0±0.21^{b}	35.7±0.29^{a}	1.0±0.00^{a}	84.7±0.79^{b}	57.7±0.29^{a}	27.5±0.26^{b}
Significance								
Housing	0.441	0.778	0.008	0.088	0.001	0.281	0.002	0.566
Feed source	0.028	0.000	0.156	0.003	0.000	0.001	0.000	0.066
Housing x feed source	0.276	0.487	0.088	0.020	0.000	0.281	0.313	0.265

[ab] Means along the same column with different superscripts at each housing system and feed source are significantly different ($p<0.05$).

4.11. Marketing of Poultry Products

4.11.1. Main actors in purchase of exotic poultry products

Marketing of exotic chicken products in the study area was practiced at farm-gate, local retail shops, supermarkets and collectors shops (Table 21). The main actors involved in purchase of exotic poultry products from small scale intensive poultry farms were urban private consumers, collectors, local retail shops, pastries, restaurants and snacks houses.

Supermarkets are also the main actors involved in exotic poultry products marketing but they purchased the eggs form large scale poultry farms and whole sellers. Most (47.4%) of the small scale intensive poultry farmers of the study area sell the daily collected eggs to the local retail shops around their residence while 16%, 12.8%, 10.9%, 7.7% and 5.1% sell to the restaurants, collectors, private consumers, snacks houses and pastries, respectively. The main reasons of choice to which they are selling was proximity to home/farm (55.8%), regular clients (25.6%) and better price (18.6%). None of the interviewed small scale intensive poultry farmers sell the eggs to supermarkets.

Table 21. Main actors involved in purchasing of exotic poultry products

Variable	Number of respondents	%
Actors involved in purchasing		
Local retail shops	74	47.4
Restaurants	25	16.0
Collectors	20	12.8
Private consumers	17	10.9
Snacks houses	12	7.7
Pastries	8	5.1
Reasons of choice		
Proximity to home/farm	87	55.8
Regular clients	40	25.6
Better price	29	18.6

4.11.2. Marketing channels of exotic poultry products

According to the present study, exotic chicken products were sold direct to the private consumers, local retail shops, restaurants, pastries, snacks houses and collectors. Five exotic chicken eggs market channels were identified in the study area. The channels were:

Channel one = Producer ➡ Consumer

Channel two = Producer ➡ Collector ➡ local retail shops ➡ Consumer

Channel three = Producer ➡ Local retail shops ➡ Consumer

Channel four = Producer ➡ Collector ➡ (restaurant, pastry & snack house) ➡ Customer

Channel five = Producer ➡ (Restaurant, Pastry & Snack house) ➡ Customer

Marketing Channel three was found to be the most dominant egg market outlet in the small scale intensive urban poultry production in the study area. On the other hand, three market channels were identified in case of spent layers selling. The channels were:

Channel one = Producer ➡ Consumer

Channel two = Producer ➡ Collector ➡ Consumer

Channel three = Producer ➡ Restaurant ➡ Customer

Among the three market channels of spent layer marketing, channel one was found to be the dominant market outlet in the study area during depopulation of the spent layers which usually held during religious festivals and Ethiopian New Year celebration time.

4.11.3. Market access and means of transportation for farm inputs and outputs

Most (59.6%) of the small scale intensive poultry farmers in the study area stated that they have access for purchasing poultry farm inputs in their surrounding while the rest (40.4%) have no access in the nearby area (Table 22). On the other hand, 65.4% of the interviewed poultry farmers said that they have access for selling poultry products at the farm gate, to the local retail shops, restaurants, collectors and consumers while 34.6% of them had no access for selling in the nearby area. All (100%) of the interviewed small scale intensive poultry farmers of the study area purchased the farm inputs from private companies reside in Addis Ababa and the surrounding towns. For transporting farm inputs like feeds and birds they mainly used public transport (90.4%) and on foot using hired labour (9.6%). Majority (85.9%) of the urban small scale intensive poultry farmers transported the daily collected eggs to the market center on foot using hand basket while the rest (14.1%) used public transport.

Table 22. Market access and means of transportation for poultry farm inputs and outputs

Variable	Number of respondents	%
Market access for inputs		
Yes	93	59.6
No	63	40.4
Market access for outputs		
Yes	102	65.4
No	54	34.6
Means of transportation for farm output		
Using vehicle	22	14.1
On foot	134	85.9
Means of transportation for farm inputs		
Using vehicle	141	90.4
On foot	15	9.6

4.11.4. Preference and frequency of consumption of poultry products

The urban small scale intensive poultry farmers and the urban consumers of the study area mainly preferred local poultry products for consumption (Table 23). Majority (42.3%) of the urban small scale intensive poultry farmers indicated that they consume chicken eggs twice a week while the urban consumers in restaurants and snacks houses consume more than three times a week (40%). Both the small scale intensive poultry farmers and urban consumers consume chicken meat more than three times a year in particular during religious festivals and on special occasions. The chi-square test indicated that, there was significant ($P<0.001$) difference between poultry farmers and urban consumers in the preference and consumption frequency of chicken eggs.

Table 23. Preference and frequency of consumption of poultry products

Variable	Poultry farmers (N=156)	Urban consumers (N=105)	X^2-value	p-value
	N (%)	N (%)		
Chicken meat preference				
Exotic	27(17.3)	8(7.6)	5.077	0.079
Local	98(62.8)	74(70.5)		
Equally preferred	31(19.9)	23(21.9)		
Eggs preference				
Exotic	12(7.7)	6(5.7)	20.222***	0.000
Local	102(65.4)	93(88.6)		
Equally preferred	42(26.9)	6(5.7)		
Chicken meat consumption frequency				
Once a year	11(7.1)	5(4.8)	1.843	0.606
Twice a year	23(14.7)	20(19.0)		
Three times a year	46(29.5)	26(24.8)		
More than three times a year	76(48.7)	54(51.4)		
Egg consumption frequency				
Once a week	34(21.8)	13(12.4)	34.978***	0.000
Twice a week	66(42.3)	24(22.9)		
Three times a week	40(25.6)	26(24.8)		
More than three times a week	16(10.3)	42(40.0)		

*******significant at less than 1% level of significance

4.11.5. Seasonal prices of poultry products and price trend

The average price of poultry products at different seasons and market centers is presented in Table 24. The price of eggs and spent layers were significantly ($P<0.05$) different in different occasions at the farm gate, local retail shops and collectors. The seasonal prices of eggs in supermarkets were not variable ($P>0.05$) while dressed chicken meat prices were significantly variable ($P<0.05$).

Table 24. Price of poultry products at different occasions at different market centers

Variable	Price in Birr of eggs, spent layer and dressed chicken meat					
	Year round	Christian festival	Muslim festival	New year celebration	Overall mean	p-value
	(Mean±SE)					
Producer (N=156)						
Eggs	2.7±0.01[a]	3.0±0.01[b]	2.7±0.02[a]	3.0±0.01[b]	2.8±0.01	0.000
Spent layer	92.1±1.09[a]	113.4±0.95[c]	92.6±1.09[a]	99.9±1.20[b]	99.5±0.64	0.000
Collectors (N=30)						
Eggs	3.1±0.02[a]	3.3±0.01[b]	3.1±0.02[a]	3.3±0.01[b]	3.2±0.01	0.000
Spent layer	110.8±1.13[a]	128.3±0.99[b]	111.2±1.26[a]	126.0±1.11[b]	119.1±0.93	0.000
Supermarkets (N=30)						
Eggs	3.8±0.02	3.8±0.01	3.8±0.02	3.8±0.01	3.8±0.01	0.990
Dressed chicken meat/kg	108.16±0.17[a]	108.60±0.13[b]	108.40±0.14[ab]	108.73±0.10[b]	108.5±0.07	0.026
Local retail shops (N=30)						
Eggs	3.45±0.01[a]	3.72±0.01[d]	3.50±0.01[b]	3.66±0.01[c]	3.6±0.01	0.000

[a,b,c,d] *Least square means with different superscripts within a row are significantly different (P<0.05)*

As illustrated in Figure 2, the prices of live local and exotic chicken have been increasing from time to time while the price of dressed chicken meat fluctuates. The local live chicken fetches a higher price than the exotic spent layer in all the 5 years considered.

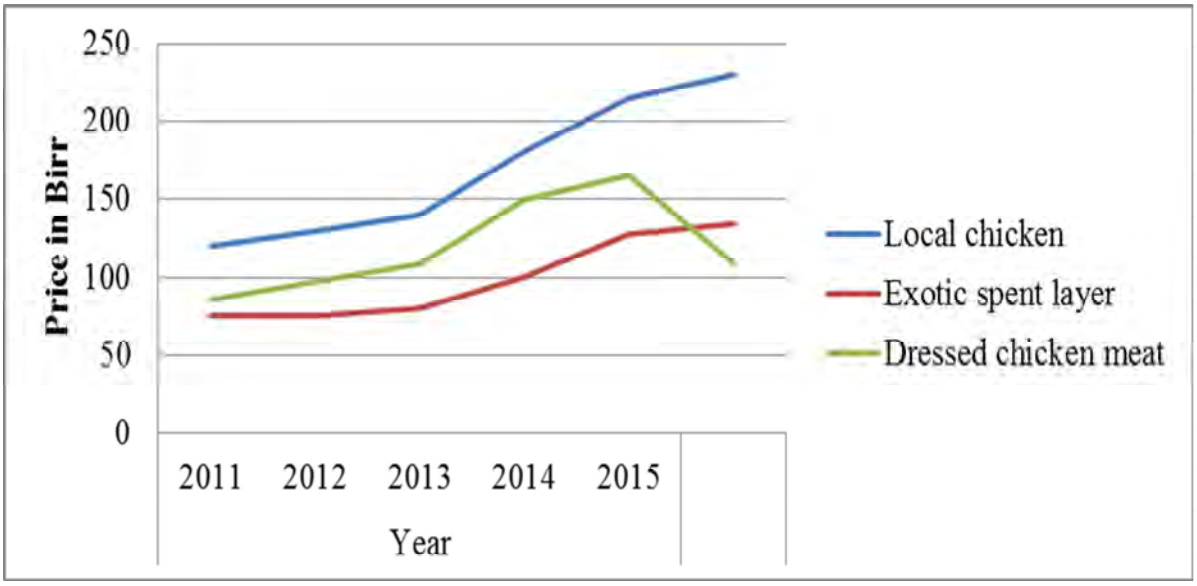

Figure 2. Price trend of live and dressed chicken meat in the last five years

As shown in Figure 3, higher price was offered for local chicken eggs than exotic. But nowadays, the price offered for exotic chicken eggs become higher than the local chicken eggs.

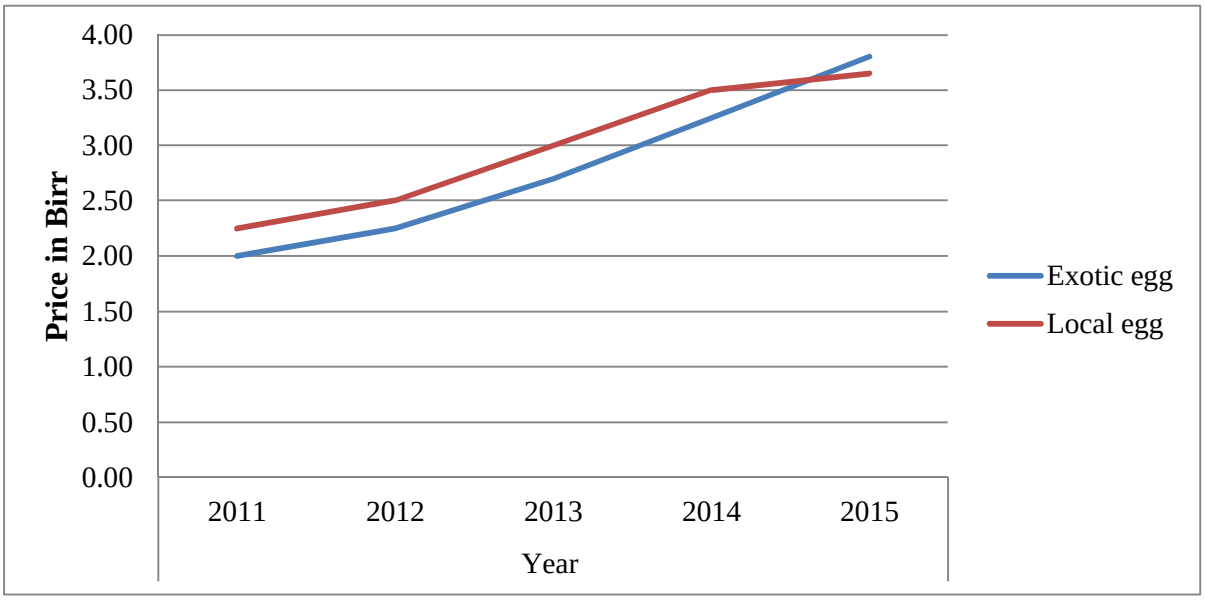

Figure 3. Price trend of exotic and local chicken eggs in the last five years

4.11.6. Marketing constraints

The study revealed that small scale intensive poultry farmers in the study area encountered different market constraints during purchasing of farm inputs and selling of poultry products (Table 25). The main constraints encountered during purchasing of poultry farm inputs were high price of feed (1^{st}), unavailability of pullets in time (2^{nd}), high price of pullets (3^{rd}) and transportation cost (4^{th}). On the other hand, the main constraints encountered in selling of poultry products were poor market for spent layer (1^{st}), lack of their own market center for selling (2^{nd}), large scale poultry farms market interference (3^{rd}) and price fluctuation (4^{th}) according to their importance.

Table 25. Poultry marketing constraints in small scale intensive urban poultry farming

Constraints	1^{st}	2^{nd}	3^{rd}	Index	Rank
During purchasing					
High price of feed	90	53	13	0.416	1
Unavailability of pullets in time	49	69	29	0.335	2
High price of pullets	17	27	85	0.203	3
Transportation cost	0	7	29	0.046	4
During selling					
Poor market for spent layer	105	34	4	0.413	1
Lack of their own market center	37	97	7	0.333	2
Large scale farms market interference	2	9	105	0.138	3
Price fluctuation	12	16	40	0.115	4

4.12. Utilization of Poultry Products by Restaurants, Pastries and Snacks Houses

4.12.1. Place of purchase of poultry products and reasons for choice

The study revealed that the restaurants in the study area mainly purchased the exotic chicken eggs from the nearby supermarkets (48%) while the rest of them from collectors (24%),

local retail shops (20%) and producers (8%) (Table 26). The chicken meat was mainly purchased from supermarkets in dressed and packed form. According to the restaurants, their main reasons for choice of the source of chicken products for purchase were regular clients (76%) and the proximity to working place (24%). Pastries of the study area purchased the eggs from collectors (48%), supermarkets (44%) and producers (8%). The main reasons for choice of the source of chicken products for purchase were confidence on sellers (40%) and they are their regular clients (60%). The snacks houses in the study area purchased the eggs mainly from collectors (72%) and local retail shops (28%). The main reasons for choice of the source of chicken products for purchase were regular clients (52%), confident on sellers (28%) and proximity to working place (20%).

Table 26. Sources of poultry products for purchase and reasons for choice of the source of chicken products for purchase

Variable	Restaurants		Pastries (N=25)		Snacks houses	
	N	%	N	%	N	%
Source of chicken products						
Producers	2	8	2	8	-	-
Local retail shops	5	20	-	-	7	28
Collectors	6	24	12	48	18	72
Supermarkets	12	48	11	44	-	-
Reason for choice of sources						
Confident on sellers	-	-	10	40	7	28
Regular client	19	76	15	60	13	52
Proximity to working place	6	24	-	-	5	20

4.12.2. Frequency of purchases of poultry products and amount purchased

The restaurants in the study area purchased the eggs twice per week (64%) and on weekly basis (36%) while the chicken meat on weekly (24%), every two weeks (48%) and monthly (28%) basis (Figure 4). The frequency of purchases of chicken meat mainly depended on the

customers demand and request for some kind of special ceremonies and occasions. Most of the pastries (72%) and snacks houses (76%) purchased the exotic chicken eggs twice per week.

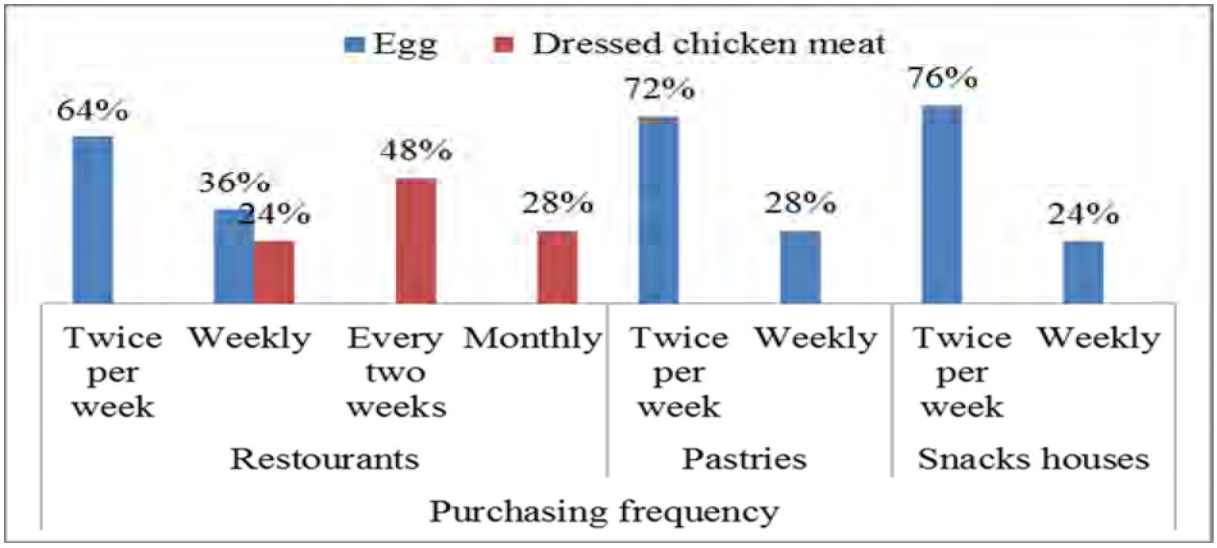

Figure 4. Purchasing frequency of poultry products by restaurants, pastries and snacks houses

The present study revealed that restaurants, pastries and snacks houses purchased on average 78, 308 and 109 eggs at one time (Table 27). The average number of eggs used per day for making dishes by the restaurants, snacks houses and for baking cakes by the pastries was 16, 35 and 123 eggs, respectively. The restaurants in the study area purchased on average 4.28 kg of slaughtered chicken meat which ranged from 3 to 5 kg in dressed and packed form at one time, of which on average 1.2 kg chicken meat was used for making dishes per week that depended on the customers demand. The present study revealed that there was a variation in the number of eggs purchased at one time among the restaurants, pastries and snacks houses ($P<0.001$). The highest number of eggs was purchased by the pastries followed by the snacks houses and restaurants. There was no significant difference ($p>0.05$) observed between the restaurants and snacks houses in the number of eggs purchased at one time. The number of eggs used per day significantly ($P<0.001$) varied among the restaurants, pastries and snacks houses. Significantly more number of eggs was utilized by pastries for baking cakes than that of restaurants and snacks houses.

Table 27. Number of eggs purchased and used by restaurants, pastries and snacks

Variable	Restaurants	Pastries (N= 25)	Snacks	Overall mean	p-value
	Mean±SE				
Eggs purchased at one time	78.0±6.25[a]	308.4±20.82[b]	109.2±4.86[a]	165.2±13.94	0.000
Eggs used per day	16.2±0.95[a]	123.4±8.33[c]	35.8±2.06[b]	58.5±6.11	0.000

[a,b,c] *Least square means with different superscripts within a row are significantly different (p<0.001).*

4.12.3. Preference of exotic poultry products over local chicken products

Majority (48%) of the restaurants in the study area preferred purchasing of exotic chicken eggs due to its bigger size (66.7%) and less chance of spoilage (33.3%), while, the restaurants that preferred the local eggs were due to customer's preference for its flavor and deep yellowish yolk color (Table 28). Most (48%) of the restaurants preferred purchasing of exotic chicken in dressed and packed form while 32% of them preferred the local chicken for home slaughtering and 20% of them equally preferred both products. The main reasons for choice of exotic chicken meat over local chicken meat were its bigger size (58.3%) and ease of preparation (41.7%). Traditional dishes like "Doro wat" or chicken stew prepared from local chicken meat is more preferred by the customers of the restaurants.

All of the pastries preferred the exotic chicken eggs over the local one for making different types of cakes due to its bigger size (48%), convenience for making different colored cakes due to its light yolk color (32%) and less chance of spoilage (20%). Only 6% of the snacks houses preferred exotic chicken eggs due to its bigger size and less chance of spoilage. While majority of the snacks houses mainly preferred the local eggs due to its taste and deep yellowish yolk color that makes it to be preferred by their customers.

Table 28. Preference of exotic chicken products over local chicken products

Variable	Restaurants		Pastries (N=25)		Snacks houses	
	N	%	N	%	N	%
Preference of eggs						
Exotic	12	48	25	100	6	24
Local	9	36	-	-	14	56
Equally preferred	4	16	-	-	5	20
Reasons for choice of exotic						
Bigger size	8	66.7	12	48	3	50
Less chance of spoilage	4	33.3	5	20	3	50
Taste	-	-	-	-	-	-
Yolk color	-	-	8	32	-	-
Preference of chicken meat						
Exotic	12	48				
Local	8	32				
Equally preferred	5	20				
Reasons for choice of exotic						
Bigger size	7	58.3				
Ease of preparation	5	41.7				

4.12.4. Main chicken meat and egg dishes prepared and utilized

The type of dishes made from exotic chicken meat and eggs varied in most of the restaurants depending on their level of services. According to the restaurants, they mainly used exotic eggs and dressed chicken meat for preparing different dishes. The eggs are also included in different forms in preparing foreign and traditional dishes. The commonly prepared dishes of chicken meat in restaurants were chicken *arusto, chicken stir-fried, chicken breast, chicken salad*. The dishes made of eggs were *fried egg, egg omelette, scrambled egg, egg salad, egg sandwich, egg slice and egg special omelette*. The chicken meat and eggs were also used in making traditional foods like *Doro wat*, one of Ethiopia's most famous dishes mainly served

during holidays and on special occasions. The pastries used the eggs for making different kinds of cakes having different tastes. According to the pastries, cakes made of eggs have longer shelf life than the cakes made of table oil. Some of the common cakes made of eggs were *zebib, tourta, curebat, black forest, white forest, chocolates* cake etc. The snacks houses also used the eggs for making different dishes mainly served at breakfast time like *egg omelette, egg scrambled, egg sandwich, fried egg* and also included in different forms for making dishes.

4.12.5. Marketing constraints in purchasing of poultry products

The main marketing constraints that the restaurants, pastries and snacks houses encountered during purchasing of chicken products are presented in Table 29. The high price of eggs is one of the main constraints encountered by the restaurants, pastries and snack houses. The high price of dressed chicken meat also the main constraint encountered by the restaurants.

Table 29. Constraints in purchases of poultry products

Constraints	1st	2nd	3rd	Index	Rank
Restaurants					
High price of eggs and chicken meat	15	8	2	0.420	1
Less supply of dressed chicken meat	6	6	8	0.253	2
Cracked eggs	4	8	9	0.247	3
Unavailability of eggs in nearby area	0	3	6	0.080	4
Pastries					
High price of eggs	20	3	2	0.453	1
Shortage of exotic eggs supply	5	18	0	0.340	2
Cracked eggs	0	4	11	0.127	3
Cost of transportation	0	0	12	0.080	4
Snacks houses					
High price of eggs	19	4	2	0.447	1
Less supply of local eggs	6	16	3	0.353	2
Cracked eggs	0	5	20	0.200	3

4.13. Poultry Waste Management Practices

4.13.1. Common wastes in small scale intensive urban poultry farming

According to the small scale intensive poultry farmers, manure (50.6%) was the major waste in their farms followed by litter/manure mix (35.9%) and dead birds (13.5%) depending on the type of housing system (Figure 5).

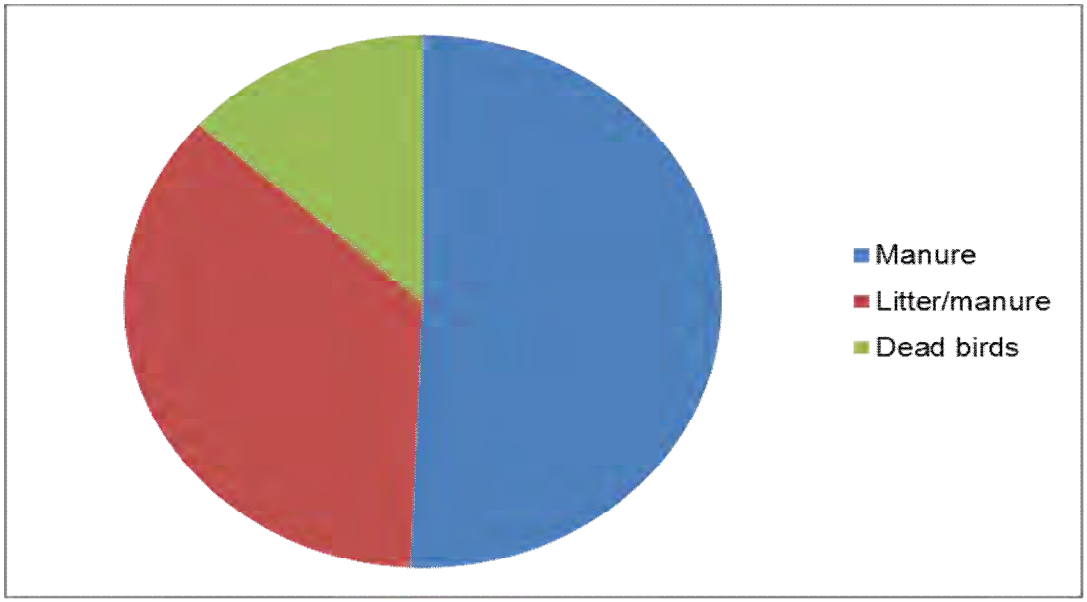

Figure 5. Common wastes in urban small scale intensive poultry farming

4.13.2. Household labor allocation in removing poultry waste

Among the family members 37.7% of the wives, 23.0% of daughters, 20.2% of household mades, 18.6% of sons and 0.3% of husbands were involved in cleaning and removing the poultry farm wastes such as manure and/or litter, dead birds and other poultry farm wastes (Table 30). In the present results, the involvement of husbands in cleaning and removing the wastes is relatively very less compared with the other family members.

Table 30. Household labor allocation for poultry waste removal

Variable	Frequency	%
Husband	1	0.3
Wife	59	37.7
Daughters	36	23.2
Sons	29	18.6
Household maids	31	20.2

4.13.3. Floor type and litter materials used in small scale intensive poultry farms

Most (84.5%) of the poultry houses had a non-cemented floors covered with bedding materials, 15.5% had cemented floors (Table 31). About 62.2% of the poultry farmers that had floor housing used litter material like Teff (*Eragrostis teff*) straw (70.1%) and wood shavings (29.9%).

Table 31. Type of floor and litter materials used in small scale intensive poultry housing

Variable	Frequency	%
Floor type		
Non-cemented	82	84.5
Cemented	15	15.5
Litter material		
Teff (*Eragrostis teff*) straw	68	70.1
Wood shavings	29	29.9

4.13.4. Method of waste collection, transportation and disposal

Manual scrapping with shovel was the main method of waste collection in small scale intensive poultry farms of the study area in particular in the floor housing system. In case of cage housing system, poultry farmers mainly put a plastic sheet under each tier of the cage for collection of droppings and removing it every day from the plastic sheet by flushing

water. Most (94.3%) of the poultry farmers used polythene and hessian sack to transport the waste to the dumping site using hand-carrying system, while 5.7% of them used wheel barrow.

As shown in Table 32, manure/litter in the study area were disposed at the dump site (64.7%), marketing for use as a fertilizer (21.8%) for urban vegetable and flower seedling farmers, given freely to neighborhood farmers for land application (10.9%) and used it as a fertilizer in their own garden farm (2.6%). The main methods of dead birds disposal were throw away it to dump site (83.3%), burning (13.5%) and burial (3.2%).

Table 32. Methods of poultry waste transportation and disposal

Variable	Frequency	%
Waste transportation		
Wheel barrow	9	5.7
Using hand-carrying	147	94.3
Manure/litter disposal		
Disposed at dump site	101	64.7
Marketing as a fertilizer	34	21.8
Given freely to neighborhood farmers	17	10.9
Fertilizing their garden farm	4	2.6
Dead birds disposal		
Throw away it to dump site	130	83.3
Burning	21	13.5
Burial	5	3.2

4.13.5. Frequency of waste removal in cage and floor housing system

Poultry farmers in the study area that used the cage housing system removed the manure every day (66.1%) while those using the modified cage system which enables to put a litter under each tier were removed the manure every month (11.9%) and every three months (22%) (Table 33). On the other hand, poultry famers that used the floor system removed

manure/litter once a year and manipulating the litter every 3 and 6 months depending on its condition.

Table 33. Frequency of waste removal in cage and floor housing system

Variable	Frequency	%
Cage		
Every day	39	66.1
Every month	7	11.9
Every three months	13	22.0
Floor		
Once every year	97	100

4.13.6. Constraints of waste disposal in small scale intensive poultry farms

The major constraints of waste disposal encountered by the small scale intensive poultry farmers of the study area were nuisance odour (1^{st}), lack of convenient dump site (2^{nd}), lack of market for selling the litter/manure (3^{rd}), lack of transportation facilities (4^{th}) and shortage of labor (5^{th}) (Table 34).

Table 34. Major constraints of waste disposal in small scale intensive poultry farming

Constraints	1^{st}	2^{nd}	3^{rd}	4^{th}	5^{th}	Index	Rank
Nuisance odour	119	33	0	1	3	0.313	1
Lack of convenient dump site	32	94	30	0	0	0.268	2
Lack of market for selling manure	0	0	82	48	26	0.157	3
Lack of transportation	5	29	17	62	43	0.153	4
Shortage of labour	0	0	27	45	84	0.109	5

4.14. Constraints, Opportunities and Socio-economic Factors Affecting Flock Size

4.14.1. Constraints and associated issues of small scale urban poultry farming

As presented in Table 35, the major constraints encountered by the small scale intensive poultry farmers in the study area were the high price of feed (1^{st}), shortage of land (2^{nd}), unavailability of pullets in time (3^{rd}), high cost of pullets (4^{th}), feed quality (5^{th}), shortage of water (6^{th}), unavailability of feed in the nearby area (7^{th}), marketing difficulties during selling of poultry products (8^{th}), health problem (9^{th}), lack of access to credit (10^{th}) and inadequate training (11^{th}) according to their importance.

Table 35. Constraints of small scale intensive urban poultry farming

Constraints	1^{st}	2^{nd}	3^{rd}	4^{th}	5^{th}	Index	Rank
Price of feed	90	30	7	20	9	0.274	1
Shortage of land	42	30	12	33	18	0.192	2
Unavailability of pullets in time	6	37	7	7	20	0.100	3
High cost of pullets	12	4	38	14	10	0.097	4
Feed quality	0	15	30	21	30	0.095	5
Shortage of water	0	8	13	14	24	0.053	6
Unavailability of feed in nearby area	4	11	3	10	27	0.051	7
Marketing difficulties during selling	0	0	21	25	1	0.049	8
Health problem	0	9	18	5	8	0.046	9
Lack of access to credit	2	7	6	1	3	0.026	10
Inadequate training	0	5	1	6	6	0.018	11

The study revealed that all of the small scale intensive poultry farmers of the study area have feeling of threat in poultry production due to the increase in cost of feed (42.3%), disease outbreak (30.1%), displacement from their residence (15.4%) owing to housing development program and illegal land ownership, discomfort and complaint from the neighbors (7.1%) due to the nuisance odour of poultry droppings and big poultry farms market interference

(5.1%) in reducing egg and spent layer selling price in particular during religious festival and New year celebration time (Table 36).

Table 36. Threats to small scale intensive urban poultry farming

Threats	Frequency	%
Increase in cost of feed	66	42.3
Disease outbreak	47	30.1
Displacement from their residence	24	15.4
Compliant from neighbors due to nuisance odour	11	7.1
Big poultry farms market interference	8	5.1

As shown in Table 37, shortage of land (42.3%) was the main barrier for future expansion of poultry farm which is followed by inability to construct and repair poultry houses (19.9%) due to the new poultry housing regulation imposed by the city administration, the increase in price of formulated poultry feed (18.6%), lack of capital (13.5%) and inadequate supply of good performing pullets in time of request (5.8%).

Table 37. Barriers for future expansion of the poultry farm

Variable	Frequency	%
Shortage of land	66	42.3
Poultry housing construction regulation	31	19.9
High price of feed	29	18.6
Lack of capital	21	13.5
Inadequate supply of pullets	9	5.8

4.14.2. Challenges encountered by offices working on urban poultry farming

The main challenges mentioned by the sub-city urban poultry production offices were:

- Lack of transportation facilities so as to provide a regular technical support to the poultry farmers of the study area.

- High turnover of expertise due to lack of incentives in motivating the urban agricultural experts and inadequate salary payment.
- Inadequate on job training for the experts working on poultry production.
- Less attention given by NGOs (non-governmental organizations) for urban poultry production to work in collaboration with urban agricultural offices in each sub-city.
- Inadequate involvement of investors to establish poultry multiplication and distribution centers and feed processing plants so as to distribute day old chicks and pullets with the required number and quality and also poultry feed with the required amount and quality.
- Difficulties in creating awareness for the urban dwellers to be engaged in poultry farming business due to disease risk, nuisance odour of poultry droppings and shortage of land.
- Illegal practices of changing poultry house into living house for renting after getting a license for construction of a poultry house.

4.14.3. Socio-economic factors affecting flock size

As shown in Table 38, flock size was significantly affected by age ($p<0.05$), family size ($p<0.01$), educational level ($p<0.05$) and farming experience ($p<0.001$) of the poultry farmers. However, sex, sideline business and housing system did not affect the flock size ($p>0.05$).

Table 38. Analysis of variance for factors affecting flock size

Source of variation	Df	Mean Squares
Sex	1	8164.3
Age	2	9504.3*
Family size	2	11297.3**
Educational level	3	8325.8*
Sideline business	2	6269.0
Farming experience	2	25090.6***
Housing system	1	6418.4
Error	142	2329.1
R^2		0.52

N= number of observations, *= P<0.05, **= P<0.01, ***= P<0.001

The least square significance difference test for factors affecting flock size revealed that young age group and larger family size kept large flock size (Table 39). Poultry farmers that achieved a higher educational level kept larger flock size than those having a least educational level. Poultry farmers that have high years of experience kept larger flocks size than those having very few years of experience.

Table 39. Least significance difference test for factors affecting flock size

Source of variation	N	Mean(SE)
Sex		
Male	67	151.1(8.79)
Female	89	134.5(6.59)
Age (yrs)		*
Up to 35	67	178.4(8.05)[b]
36-50	75	116.7(6.37)[a]
51 yrs and above	14	99.3(9.88)[a]
Family size (p)		*
1-5	96	117.8(4.56)[a]
6-10	41	178.4(9.98)[b]
10 and above	19	182.5(24.00)[b]
Educational level		**
No education	38	111.6(6.24)[a]
Primary education	34	110.8(7.38)[a]
Secondary education	57	146.7(8.55)[b]
Tertiary education	27	212.0(5.35)[c]
Sideline business		
Civil servants	33	111.5(8.70)
Small business	58	152.9(7.81)
None	65	146.9(9.44)
Farming experience (yrs)		***
1-3	45	108.7(7.12)[a]
3-5	94	144.0(6.88)[b]
>5	17	215.8(11.30)[c]
Housing system		
Floor	97	134.4(6.71)
Cage	59	153.5(8.69)

N= number of observations, p = persons, * = P<0.05, ** = P<0.01, *** = P<0.001, means with the same letter of superscript in the same column did not differ significantly

4.14.4. Opportunities for small scale intensive urban poultry farming

The major opportunities of urban poultry production identified in the present study were:

- A high premium price for exotic eggs at the market center due to the shortage of local egg supply in the market.
- The increase in demand for table eggs laid by exotic chicken due to the increase in number of hotels, restaurants and pastries in the study area.
- An emerging middle-class urban dwellers with higher income and more buying power.
- Credit service availability by the micro finance institution situated in each Sub-city for those who saved at least 20% of the total amount of money requested to establish poultry farm.
- Availability of experts at city and sub-city level for the technical support and extension services.
- Availability of veterinary services in each sub-city with a minimum veterinary drug price at veterinary drug store.
- The inclusion of urban agriculture in the city master plan of Addis Ababa in general and poultry production in particular created an opportunity to pay more attention by the concerned higher officials of the city administration for the poultry sub-sector.
- The preparation of a new poultry housing design for floor and cage system housing with different flock sizes capacity by the urban agriculture office of the city for the urban dwellers that have a legalized land property ownership certificate and want to be engaged in poultry farming business.

5. DISCUSSION

The results revealed that 57.1% of the poultry farmers were female and 42.9% of them were male, which contradicted the results of Bamiro *et al*. (2013) in peri-urban areas of Legos, where the majority of the poultry farmers were male and Akintude *et al*. (2015) who reported modern poultry farming is still predominantly a male occupation in southwest Nigeria. The higher involvement of women in poultry farming in the study area might be due to the fact that most of them are house wives who have no other job opportunities.

In the present study most poultry farmers attended secondary education and very few of them had tertiary education. In contrast to this, Jatto (2012) and Bamiro *et al*. (2013) reported that most of the poultry farmers had tertiary education. The less involvement of highly educated personnel in poultry farming in the study area might be due to shortage of capital, land, attractiveness and the new regulation on poultry housing system in urban areas like Addis Ababa. The present result revealed that the urban small scale intensive poultry faming is mainly practiced by the medium age groups ranging from 36 to 50 years of age. Similarly, Bamiro *et al*. (2013) reported that most of the poultry farmers in peri-urban areas were 31-50 years old. In contrast to this, Adebayo and Adeola (2005) reported that majority (74%) of the poultry farmers fall within the age group of 20-40 years.

The family size (5.29 persons) of poultry farmers in the study area was higher than the value (3.6 persons/HH) reported by city government of Addis Ababa bureau of finance and economic development (BoFED, 2013). The average farming experience (3.2 years) in the present study was 66.9% lower than the value (9.67years) reported by Ojo (2003) for commercial egg producers. Most poultry farmers had more than 6 years of experience (Bamiro *et al*., 2013) which is higher than the value reported in the present study (3.2 years). According to Onyebinama (2004), previous experiences in farm business management enable farmers to set realistic time and cost targets, allocate, combine and utilize resources efficiently and identify production risks.

Most poultry farmers of the study area mainly consume eggs of local chicken instead of using the eggs form their own poultry farm. This is due to children's preference for local chicken eggs over exotic chicken eggs for its deep yellowish color and flavor. Some poultry farmers mentioned that they mainly did sell the eggs from their own farms and did purchase the local eggs form the market so as to satisfy their children's needs.

The responsibilities of husbands were relatively very less in most of the poultry farm operation in particular in cleaning operation as compared with the other family members which, might be due to the belief that cleaning operation is the responsibilities of wives and young daughters. Besides, poultry farming is considered as female jobs by most people of the study area. In contrast to the present study, Jatto (2012) reported that due to the role of religion and custom in the livelihood of the people, males have to provide for the household and have high dominance and productivity is expected to be higher because males have tendency to be more labor efficient.

The average flock size in the present study was lower by 73.9% than the average flock size (541.2 birds) reported by Badubi and Ravindran (2004) for small scale layer farms in Botswana. The present study revealed that egg production in the study area is predominantly based on a small-scale intensive system. Majority (34.6%) of the poultry farmers had less than or equal to 100 layer birds which were considerably lower than reported by Adebayo and Adeola (2005) where 70% of the poultry farmers had birds ranging from 1000-3000. The lower flock size in the present study might be due to the shortage of land, capital and high purchasing price of pullets to have a larger flock size in the study area.

The dominance of Bovans brown layer breed of bird in the study area is not by choice, but due to the fact that it is the only available breed in the supplier farms and kept by the poultry farmers during the study period. The supply of the required layer breed is determined by the supplier farms. The present study revealed that small scale intensive poultry farmers of the study area obtain foundation and replacement breed from privately owned large scale poultry farms. Similarly, Desalew *et al*. (2013) reported that the majority of poultry farmers in Ada'a and Lume districts purchased improved chicks from private hatcheries.

Nzietchueng (2008) also reported that most small-scale poultry farms obtain their foundation stock from large-scale commercial farms which is in agreement with the present findings.

All suppliers of pullets are located in Bishoftu which is a neighboring town of Addis Ababa. Mostly poultry farmers purchased three months old pullets depending on the supplier interest and availability at the time of request in the supplier farms. Due to the unavailability of replacement layer breeds on time of request, urban small scale intensive poultry farms may get pullets for their next production cycle after waiting for 8 months and above. As a result, the unavailability of replacement layer breeds and the long waiting time for pullets is making the urban small scale intensive system of poultry farming less demanded by producers and has contributed to the withdrawal of many registered poultry farmers from poultry farming.

The current study revealed that the main source of money for financing the small scale intensive system of poultry faming in the study area was from governmental micro finance institution followed by family, personal savings and religious organizations, which contradicted the reports of Adebayo and Adeola (2005) where most (68%) of the poultry farmers financed their poultry farms through personal savings and friends/relatives and the rest sourcing through financial institutions. This implies that the micro finance institutions situated in each sub-city of the study area are playing a great role in financing the urban dwellers who are involved in urban agriculture in general and poultry production in particular.

The floor housing system of layers in the current study contradicts the finding of Akintunde *et al*. (2015), where the majority of farmers operated in battery cage system while only few farmers reared birds on floor system. Poultry rearing using floor system by the majority of poultry farmers in the study area is due to the fact that the floor housing system is much cheaper and it requires relatively much less initial capital. However, it is labour intensive to manage feeding, egg collection, cleaning of the floor and changing of the litter. Teff straw and wood shavings are the common litter material used in the floor housing system in the study area. The modified cage housing technology which is developed by Friends Agro-

industry is conducive to use litter material under each tier and is now playing a great role in minimizing the bad odour coming from poultry dropping and reducing nuisance to neighbors.

The main source of formulated poultry feed for the small scale poultry farms of the study area was private feed manufacturers and large scale commercial farms. Similarly, Nzietchueng (2008) reported that most small-scale poultry farms obtain their feed from large-scale commercial farms. In agreement with present finding, Badubi and Ravindran (2004) reported that although there was considerable interest, on-farm mixing of feeds was not practiced owing to the scarcity of raw materials and the lack of knowledge on proper feed formulation in the small scale layer production. Among the private feed manufacturers, Friends' Agro-industry accounted for a largest share in the supply of formulated poultry feed. The price of the formulated poultry feed was increasing from time to time due to the increment of ingredients purchasing price. Owing to the high price incurred in formulated feed, its quality and unavailability in the nearby area feed is becoming the main problem faced by most of the poultry farmers of the study area. Since the study area is a capital city of the country, the source of water was mainly from tap water, however water was frequently unavailable, which was increasingly a problem for most of the poultry farmers.

The reasons for the use of traditional medicine for treating sick birds by some of the poultry farmers is because of the fear of the cost to be incurred for veterinary health services and unawareness of the services rendered by the governmental veterinary health services in each sub city. There is a regular vaccination program against the common diseases like Newcastle, Marek's and Gumboro based on the instruction given by the supplier of birds. The application of regular vaccination is due to the fact that there is fear of economical lose due to death of birds. According to Nasser *et al*. (2000), Newcastle disease (ND) is the main cause of economic loss in poultry production in Ethiopia. In the study area, there is access for veterinary health services with a minimum price from governmental veterinary health services situated in each sub-city. In contrast to this, Adebayo and Adeola (2005) reported that poultry farmers accessed veterinary services mostly from those rendered by private sources.

Based on the biosecurity measures attributes, there is a poor to minimum biosecurity practices in most of the small scale intensive poultry farms of the study area, which agrees with the findings of Wossen (2006) who reported that the bio-security status in many of the intensive poultry farms is extremely poor. Akintude *et al*. (2015) also reported that there is a minimum and moderate biosecurity in urban and peri-urban commercial poultry production in southwest Nigeria.

The HDEP and HDEP were affected by educational level and family size of the poultry farmers. In agreement with the current study, Adebayo and Adeola (2005) reported that educational level of farmers had effect on average egg production, which implies the higher educational level and family size; the better would be in understanding of farm operation and efficiency. Besides poultry farmers need to have good education on poultry keeping so that they are able to manage the farm properly. This is due to the fact that sound knowledge and efficient management are the basis for ensuring profitability in poultry business.

The age at first egg in the present study was shorter than the value (165.5 days) reported by Desalew *et al.* (2013) for Bovans brown laying hens in east Showa zone of Ethiopia. On the other hand, the age at first egg and peak of lay in the present study were higher than the value (126 and 200 days) reported by Farooq *et al*. (2002) for commercial laying hens and Mussawar *et al*. (2004) which were 125 days and 201 days, respectively. Ershad (2005) also reported a shorter age at first egg (133 days) for Bovans Nera. The late age at first egg and peak of lay in the present study might be due to strain differences in the maturity and management.

The current study revealed that layers kept in cages attained the age at first egg and at peak of lay earlier. Similar observations were made by Farooq (2002) in Hyline and Hisex layers reared in cage compared to those on floor. This might be due to a comparatively better feed utilization and a consequently rapid growth in cage systems as compared to floor rearing. Feed efficiency in floor system of housing is lower due to the higher mobility of the animals.

Age at first egg and peak of lay were found negatively and significantly correlated with peak percent lay, On the other hand, age at first egg and peak of lay were negatively and non-significantly correlated with hen-day and hen-housed egg production percentage. In agreement with the present finding, Mussawar *et al. (*2004) reported hen-day egg production percentage was negatively correlated with age-at-first egg. The reason for the negative correlation between age at first lay and peak of lay with that of hen-day and hen-housed egg production percentage might be due to the fact that birds having a delayed age at first egg and peak of lay had a lower egg production performance with a short egg laying period. Flock size was negatively and non-significantly correlated with age at first egg whereas positively and non-significantly correlated with age at peak of lay. This suggests that in large sized flocks, birds' attain age at first egg earlier than birds in small sized flocks. This might be due to better management practices in large sized flocks.

The average hen-day egg production percentage in the present study was lower than the value (83.5%, 77.16% and 76.05%) reported by El-Sagheer and Hassanein (2006) for Bovans brown layer strain, Kabir & Haque (2010) for Isa brown layer strain and Ershad (2005) for Bovans Nera, respectively. In contrast to this, a lower hen-day egg production percentage (66.1%) was reported by Ehtesham & Chowdhury (2002) for shaver 579 layer breed under intensive system. The reason for the differences in hen-day egg production percentage might be due to differences in strain of birds and management. The hen-housed egg production percentage (66.1%) in the present result was lower than the value (68.72%) reported by Yakubu *et al*. (2007) for Bovans brown layer. The differences might be due to differences in management and environmental condition in the two study areas.

Higher hen-day and hen-housed egg production percentage was found for layers kept in cages than those kept on floor. Similarly, Yakubu *et al*. (2007) reported that a higher hen-housed egg production percentage for Bovans brown layer in cage (74.06%) than floor (69.16%). Flock *et al*. (2005) also reported that birds in cages lay more eggs than those on floor. The higher per cent HDEP and HHEP may be attributed to better feed utilization efficiency in cage compared to floor housing system. According to Tauson *et al*. (1999), "caged birds performed better because they were relatively guarded against air pollution and

pathogenic organisms". This may also be indicative of the fact that hens in cage were more efficient in feed conversion and there was lesser incidence of feed wastage.

A Significantly higher percentage of hen-day and hen-housed egg production percentage were found in large sized flocks than small sized. Kumar and Mahalati (1998) and Nair and Ghadoliya (2000) reported better egg-laying performance in large than small sized flocks which is in agreement with the present finding. The significantly higher HDEP and HHEP in large compared to small flock size might be due to the better management in large size flocks in terms of housing, biosecurity and feeding practices as it was observed during data collection.

Mortality of birds during laying period was negatively and significantly correlated with the hen-day and hen-housed egg production percentage, which implies that as the mortality of birds reduced there would be more layers in the flock as a result, the egg production (HDEP% & HHEP%) performance will be higher.

The average peak percent lay (90.5%) in the present study was lower than the peak percent lay (95%) recommended by the company for Bovans brown egg layer strain. It was also lower than the peak percent lay reported by Farooq *et al*. (2002) and Mussawar *et al*. (2004) for commercial layers which were 92.13% and 91.6%, respectively. In contrast to this, Kabir and Haque (2010) reported a lower peak percent lay (87%) for Isa brown layer strain. The differences in peak percent lay might be due to differences in management and strain. Significantly higher peak per cent lay was found in large sized flocks of more than 200 birds and birds kept in cage. The average length of lay in the present study was 50 weeks (350 days) which ranged from 48 to 52 weeks, which was lower than the length of lay (72 weeks) recommended by the company for Bovans brown layer. North (1984) and Petek (1999) also reported a higher length of lay (more than 52 weeks) which was inconsistent with the present study. The reason for the lower length of lay in the present study might be due to the poor demand for moulted spent layers by most of the urban dwellers in the study area forcing farmers to sell birds before moulting. On the other hand, a lower length of lay (32.57weeks) was reported by Mussawar *et al*. (2004) for commercial layer breed. A significantly longer

length of lay was found for birds kept in cage and in large sized flocks. This might be due to the fact that better management contributed to longer length of lay for birds in large sized flocks kept in cage.

In agreement with present finding, Farooq *et al.* (2002) reported a lower mortality in large size than small size flocks. This might be due to better management practices in large sized flocks. Similarly, Kreienbrock *et al.* (2004) as cited by Gerzilov *et al*. (2012) reported higher mortality rates and lower production in floor system compared to conventional cages. Van Horne (1996) also reported a higher mortality in flocks kept on floor compared to those in cages. According to the poultry farmers, disease is the main cause of mortality of birds in a flock. The higher mortality of birds in floor system due to the fact that birds are likely to be exposed to disease, pest attacks and might peck one another leading to mortality of birds. In agreement with the present finding, Mussawar *et al*. (2004) reported that flock size was negatively correlated with mortality. Differences in mortality might be due to the fact that better measures might be taken to prevent disease losses in large sized flocks.

All of the formulated layers feed samples considered in the present study had much higher nutrient level in terms of CP, CF, ash, EE, ME and Ca than the optimum nutrient level recommended by Uppal *et al.* (2008) for laying chicken feed. The CP level of the three of the formulated feeds (II,III and IV) considered in the present study was much higher than the value 22.7% and 20.84% reported by Ermias *et al.* (2015) and Taddele *et al*. (2002) for commercial layer ration, respectively. The difference might be due to either the manufacturers using high protein source feed ingredients or using inappropriate feed formulation technique. However, the presence of high crude protein level in the formulated diets is not economical for the manufacturers owing to the high cost of protein rich sources. Besides, the excess protein consumed above the birds' requirement is oxidized to energy and the excess energy would decrease feed intake, which leads to a decrease in egg production performance and quality. According to Leeson *et al*. (2001), dietary protein in excess causes higher nitrogen losses in feces and contributes to environmental pollution which implies the negative impact of using excess dietary protein in formulated poultry feed. Latshaw and Zhao (2011) also reported that an excess of CP in poultry feed increases nitrogen load to the

environment and often results in increased feed cost. Thus, it implies that it is necessary to provide protein according to the requirement of birds.

The energy level of all the four formulated layers feeds evaluated in terms of ME (kal/kg/DM) was above the minimum recommended level which is above 2600 kcal/kg/DM. However, Nagle *et al*. (2005) reported that the actual requirement of metabolizable energy (ME) levels for specific strains of birds may differ significantly from the levels recommended for least cost diet formulations. The ME level of the formulated layers diet in the present study was lower than the value (2985.5 kcal/kg/DM) reported by Ermias *et al*. (2015) for commercial layers diet.

The mean egg weight, egg length, egg width, shape index and shell thickness of the external egg quality traits determined in the present study were higher than the value reported by Rath *et al*. (2015) for white leghorn layer birds. On the other hand, the yolk height, albumen height yolk weight, albumen weight, yolk color, Haugh unit, albumen percentage and yolk percentage of the internal egg quality traits were lower than the value reported by Olawumi and Ogunlade (2008) for Isa Brown layer breeder. The differences in external and internal egg quality traits might be due to differences in breed and management.

The Haugh unit (83.3) value determined in the present study falls into a firm (AA quality) which is a Haugh unit value of 72 and above. This is an egg white that is sufficiently thick or viscous based on USDA's terms descriptive of the egg white and its Haugh unit. The Haugh unit value in the present study was higher than the value (81.7) reported by Desalew (2012) for Bovans Brown. This higher in Haugh unit value might be due to the freshness of the eggs considered for egg quality traits analysis and management differences. The shape index value in the present study (78.1) falls into a round egg category which is above 76. The value of shape index in the present study was higher than the value (76.3) reported by Moula *et al* (2010) for ISA Brown layer strain. This difference might be due to strain differences.

In agreement with the present finding, Olawumi and Ogunlade (2008) reported statistically significant positive correlation between egg weight and egg length and egg width. The

statistically negative and positive correlation between egg shape index and egg length and egg width found in this study corroborated the results of previous researches (Ozcelic, 2002, Olawumi and Ogunlade, 2008). The negative and positive correlation of egg shape index with that of egg length and width might be due the fact that egg shape index is directly proportional to the egg width and inversely proportional to the egg length when it is calculated. This implies that egg width is a good estimator of egg shape index and the increase in the egg length results in a lower shape index value.

The non-significant positive correlation between egg weight and egg shape index was inconsistent with the findings of Debnath and Ghosh (2015), who reported a statistically significant but negative correlation between egg weight and shape index for layer birds. There was a statistically significant positive correlation between egg weight and shell thickness, which is in agreement with the reports of (Olawumi and Ogunlade, 2008; Kul and Seker, 2004). This implies that heavier eggs have higher shell weight than lighter eggs. The significant positive correlation between egg weight and shell percentage might contribute to increase in shell quality through selection for increased egg weight. In contrast to the present finding, Kul and Seker (2004) reported a statistically significant negative correlation between egg weight and the shell percentage.

There was a significant positive correlation between albumen height and Haugh unit value which is consistent with the previous researches (Oluwami and Ogunlade, 2008, Sarica *et al*., 2012). This implies that an increase in albumen height also results in an increase in Haugh unit value. The increase in albumen height also results in an increase in yolk weight and albumen weight due to the significant positive correlation among these traits. On the other hand, an increase in albumen height results in a decrease in albumen and yolk percentage. A significant negative correlation between yolk weight and albumen percentage in the present study was in agreement with the report of Debnath and Ghosh (2015). This indicated that the albumen percentage decreases as the yolk weight increases. A statistically significant positive correlation between yolk height and Haugh unit found in the present study was consistent with the report of Oluwami and Ogunlade (2008). In agreement with the present finding, Kul and seker (2004) reported a negative correlation between yolk

weight and albumen percentage. This implies that the increase in yolk weight, yolk height and yolk percentage might improve the yolk quality of an egg.

The statistically significant positive correlation observed between egg weight and most of the internal egg quality traits in the present study were in agreement with the report of Islam and Dutta (2010) and Wolanski *et al*. (2006) who observed a positive correlation between egg weight and some of the internal egg quality traits. This implies that egg weight has a direct relationship with most of the internal egg quality traits like yolk height, albumen height, yolk weight and albumen weight. However, an increase in egg weight decreases the albumen and yolk percentage according to the present study. The strong relationship between egg weight and albumen weight in this study was consistent with the reports of Oluleye *et al.* (2015); Kul and Seker (2004), which indicated that albumen weight is a good indicator for egg weight due to its strong positive correlation with egg weight.

Inconsistent with the present finding, Debnath and Ghosh (2015) reported a significant but negative correlation between shape index and yolk weight. A negative and non-significant correlation between shape index and some of internal traits like yolk percentage, yolk height, yolk diameter and albumin height in this study was consistent with the findings of Kul and Seker (2004) and Olawumi and Ogunlade (2008) except for the yolk percentage and albumen height.

A statistically significant positive correlation found between shell thickness and yolk weight and albumen weight and a positive but non-significant correlation observed between shell thickness and yolk height, albumen height, Haugh unit and yolk percentage contradicted the reported statistically non-significant but negative correlation between shell thickens and some of internal egg quality traits like Haugh unit, yolk height and yolk percentage (Debnath and Ghosh, 2015). A positive correlation between shell percentage with yolk height, yolk weight, albumen height, albumen weight, yolk color and Haugh unit except for albumen and yolk percentage, which were significantly but negatively correlated were inconsistent with reports of Kul and Seker (2004) and Olawumi and Ogunlade (2008) who found a negative

correlation between the shell percentage and all the internal quality traits except for albumen and yolk percentage.

The present study revealed that housing system had a significant effect on egg weight, which contradicted the findings of Ledvinka *et al* (2012) and Thomas and Ravindran (2005) who reported the non-significant effect of housing on egg weight. In the present study, the heavier egg weight determined in cage than floor housing system is in corroboration with reports of Englmaierova *et al*. (2014) and Jenderal *et al*. (2004), who recorded heavier eggs in cages. But contradicted with reports of Zemkova *et al*. (2007), Singh *et al*. (2009), Tumova and Ebeid (2005) and Pistekova *et al*. (2006), who recorded heavier eggs on floor. Shell thickness was not significantly influenced by housing system in the present study, which contradicted with Englmaierova *et al*. (2014) who reported the influence of housing system on shell thickness which was a lower egg shell thickness for eggs produced in cages.

Housing system did not influence yolk height, albumen height, albumen weight, Haugh unit and yolk percentage, which agreed with findings of Ledvinka *et al*. (2012) who reported the non-significant effect of housing on albumen weight and yolk percentage. A significantly higher yolk weight found in cage eggs than floor was in contrast with the report of Sing *et al*. (2009), who found heavier yolk in eggs from floor pens in comparison to cage eggs. The yolk color in the present study was higher in cage eggs than floor which is in agreement with the report of Hidalgo *et al*. (2008). The higher yolk color in cage system might be due to the better supply of green feed for birds in cage system owing to lack of access for birds in cage system to scratch. On the other hand, Pistekova *et al*. (2006), and Singh *et al*. (2009) reported deeper yolk colour in floor pens than in cages which is inconsistent with the present study. Haugh unit in the present study was not influenced by housing system which was in contrast with the reports of Hidalgo *et al*. (2008), Singh *et al*. (2009), and Tumova *et al*. (2009), who found inferior quality of albumen in non-cage housing systems. According to Englmaierova *et al*. (2014) all of the internal and external egg quality traits were influenced by the housing system which is in part consistent with the present finding.

The formulated feed sources considered in the present study had a significant effect on external egg quality traits except on egg width and shell thickness. These might be due to differences in protein and energy level of the formulated feeds. Similarly, Uddin *et al*. (1991) also reported that egg weight increased with increasing dietary protein and energy levels. For instance, Harms *et al*. (2000) observed that hens fed high-energy diets (containing around 6% oil) produce heavier eggs. In the present study, significantly higher egg weight was recorded from farms using a formulated feed source having 32.5% CP and 2679.4kcal of ME/kg. The heavier egg weight might be due to the high CP of the feed. According to Babiker *et al.* (2010) egg weight, mass, length and width and shape index and feed conversion were not influenced by dietary energy level.

In the present study, all the four formulated feeds with different levels of crude protein and energy levels had an effect on most internal egg quality traits except for yolk weight and yolk percentage, which contradicted a bit with Ghazvinian *et al*. (2011) who reported that protein level had effect on yolk weight and percentage. Inconsistent with the present finding, Garcia *et al*. (2005) also reported that protein levels in formulated feeds had an effect on yolk percentage. Junqueira *et al*. (2006) reported that different levels of energy and protein feeds had no effect on Haugh units which contradicts with the present finding. Yolk color was significantly influenced by the formulated feed sources considered in the present study. The highest yolk color value was recorded in eggs obtained from farms that used the formulated feed I. These differences in yolk color might be due to the use of synthetic pigments in the formulated feed by the manufacturer of formulated feed I. Silmarly, Alemu and Tadelle (1997) reported that commercial producers use imported purified or synthetic pigments at extremely high cost.

In agreement to the current study, Meseret *et al*. (2011) and Fisseha and Tadelle (2010) reported that egg marketing takes placed in various places including: urban markets, local markets, at larger woreda markets and farm gates. The main actors involved in exotic poultry products marketing in the study area were urban private consumers, producers, collectors, local retail shops, pastries, restaurants, snacks houses and supermarkets, which corroborated the reported village chicken and egg marketing system in Bure town (Fisseha

and Tadelle, 2010). This suggests that there is similarity of actors involved in exotic chicken products marketing in both big cities and towns of different localities.

The small scale intensive urban poultry farmers in the study area are not VAT (value added tax) registered and they mainly sell the eggs to the local retail shops with a lower price. This might be due to the fact that the local retail shops do not request a receipt from the poultry farmers for the purchasing of eggs. On the other hand, most of the big hotels and restaurants, pastries and supermarkets were vat registered due to the new tax system and need a receipt for each purchase of poultry products. Thus, they mainly purchase the poultry products from vat registered producers and whole sellers so as to make their financial system legalized. However, this tax system has led most of the small scale intensive urban poultry farmer's from getting the maximum profit margin from the sale of eggs due to selling of eggs with lower price mainly for the local retail shops.

The dominant market channel for exotic chicken eggs in the study area was selling of the eggs by producers directly to the local retail shops that will finally be reaching to consumers, which differed a bit that reported by Meseret *et al*. (2011) for village chicken marketing system where the farmers directly sell their chicken to consumers and/or to small retail (traders) who take them to large urban centers. In case of spent layers marketing, the producers mainly sell directly to consumers in particular during religious festivals and special occasions. Similarly, Kena *et al*. (2003) in East Showa zone reported that the two largest chicken marketing channels in poultry production are farmers directly sell to consumers and farmers sell to small retail traders who take the chicken to large urban centers.

Majority of the small scale intensive poultry farmers and urban consumers of the study area mainly preferred local chicken products for consumption due to its falvour and taste, which was in agreement with Durmuş *et al*. (2012) where local chicken were mostly preferred by consumers due to its natural, flavour and manual slaughter. According to Tikasz *et al*. (2009), consumers prefer the farm chicken due to the healthiness and high quality of this product which is in agreement with the present study. Sonalya and Swan (2004) also

reported that in both urban and particularly rural markets, local chicken meat is preferred due to its flavor than exotic broiler chicken meat and the tougher muscle texture which is more suited to dishes with longer cooking time, such as soup. Very few urban consumers in the study area preferred exotic chicken for consumption due to the high price of local chicken in particular during religious and New Year festivals. Chicken meat consumption by the small scale intensive poultry famers and urban consumers was mainly more than three times a year by considering religious festivals and special occasions in the form of "Doro wat". According to Durmuş *et al*. (2012), nearly half of the people in Turkey consume poultry meat at least once a week which was much frequently than the frequency of chicken meat consumption in the study area. This difference in frequency of chicken meat consumption might be due to the differences in economic status of consumers, the chicken price, presence of other substitutes like beef and mutton and the influence of fasting period in the study area. The chicken eggs were mainly consumed twice per week by the small scale intensive poultry farmers while the urban consumers consumed more than three times per week. This difference might be due to the fact that the urban consumers mainly consume in the snacks houses and restaurants that prepared mostly egg dishes at break fasts time and this led them to consume egg dishes most of the time.

Most of the time small scale intensive poultry farmers in the study area do not consider the time of spent layer disposal to coincide with festival period at the time of purchasing the pullets due to the unavailability of pullets on time of request from the source. Thus, they are obliged to sell the spent layer with lower price at the time of spent layer disposal. The price of spent layer was relatively lower than local chicken due to the consumer's preference for local chicken breeds for sacrifice. Similarly, Kenea *et al* (2003) reported that during holidays, consumers prefer to buy local breeds having particular colours for sacrifices and cultural reasons due to the fact that modern farmers produce exotic breeds having either red or white colour and do not supply preferred coloured chickens. However, those urban consumers that preferred exotic chicken products over the local one might be due to the higher price of local chicken products which is unaffordable during festival periods.

The higher selling price for exotic chicken products at supermarkets might be due to VAT registration which allows someone to engage into commercial activities involving the production and distribution of goods and the provision of services with 'added value. Whereas, the local shopkeepers and majority of the collectors are not VAT registered and as a result they sell with a lower price than supermarkets. The present study revealed that the price of exotic chicken eggs was influenced by festival periods at the farm gate, local shopkeepers and collector's shops whereas the prices in supermarkets didn't significantly vary. The statistical significant difference observed on the price of dressed chicken meat at different festivity in the present study were in agreement with the report of Fisseha and Tadelle (2010) and Kenea *et al*. (2003) who observed the influence of religious festivity on the price of chicken products.

The price offered for local chicken products was higher than the price offered for exotic chicken products for the last several years in the study area. Currently, the price offered for exotic chicken eggs become higher than the local chicken eggs owing to the high demand by restaurants and pastries for its larger size and less chance of spoilage. However, the price consumers' willing to pay for the spent layer was still lower than the local chicken. A premium price for local chicken might be due to the fact that the meat is tastier, strong flavored, tougher and retains its texture when preparing traditional dishes like "Doro wat" one of Ethiopia's most famous dishes mainly served during holidays and on special occasion. The price of exotic dressed chicken meat is also increasing from time to time due to the increase in demand for dressed chicken meat by the restaurants and urban consumers.

Currently, the involvement of government enterprises in the provision of poultry farm inputs become reduced due to the privatization policy that the government has been implementing in changing governmental enterprises into private enterprises. However, the private enterprises are not providing the poultry farm inputs at its required amount, quality and on time of request in particular in the provision of day old chicks and pullets. Moreover, the unavailability of formulated poultry feed supply in the nearby area which incurred high transportation cost.

In agreement with the current study, Maqbool *et al*. (2005) reported that the main problems encountered in marketing of commercial poultry products in Pakistan were the price of feed and medicine, transportation, and lacking of health facilities. Poor sells for the spent layer due to low interest of consumers in consuming exotic chicken, lack of their own market center so as to get the maximum profit margin by selling to the final consumer, the interference of large scale poultry farms in reducing the selling price during festival periods and price fluctuation due to the influence of fasting period were the constraints encountered during selling of poultry products.

Most of the restaurants, pastries and snacks houses purchased the exotic chicken eggs mainly from the nearby supermarkets and collectors shops. Similarly, FAO (2009) reported that poultry products are usually purchased in formal market, from street vendors or in supermarkets in Indonesia. Majority of the restaurants in the study area preferred purchasing of exotic chicken eggs due to its bigger size and less chance of spoilage. Whereas those restaurants that preferred the local chicken eggs were due to customer's preference for its flavor and deep yellowish yolk color. The restaurants in the study area mainly preferred purchasing of exotic chicken meat due to its bigger size, ease of preparation and its soft muscle texture makes it suitable for making foreign dishes. In contrast to the present finding, FAO (2009) reported that the restaurants in Cambodia use family-raised local chickens, not industrial birds. The purchasing of dressed exotic chicken meat from supermarkets by the restaurants in the study area was in agreement with the report FAO (2009) that reported restaurants in Cambodia buy dressed chicken meat from supermarkets. The purchasing of dressed chicken meat might be due to avoiding the time spent in the slaughtering process of live chicken and to make the chicken dishes available for the customers just in time of request. Those restaurants that preferred the local chicken meat was because of their customer's preference due to its taste, flavor and its suitability in preparing traditional dishes like chicken stew ("Doro Wat"). Whereas, the exotic chicken meat is not suited to prepare traditional dishes like chicken stew ("Doro Wat") that takes longer cooking time due to the soft muscle texture.

The exotic chicken eggs were mainly preferred by pastries due to its bigger size that makes it to make relatively more number of cakes than local chicken eggs, its light yolk colour makes it convenient for making different kind of colored cakes and the less chance of spoilage makes it to be stored for more number of days. Whereas, the local chicken eggs are not preferred by pastries for making cakes. This is due to the fact that the local chicken eggs has a deep yellowish yolk color which makes it not to be suitable in preparing different colour cakes owing to the dominance of the deep yellowish yolk colour that cannot be easily avoided. Whereas, the snacks houses mainly preferred the local eggs due to it taste and deep yellowish yolk color that makes it to be more preferred by their customers. However, the snacks houses also used the exotic chicken eggs by mixing with the local chicken eggs in preparing egg dishes due to shortage of local egg supply with required number and quality at the market center. Though, most of the time they faced complains from their customers due to the lack of deep yellowish color, local egg taste and flavor from foods made from exotic chicken eggs.

In agreement to the current study, FAO (2009) reported that poultry products were purchased mostly on a weekly basis. The number of exotic chicken eggs purchased and used at one time by pastries was much higher than the restaurants and snacks houses. The higher number of eggs purchased and used in pastries might be due to more number of eggs required in making different types of cakes.

The average number of eggs (16 eggs) per day and chicken meat (1.2 kg) per week utilized in the restaurants of the study area was much lower than the amount (26 eggs and 6.6 kg of poultry meat per day) utilized by the restaurants in Cambodia (FAO (2009). The less chicken meat consumption in study area might be due to the preference of the urban consumers for chicken meat prepared at home in the form of “Doro wat” during festivals period and special occasions. Moreover, the unaffordable price requested by the restaurants for dishes prepared from chicken meat and the presence of other food substitute made from beef and mutton which has a high demand by the urban customers in the restaurants. In agreement to the current study, Jayaraman *et al.* (2013) reported that chicken meat as the most common dishes served during special occasions in Malaysia. Rimal (2002) reported that consumers in

developed countries are consuming a lesser amount of red meat such as beef and more non-red meats such as poultry, which contradicted the findings of the present study.

The type and number of dishes prepared from exotic chicken meat and eggs were varied in most of restaurants depending on their level of services. The commonly prepared dishes of chicken meat in restaurants were chicken *arusto, chicken stir-fried, chicken breast and chicken salad*. Similarly, Durmus *et al*. (2012) reported that in restaurants poultry meat is mostly consumed in the chicken Doner form which was followed by the barbecue form, roasted form and the stew form. The pastries also used the eggs for making different kind of cakes having a longer shelf life than the cakes made without eggs. The urban dwellers mainly prepared traditional dishes like "Doro wat" using local chicken meat due to its flavor, taste and texture while the restaurants mainly used the exotic dressed chicken meat. In present study, traditional dishes made of local chicken meat and eggs are highly preferred by the customers in the restaurants is in corroboration with the report of Higenyi *et al*. (2014) who reported that restaurants considered customer preference and economic factors as more important determinants of native poultry meat usage. The increase in price of eggs was one of the main constraints encountered by the restaurants, pastries and snacks houses. This led them to increase the prices of the different food items prepared from eggs; however there is a complaint from their customers due to the increases in price of food items.

The roles of husbands in cleaning and removing farm wastes were relatively very less compared with the other family members. The less involvement of husbands in cleaning and waste removal might be due to the cultural believes that considering cleaning activities as female jobs in the study area. Most (84.5%) of the small scale intensive poultry houses of the study area had non-cemented floor covered with bedding materials like Teff (*Eragrostis teff*) straw and wood shavings. In contrast to this, Kalu (2015) reported that majority (96.6%) of the poultry houses had concrete floors in Port Harcourt. The reason for the less use of concrete floor in the study area might be due to the high cost needed to make a concrete floor.

Teff (*Eragrostis teff*) straw was one of as the main litter material used by poultry farmers in the study area, which contradicted the findings of Adeyemi and Malomo (2014) who reported that wood shaving is the most popularly used litter material in Abeokuta, Ogun State, Nigeria. The reason for the use of Teff (*Eragrostis teff*) straw as the main litter material in the study area is due to its availability and the main crops cultivated by most of the farmers in the surrounding areas of the study area. Manual scrapping with shovel was the main method of waste collection in small scale intensive poultry farms in the study area, which agreed with the finding of Adeyemi and Malomo (2014) who reported that in floor houses, scraping with shovel was the most common method of waste collection in Nigeria. In case of cage system, poultry farmers of the study area mainly put a plastic sheet under each tier for collection of droppings and removing it every day from the plastic sheet by flushing water.

Most (94%) of the small scale intensive poultry farmers in the study area used polythene and hessian sack for carrying the wastes to the dump site, which contradicted the finding of Adeyemi and Malomo (2014) who reported the common methods of waste transportation were the use of wheel barrow, tractor trailer and head pan in Nigeria. The difference in the use of transportation means for poultry waste disposal might be due to the scale of operation and the amount of waste generated.

Majority of the small scale intensive poultry farmers of the study area removed the manure/litter by disposed of it in the dump site around their residence, which contradicted the findings of Moreki and Keaikitse (2013) who reported manure/litter disposed of by giving it away to other farmers to use in their arable fields in Botswana and Mijinyawa and Dlamini (2007) who reported manure/litter disposed of using as fertilizer in their own farms in Swaziland. Most of the small scale intensive poultry farmers of the study area are less aware of the use of poultry waste as a fertilizer in their garden farm. The less use of poultry wastes as a fertilizer in their garden farm might be due to the nuisance odour of poultry droppings to use it without any treatment. Very few of the small scale intensive urban poultry farmers sell the manure/litter as a fertilizer to the vegetable and flower seedling farmers of the study area as a way of disposal of poultry waste, which contradicted the

finding of Paraso *et al.* (2010) who reported the sale of chicken manure in small-scale enterprises is almost impossible due to the fewer number of birds.

The main disposal methods of dead birds in small scale intensive system of poultry farming in the study area were throw away it to dump site and burning, which contradicted the finding of Moreki and Keaikitse (2013) who reported the common methods of mortality disposal were through landfills. But in agreement with Paraso *et al.* (2010) who reported dead birds from farms were mostly buried. The limited use of advanced disposal methods of dead birds in the study area might be due to a limited skills, knowledge and lack of technology on how to properly dispose of dead birds. One of the main constraints of poultry waste disposal faced by majority of the small scale intensive poultry farmers were the nuisance odour that makes it difficult in the process of handling and disposal, which contradicted the findings of Moreki and Keaikitse (2013) and Adedayo (2012) who reported lack of transportation facilities was a major constraint in disposing of poultry waste from the farms in Botswana and Nigeria, respectively.

The high price of feed was the major constraint often encountered by the small scale intensive urban poultry farmers of the study area is in corroboration with reports of Moreki (2010) in Botswana, Asare-Boadu (2010) in Ghana and Ghasura *et al*. (2013) in Gujarat who reported high feed cost was the main constraint faced by small scale poultry farms. Bukar-kolo *et al.* (2006) in Gombe state, Ovwigho *et al*. (2009) in Delta state and Alabi and Osifo (2004) in Edo state in Nigeria reported that infectious diseases and mortality of adult birds were the major constraints of small scale poultry farm enterprises, which is contradicted with the present finding. The increase in cost of feed as the main threat for small scale intensive poultry farms in the present study was in agreement with the report of Ago-Ind (2002) who reported high cost of feed as a threat to the poultry industry in Nigeria. This implies that an increase in price of feed cost and other associated constraints are the bottlenecks for the development of the poultry sector and might also the causes for the abandoning of many of the urban small scale intensive poultry farms.

Lack of transportation facility was one of the main challenges faced by the urban agricultural offices of each sub-city for not able to provide the required extension and technical support, which agreed with findings of PAR (2000) as cited by Moreki, 2010 who reported inadequate extension service due to shortage of transport resources was the main challenge faced in Botswana. Disease outbreaks also a feeling of threat to the small scale poultry farmers in the study area. This might be due to the situations happened in 2006 for the suspicion of a threat of AI (Avaian influenza) in Ethiopia in Gurage state poultry multiplication center that led for the death of hundreds of chickens and led to massive consumer panic about chickens, depressed demand, and led to fall in prices (Dawit *et al*., 2009). Big poultry farms market interference in reducing the price of eggs also created a feeling of threat of bankruptcy. On the other hand, frequent complaints from neighbors on the nuisance odour of poultry droppings created a feeling of threat due to the social and public health concern. Lack of capital as one of the barrier for future expansion of poultry farm in the study area, which was in agreement with Jabbar *et al*. (2011) who reported capital as a barrier for the expansion of poultry farm in Bangladesh.

The flock size in the present study was significantly affected by age, family size, educational level and farming experience of the poultry farmers were in agreement with the report of Emaikwu *et al.* (2011) who reported year of experience; educational level and family size directly influence flock size. This implies that the larger the family size, higher educational level and experience gained contributed in keeping large flock size and to apply better production practices for the better efficiency of the poultry farms.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1. Conclusions

The study revealed that small scale intensive system of poultry farming is mainly practiced by females and by medium age groups of the urban dwellers of Addis Ababa as an income generating activity. The poultry famers mainly depend on large scale poultry farms in sourcing feed and layer breeds. Larger family size, better education, keeping large flock size and using cage system housing reveal significant effect on the performance of farms in terms of egg production.

Layer birds kept in cages laid the first egg and attained peak of lay earlier than those kept on floor housing. Layer birds reared in cage and large sized flock performed better than birds in small sized flock and floor system housing in terms of egg production. A higher mortality rate was also recorded on floor than cage housing system possibly due to the higher exposure of birds to disease and pest attacks in floor housing. This implies that the use of cage housing system and having large flock is more advantageous than rearing birds in floor housing system with small flock size in terms of producing larger number of eggs and reducing the chance of bird's mortality under small scale intensive poultry farming and also for efficient utilization of the land owing to shortage of land.

The nutrient content of the formulated layer feeds considered in the present study were found to be above the recommended level in terms of metabolizable energy, protein, ash, crude fiber and ether extract. This implies that there is improper balance of nutrients in formulating the layer feeds by the manufacturers and improperly balanced nutrients in poultry feeds has a negative impact on the performance of the birds and cost of production.

Desirable external egg quality traits were observed in eggs collected from caged birds than those from floor housing due to the better management of birds in cage system. Egg weight is a good estimator of internal egg quality traits due to its strong positive correlation with most of the internal egg quality traits. The albumen height is a good estimator for the Haugh unit value owing to its strong positive correlation with Haugh unit. Yolk weight, yolk color

and albumen percentage of internal egg quality traits were influenced by the housing system used for rearing birds. Different values were observed in most of the external and internal egg quality traits collected from the different farms due to differences in the nutrient content of the formulated feeds used and the housing system the birds were reared in.

Selling of eggs to the local retail shops was one of the dominant market channels in small scale intensive urban poultry farming. Pastries and restaurants mainly preferred exotic chicken eggs. There is a high price for chicken products during festival period due to the tradition of using Doro wat during festivities and the affordability of the chickens by majority households.

The high price of feeds and poor sales for spent layers is the main market constraint faced in small scale intensive urban poultry production in the study area. Poultry products collectors played a great role in the supply of exotic eggs for pastries and snacks houses while the supermarkets are the main suppliers of exotic chicken eggs and dressed chicken meat for the restaurants. Currently, the price offered for exotic chicken eggs is higher than the local chicken eggs and becoming more preferred by the pastries and restaurants due to its bigger size and less chance of spoilage. The number of chicken eggs purchased and used for making food significantly varied among the restaurants, pastries and snacks houses. The increase in price of eggs became the main constraint faced by the restaurants, pastries and snacks houses.

Manure is the major poultry waste in small scale intensive poultry farms which is followed by litter/manure mix and dead birds. Manual scrapping with shovel was the main method of waste collection. Polythene and hessian sack were the means of transporting farm wastes in to the dump site using hand carrying system. Disposal of manure and or/litter in the dump site was the main method of disposal in the study area. Throwing away to dump site, burning and burial are methods of dead birds disposal in the study area. The nuisance odour created by poultry manure and lack of convenient dump site were the main constraints seriously encountered in disposing of poultry waste.

The high price of feed, shortage of land, poor feed quality, high cost of pullets, and unavailability of pullets at time of request were the main often encountered constraints by the small scale intensive urban poultry farmers. The current increase in price of feed and disease outbreak creates a feeling of threat to urban poultry farmers. Shortage of land and poultry housing construction regulation are now becoming the main barrier for future expansion of urban poultry farming. Lack of transportation facility and turn-over of experts have negative impacts in the provision of extension and technical support by offices working in urban poultry farming. The number of birds kept by the small scale intensive poultry farmers was mainly influenced by age of the poultry farmer, family size, educational level and farming experience. The premium price for exotic eggs at the market center due to the shortage of local egg supply in the market and its high demand for its quality by hotels, restaurants and pastries and household consumers become a good opportunity for the small scale intensive poultry farmers.

6.2. Recommendations

Based on the above conclusions the following are recommended:

- Education is important to apply an efficient management practice for the better performance of the poultry farms. Thus, attention has to be given to attract educated individuals of different disciplines to be involved in the sector by provision of land and credit facilities.
- The government has to improve regulations related to construction of poultry housing to facilitate the participation of the urban dwellers in particular those youths, pensioners and unemployed people in urban poultry farming thereby creating job opportunities and fulfilling the protein demand of the urban dwellers.
- Poultry farmers and interested urban dwellers have to be advised to use the cage system housing technology which enables them to keep more number of birds within a small land size and also to be more economical in producing dozens of eggs and reducing bird’s mortality thereby contributing to solving of the problem of land shortage.

- Poultry feed manufacturers should be advised on the proper ration formulation to produce a feed based on nutrient requirements of birds so as to be more economical by avoiding unnecessary wastage of expensive feeds.
- Establishing poultry manure collection dump site in each potential sub-cites will help to collect the poultry manure properly and to use it for bio-gas production, as a ruminant feed and as an organic fertilizer. Moreover it keeps the environment safe from pollution.
- The high price of feed and birds (day old chicks and pullets) and its unavailability at required amount and quality is becoming a bottleneck for the sector. Thus, it needs government and private investors' participation in the establishment of poultry feed processing center and poultry breeding multiplication center so as to provide a feed with a standard quality and a minimum price; an adequate and sustainable distribution of birds for the sustainability of the urban poultry farming.
- Provision of credit facilities from financial institutions with lower interest rates can play a significant role the expansion and improvement of the urban poultry farming.
- Provision of poultry husbandry training and extension services should be improved for the better efficiency of the small scale urban poultry production. Hence, the government should encourage the urban agriculture extension agents and experts through the provision of incentives such as on job training, educational scholarships and a better salary to motivate them to provide effective training and extension services.

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8. APPENDIX

Appendix 8.1. Poultry housing system

Floor system poultry housing

Cage system poultry housing

Appendix 8.2. Egg quality analysis

Appendix 8.3. Poultry products marketing

Chicken meat at supermarkets

Exotic chicken eggs at supermarket

Live exotic chicken marketing

Exotic chicken eggs marketing

Appendix 8.4. Poultry housing design

Appendix 8.5. ANOVA Table GLM procedure

Dependent Variable: HDEP

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5336.398[a]	19	280.863	13.996	.000
Intercept	211695.935	1	211695.935	10548.952	.000
sex	.184	1	.184	.009	.924
Age	23.951	2	11.975	.597	.552
Family size	325.994	2	162.997	8.122	.000
Educational level	608.189	3	202.730	10.102	.000
Sideline business	51.586	2	25.793	1.285	.280
Farming experience	4.746	2	2.373	.118	.889
Housing system	187.477	1	187.477	9.342	.003
Feed source	90.858	3	30.286	1.509	.215
Flock size	190.370	3	63.457	3.162	.027
Error	2729.242	136	20.068		
Total	766827.078	156			
Corrected Total	8065.641	155			

a. R Squared = .662 (Adjusted R Squared = .614)

Dependent Variable: HHEP

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6493.980[a]	19	341.788	16.524	.000
Intercept	191853.455	1	191853.455	9275.230	.000
sex	.571	1	.571	.028	.868
Age	18.775	2	9.388	.454	.636
Family size	298.184	2	149.092	7.208	.001
Educational level	512.977	3	170.992	8.267	.000
Sideline business	36.815	2	18.407	.890	.413
Farming experience	3.364	2	1.682	.081	.922
Housing system	210.885	1	210.885	10.195	.002
Feed source	52.559	3	17.520	.847	.470
Flock size	569.184	3	189.728	9.172	.000
Error	2813.091	136	20.684		
Total	689932.508	156			
Corrected Total	9307.071	155			

a. R Squared = .698 (Adjusted R Squared = .656)

Dependent Variable: Peak percent lay

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	207.664[a]	19	10.930	8.985	.000
Intercept	336860.894	1	336860.894	276915.394	.000
sex	2.278	1	2.278	1.873	.173
Age	1.989	2	.995	.818	.444
Family size	1.540	2	.770	.633	.532
Educational level	19.699	3	6.566	5.398	.002
Sideline business	.056	2	.028	.023	.977
Farming experience	2.052	2	1.026	.843	.432
Housing system	58.061	1	58.061	47.729	.000
Feed source	5.937	3	1.979	1.627	.186
Flock size	12.039	3	4.013	3.299	.022
Error	165.441	136	1.216		
Total	1277746.233	156			
Corrected Total	373.105	155			

a. R Squared = .557 (Adjusted R Squared = .495)

Dependent Variable: length of lay

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	228.614[a]	19	12.032	4.139	.000
Intercept	103625.047	1	103625.047	35643.677	.000
sex	.050	1	.050	.017	.896
Age	7.745	2	3.872	1.332	.267
Family size	4.700	2	2.350	.808	.448
Educational level	11.001	3	3.667	1.261	.290
Sideline business	2.453	2	1.226	.422	.657
Farming experience	16.228	2	8.114	2.791	.065
Housing system	45.483	1	45.483	15.645	.000
Feed source	10.355	3	3.452	1.187	.317
Flock size	92.922	3	30.974	10.654	.000
Error	395.386	136	2.907		
Total	390624.000	156			
Corrected Total	624.000	155			

a. R Squared = .366 (Adjusted R Squared = .278)

Dependent Variable: age at first egg

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	625.694[a]	19	32.931	1.150	.310
Intercept	781765.386	1	781765.386	27308.478	.000
Sex	5.339	1	5.339	.186	.667
Age	34.588	2	17.294	.604	.548
Family size	58.138	2	29.069	1.015	.365
Educational level	58.559	3	19.520	.682	.565
Sideline business	39.926	2	19.963	.697	.500
Farming experience	78.043	2	39.021	1.363	.259
Housing system	203.310	1	203.310	7.102	.009
Feed source	51.886	3	17.295	.604	.613
Flock size	82.729	3	27.576	.963	.412
Error	3893.300	136	28.627		
Total	2982287.000	156			
Corrected Total	4518.994	155			

a. R Squared = .138 (Adjusted R Squared = .018)

Dependent Variable: Age at peak of lay

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2389.822[a]	19	125.780	2.355	.002
Intercept	1684589.248	1	1684589.248	31544.599	.000
Sex	10.438	1	10.438	.195	.659
Age	83.344	2	41.672	.780	.460
Family size	4.565	2	2.283	.043	.958
Educational level	221.302	3	73.767	1.381	.251
Sideline business	50.159	2	25.079	.470	.626
Farming experience	131.046	2	65.523	1.227	.296
Housing system	1498.290	1	1498.290	28.056	.000
Feed source	19.815	3	6.605	.124	.946
Flock size	118.366	3	39.455	.739	.531
Error	7262.864	136	53.403		
Total	6509503.000	156			
Corrected Total	9652.686	155			

a. R Squared = .248 (Adjusted R Squared = .142)

Dependent Variable: Flock size

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	360994.146[a]	13	27768.780	11.923	.000
Intercept	1064824.585	1	1064824.585	457.185	.000
sex	8164.257	1	8164.257	3.505	.063
Age	19008.660	2	9504.330	4.081	.019
Family size	22594.500	2	11297.250	4.850	.009
Educational level	24977.532	3	8325.844	3.575	.016
Sideline business	12537.971	2	6268.986	2.692	.071
Farming experience	50181.222	2	25090.611	10.773	.000
Housing system	6418.399	1	6418.399	2.756	.099
Error	330730.777	142	2329.090		
Total	3820292.000	156			
Corrected Total	691724.923	155			

a. R Squared = .522 (Adjusted R Squared = .478)

ANOVA egg purchased and utilized

		Sum of Squares	df	Mean Square	F	Sig.
Eggs purchased	Between Groups	781152.000	2	390576.000	94.456	.000
	Within Groups	297720.000	72	4135.000		
	Total	1078872.000	74			
Eggs utilized per day	Between Groups	162700.347	2	81350.173	131.050	.000
	Within Groups	44694.320	72	620.754		
	Total	207394.667	74			

Appendix 8.6. Questionnaires

Addis Ababa University, College of Veterinary Medicine and Agriculture

Department of Animal Production Studies

PhD Program in Animal Production

Assessment of Urban Poultry Production Practices in Addis Ababa with Emphasis on Egg Production, Product Marketing, Feed Quality and Waste Management

Name of the poultry keeper ----------

Sub city----------

District ---------- kebele……..

Date of interview----/----/---------

A. Socio-economic characteristics

1. Sex of the respondent 1. Male 2. Female
2. Age of the respondent _____
3. Family size_____
4. Educational level of the respondent
   1. No formal education 2. Primary education
   3. Secondary education 4. Tertiary education
5. Marital status
   1. Married 2. Unmarried 3. Widows
6. Owners occupation
   1. Business 2. Civil worker 3. Retired 4. Poultry farmer 5. House wife
7. Main sources of income
   1. Poultry sale 2. Salary 3. Business 4. Pension
8. Sideline business
   1. Small business 2. Civil servants 3. None
9. Experience in poultry farming?_____.
   1. One to 3 years 2. Three to 5 years 3. More than 5 years

10 When did you start poultry rearing?_____?

11. For what purpose do you raise poultry? ----------

1. Income generation 2. For income and home consumption
2. Home consumption 4.others, specify_____

12. State the number or members of your family who care of Poultry_____ ?

1. 1-5persons 2. 6-10persons 3. More than 10 persons

13. What is the name of chicken breeds you raise? _____

14. What is your source of foundation stock? _____

15. What is your source of replacement stock? _____

16. By which age classes you have started the poultry farm?

1. Day old chicks- one month's 2. One month –two months
3. Three months – four months 4. Four months and above

17. How much is the price of

1. Day old chicks_____ 4. Three months_____.
2. One month chicks_____ 5. Four months _____
3. Two months_____ 6. five months and above_____.

18. How many numbers of birds you have in your farm?

1. Layer _____ 2. Grower _____

19. For which of the following purposes you mostly spend money?

1. Purchase of birds 2. Purchase of feeds
3. Purchase of veterinary products 4. Others (specify) ----------

20. Source of money to finance your poultry farming?

1. Personal saving 2. Money lender 3.Family or friends 4. Bank
5. Micro finance institution 6.Others, specify----------

21. On average how many days per week do you and your family spends to take care of the birds? _____.

22. Household labour allocation

Activities	Husband	wife	Young daughters	Young sons	Others, specify
Feeding					
Egg collection					
Egg selling					
Input purchasing					
Cleaning					
Other activities,					

B. Housing

1. What type of housing system do you practice for your poultry raising?

   1. Floor system 2. Cage system 3. Slatted floor system 4.Others, specify-----

2. If you are using floor system, what are the main problems you faced in floor system?

_____

_____

_____.

3. If you are using cage system, what are the main problems you faced in using cage system?

_____

_____.

4. Housing condition?

   1. Share the same house with people 2. Separate house entirely constructed for poultry

5. Did you construct poultry house based on recommended extension packages?

   1. Yes 2. No

6. If no for Q.5, specify the reasons

   1. _____5._____
   2. _____6._____

7. If yes for Q 5, How much cost you spent to construct or to purchase the house (cage)_____(birr)
8. How frequently do you clean?_____How many days in week_____?
9. Do you provide litter material in the poultry house? 1. Yes 2. No
10. If yes for Q.9. What type of litter martial do you use?
    1. Teff straw 2. Wheat straw 3. Wood shavings 4. If others (specify) ___
11. Do you use proper lighting schedule for the chickens?
    1. Yes 2. No
12. If yes for Q11. For how long you put on the light bulb?
    1. 1hr 2. 2hr 3. 3hr 4. 4hr 5. 5 hr 6. 6hr 7. 12hr
13. If no for Q11. What are the main problems for not to use proper lighting schedule?

_____

_____

14. Please indicate the types of house ventilation.
    a. Natural b. fan-powered ventilation
15. Are all ventilation sites tightly closed during downtime?
    a.Yes. b. No c. Not known d. Not applicable

C. Feeding and watering

1. How do you feed your birds?
    1. Purchased formulated feed 2. Mixed at home
    3. Both 4. Others, specify_____
2. When do you feed your chickens?
    1. Morning and evening 2. Morning and afternoon
    3. Morning, afternoon and evening 4. Free access
3. How do you feed your birds?
    1. Put feed in Feeder 2. Throw on the ground for collective feeding
    3. Others, specify_____
4. What type of Feeder you use?
    1. Federer constructed by local material 2. Purchased

5. If you purchased how much is the price of the Feeder?_____

6. If you constructed from local materials what kind of materials you used to construct?

_____,_____,_____

7. Where is the source of feed for your birds?

1. Private feed manufacturer 2. Governmental
3. Purchasing the ingredients and mixing at home 4. Others specify_____

8. Who are your major feed supplier?_____

9. How much is the cost of the feed for the different age groups? (Birr/quintals)

1. Layer mash_____.
2. Grower mash_____.
3. Chicks mash_____.

10. If you purchased the ingredients and mixing at home. How much is the price of each ingredient?

Ingredient	Average price	Minimum	maximum
1.			
2.			
3.			
4.			
5.			

11. Which one is more cost effective?

1. Purchasing the ingredients and mixing at home 2. Purchasing formulated feed

12. What are the main problems in preparation of formulated feed by yourself?

1. Lack of knowledge on how to prepare 2. Cost of ingredients
3. Unavailability of ingredients 4. Others, specify____

13. What are the main problems of purchased formulated poultry feed?

1. Low quality 2. Price of feed 3. Unavailability 4. Others specify_____

14. How much amount of feed you provide per bird per day?_____g/bird/day or how much kg of feed you provide for your flock per day_____.

15. Do you provide green feed to your poultry?

a. yes b.no

16. If yes for Q 15, what kind of green feed you provide and how many times per week?

_____,_____,_____,_____.

17. What is the source of water?

1. Hole water 2. River 3. Tap water 4. Pond water 5. If others (specify)___.

18. How frequently do you provide water?

1. Free access 2. Morning only 3. Morning and evening only

4. Morning, afternoon and evening 5. If other (specify) _____

19. How do you provide water?

-_____

-_____

20. How much money you spent for the provision of feed for your poultry per one egg laying cycle? _____?

21. What type of drinker is used on the holding?

a. Nipple b. Nipple with cup c. Bell

D. Disease and biosecurity measures

1. Do you experience serious disease outbreaks? 1. Yes 2.No
2. What do you do when birds fall to sick?

a) Treat them myself b) Call in the vet. Doctor c) Kill them immediately

d) Consume them immediately e) Sell them immediately f) other, specify--------

3. Describe the common diseases you have experienced in your flock.

Name of disease	Symptoms	Favorable seasons	Local Treatment/modern treatment
1.			
2.			
3.			
4.			

4. Do you practice annual vaccination of your chicken? 1. Yes 2. No
5. Against which diseases vaccinate your chicken?
   1. Newcastle diseases 2. Marek's Disease 3. Fowl thiphoid
   4. Gumboro (infectious bursa disease) 5. Infectious bronchitis
6. Do you use anti-ectoparasites? 1. Yes 2. No
7. Do you practice deworming? 1. Yes 2. No
8. How much money you spent for veterinary treatment?_____
9. Do you have dedicated boots for the poultry house?
   1. Yes 2. No
10. Are foot dips available at the entry of each poultry house?
   1. Yes 2. No
11. What is the average downtime between layer batches in days?_____.
12. Do you have a cleaning and disinfection programme for the houses?
   1. Yes 2. No
13. Do you have a programme for rodent control?
   1. Yes 2. No
14. How long does it take to depopulate one house during clearance?
   (Maximum number of hours between starting and finishing depopulation in one house)
   _____?
15. Approximately how many people, on average, enter the house (or have direct contact) with a flock during one crop cycle?_____.

E. Culling and mortality

1. Do you purposely cull your birds at any time? 1. Yes 2. No
2. For what purpose do you cull the poultry?
   1. For consumption 2. For sale 3. Other specify----------
3. What factors determine which bird you will cull?
   1. Poor productivity 2.Old age
   3. Sickness 4.Other, specify----------
4. At what age of the bird do you decide to cull and sell it? _____

5. How much you sell the culled birds? Price/bird_____.

6. Do you have a loss of birds in your farm 1. Yes 2. No

7. If yes how many birds died per day_____? Per week_____? Per month_____?

8. Number of birds survived to the end of laying period_____?

F. Marketing

1. Do you have market access to buy poultry production inputs? 1. Yes 2. No

1.1 If no for Q2. What are the main problems?_____.

2. Where do you buy poultry production inputs?

1. NGO 2. Government 3. Private companies 4. If others (Specify)

_____, _____,_____

3. Do you have market access for your poultry products? 1. Yes 2. No

4. To whom are you selling your poultry products?

1. Restaurants 2. Pastries 3. Snacks houses 4. Private consumers

5. Local retail shops 6. Whole sellers 7. Supermarkets 8. Retailers

5. What is your reason of choice the above customers?

1. Near home/farm 2. Better price 3. Regular clients 4. Others,specify

6. Which breed type of egg you preferred for consumption?

1. Eggs from exotic breeds 2. Eggs from local chicken 3. Equally preferred

7. Which breed of chicken meat you preferred for consumption?

1. Exotic breed 2. Local chicken

3. Equally preferred by consumers

8. Frequency of egg consumption

1. Once a week 2. Twice a week 3. Three times a week

4. More than 3 times a week

9. Frequency of chicken meat consumption

1. Once a year 2. Twice a year 3. Three times a year

4. Morthan three times a year

10. How do you transport poultry products to markets?

1. Using vehicle 2. Using hand on foot 3. Others specify_____

11. How do you transport the major farm inputs(birds and feeds)

    1. Using vehicle 2. Using hand on foot 3. Others specify_____

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

    -

    -

13. State the average unit price of the poultry products that you sell?

Products	Year round	Christian festival	Muslim festival	New year celebration
Live chicken				
Eggs				

14. How much money you spend for the poultry farming per month?

    1. Purchase of feed_____(birr/month)
    2. Purchase of veterinary drugs_____ (birr/month)
    3. Labor _____(birr/month)
    4. Transporting the products_____(birr/month)
    5. Other miscellaneous costs_____ (birr/month)

15.How much money you get from the sale of poultry products per month? _____

16. What are the major constraints you faced during purchasing of poultry products?

List of constraints	Rank (1-3)
1.	
2.	
3.	
4.	
5.	
6.	
7.	

17. What are the major constraints you faced during selling of poultry products?

List of constraints	Rank (1-3)
1.	
2.	
3.	
4.	
5.	

G. Poultry egg production performance

1. Production performance

No.	**Variables**	
1	Age at first egg(wks)	
2	Age at peak of lay(wks)	
3	Hens housed at lay	
4	Birds available at peak of lay	
5	Birds available in the flock	
6	No of eggs produced per day	
7	No of eggs at peak of lay	
8	Length of lay (wks)	
10	Mortality at growing	
11	Mortality at laying	

2. Do you let your flock to molt for the 2nd cycle?

   a. Yes b. no

3. If yes for Q 2, why_____

4. If yes for Q2, what kind of mechanisms you use to molt the birds?

5. If no for Q 2, give reason you not let to molt?_____

H. Institutional support and extension services

1. Do you have access to extension services?

   1. Yes 2. No

2. How frequently do you see the extension agent or the sub-city agricultural officers?

   1. Once in a week 2. Once in two weeks 3. Once in a month 4. Not Seen

3. Have you ever discussed your poultry production and related problems with urban and sub- city agricultural officers?

   1. Yes 2. No

4. If you say No for Q.3, what are the reasons?

   1. Have no heard of them 2. Cannot easily reach them

   3. There is no need 4. If others (specify) _____

5. Is there any institutional support to your poultry farming?

   1. Yes 2. No

6. If yes for question 5, what kind of benefits obtained from the institution?

   1. Veterinary service 2. Input supply

   3. Training 4. Credit service

7. Have you ever got any training on poultry production? 1. Yes 2. No

8. If yes, for Q. 6. When?

   1. Before starting the business 2. After the business started

9. If yes, for how long you took the training?

   1.Few days 2. Few weeks 3. One month 4. Greater than 1 month

10. Training provided by

    1. Urban agriculture offices 2. NGO 3. Other, specify_____

11. Did you get credit service when you start poultry business? 1. Yes 2. No

12. If yes for Q 10, for what purpose did use the credit?

    1. Purchase of Day old chicks 2. Purchase of Poultry feed

    3. Purchase of Poultry equipment 4. If others (specify) _____

13. Do you have access to credit currently?

    1. Yes 2. No

14. If yes for Q12, where do you get the credit?

    1. Micro and small scale enterprises 2. Banks 3. NGOs 4.others specify_____

I. WASTE MANGEMT PRACTICES

1. What are the common wastes in your farm?

   1. Litter/manure 2. Manure 3. Dead birds 4. others, specify_____

2. What type of floor you used in your poultry house?

   1. Cemented 2. Non-cemented 3. Others, specify_____

3. What type of litter material you used?

   1. Teff straw 2. Wood shavings 3. Others, specify_____

4. Household labour allocation in removing poultry waste

Activities	Husband	wife	Young daughters	Young sons	Others, specify
Poultry waste removal					

5. If you are using cage housing, how do you remove the manure in your farm?

_____

_____

_____

6. How frequently you remove the manure?

   1. Every day 2. Every week 3. Every month 4. Every 2 month

   5. Every 3 month 6. Every 4 month 7. Others, specify_____

7. If you are using floor system, how do you remove the litter / manure in your farm?

_____

8. How frequently you remove the litter/manure?

   1. Every day 2. Every week 3. Every month 4. Every year

9. How do you transport the manure and or litter of your farm**?**

   1. Using hand 2. Wheelbarrow 3. Others, specify_____

10. What kind of disposal methods you used to remove manure/litter?

    1. Giving it to other farmers 2. Used it to fertilize their own garden farm

    3. Disposed it in the dumping site 4. Marketing for use as a fertilizer

    5. Others, specify_____

11. What kind of disposal methods you used to remove dead birds?

    1. Burial 2. Composting 3. Burning 4. Throw away to dogs 5. others, specify_____

12. What kind of material you used to remove manure and or litter?

    1._____

    2. _____

    3._____

13. What are the major challenges of poultry waste disposal in your farm? List and rank them accordingly.

List	Rank(1-5)
1.	
2.	
3.	
4.	
5.	
6.	
7.	

14. What should be done for proper poultry waste management practice?

J. Constraints and opportunities

1. Do you face constraints in practicing urban poultry production?

   1. Yes 2. No

2. If yes for Q 1. What are the main constraints? List and rank according to their importance

No	List the constraints	Rank (1-5)
1		
2		
3		
4		
5		
6		
7		

3. If yes for Q 1, do you have problem in getting the land?

1. Yes 2. No

4. Do you have sufficient area of land to implement your activity?

1. Yes 2. No

5. Threats to urban poultry farming

1. Displacement from residence 2. Diseases 3. Increase in price of feed

4. Compliant from neighbor's 5. Big poultry farms market interference

6. Others, specify_____.

6. Do you intend to expand poultry production?

1. Yes 2. No

7. If yes, to what size? _____

8. What are your barriers to future expansion of poultry production?

1. Lack of capital 2. High price of feed 3. Shortage of land

4. Poultry housing construction regulation 5. Inadequate supply of pullets

6. Others, specify_____.

9. is there any regulation concerning the raising of poultry in your residential area?

1. Yes 2.No

10. If yes for Q 14, what type of regulations is this?

11. What do you think the government should do to improve poultry keeping, particularly in urban areas?

_____

_____

_____

K. Record keeping

K.1.Production records

1. Do you make production records of your farm
   a. Yes b. no
2. If yes for Q1 on what basis you collected the records?
   a. daily basis b. weekly basis c. monthly basis
3. If yes for Q1. Why you keep the production record? Give reason
   -
   -
4. Do you record the number of eggs produced per day?
   a. Yes b. no
5. Do you record the amount of feed given per day?
   a. Yes b. no
6. Do you record the type of drugs/vaccines given?
   a. Yes b. no
7. Do you record the mortality of birds?
   a. Yes b.no
8. Do you make inventory of birds regularly?
   a. Yes b. no

K.2. Financial records

1. Do you make financial records of your farm?
   a.Yes b. no
2. If yes for Q1 on what basis you collected the records?
   a. daily basis b. weekly basis c. monthly basis

3. If yes for Q1. Why you keep the financial record? Give reason

-

-

4. Do you record the income from sale of eggs?

a.Yes b. no

5. Do you record the income from sale of birds?

a. Yes b. no

6. Do you record the expenditure on feed/feed ingredients purchased?

a. Yes b. no

7. Do you record the expenditure on drugs/vaccines?

a. Yes b. no

Questionnaire for Poultry products utilization by Restaurants

1. Who are your major sources of eggs?

   a. Producers (farm) b. retailers' c. whole seller's d. supermarkets

   e. others, specify_____

2. Reasons for choosing this source?

   a. low price b. have confident on sellers c. regular client d. near to the restaurant

   e. others, specify _____

3. Who are your major sources of chicken?

   a. Producers b. retailers' c. whole seller's d. supermarkets

   e. others, specify_____

4. Reasons for choosing this source?

   a. low price b. have confident on sellers c. regular client d. near o the restaurant

   e. others specify _____

5. Frequency of purchasing eggs and chicken meat

   - Eggs a. daily b. twice a week c. Weekly d. every 15 days
     e. every month
   - Chicken meat a. daily b. twice a week c. weekly d. every 15 days
     e. every month

6. How many number of eggs you purchased at one time?_____

7. How much number of poultry products you used per day for preparation of food item?

   a. Eggs per day_____?

   b. Chicken meat per day_____?

8. What kind of chicken meat you purchased?

   a. live chicken b. Dressed chicken meat

9. Reason for choosing live chicken?

   a. low price b. fresh c. easy to cook d. others, specify_____

10. Reason for choosing dressed chicken? Give reason

    -
    -
    -
    -

11. How much you purchased the poultry products?

Item	Price in birr
Live exotic chicken	
Live local chicken	
Dressed exotic chicken meat	
Dressed local chicken meat	
Eggs local	
Eggs exotic	

12. What type of major food items produced from poultry products and it price?

Food items from chicken meat	Price in birr	Food items form eggs	Price birr
1.		1.	
2.		2.	
3.		3.	
4.		4.	
5.		5.	
6.		6.	

13. Which chicken breed you purchased mostly for making food items?

a. Local chicken b. exotic chicken

14. Which chicken eggs you purchased mostly for making food items?

a. local eggs b. exotic eggs

15. Which type of chicken meat is more preferred for making food items?

a. Local chicken meat b. Exotic chicken meat c. equally preferred

16. If your answer is exotic chicken meat what are the reasons exotic chicken is more preferred?

a.Bigger size b.ease of preparation c. taste d. others, specify_____

17. Which type of egg is more preferred for making food items from poultry egg?

a. Eggs from local chicken b. Eggs from exotic c. equally preferred

18. If your answer is eggs from exotic what are the reasons eggs from exotic chicken is more preferred?

a. Bigger size b. less chance of spoilage c. taste

d. yolk color e. others, specify_____

19. If your answer is eggs from local what are the reasons eggs from local chicken meat is more preferred?

a. taste b. flavor c. yolk color d. others, specify_____

20. If your answer is local chicken meat what are the reasons local chicken meat is more preferred?

a. taste b.ease of preparation c. flavor d. others, specify_____

21. Which food item/menu is more preferred by customers?

a. Food from local chicken product b. Food from exotic chicken product

22. Do you think making food items/menu from poultry eggs is profitable?

a. Yes b. No

23. Do you think making food items from poultry meat and egg is profitable?

a.Yes b. No

24. If no for Q 21 and 22, what are the reasons?

_____
_____
_____
____.

25. If yes for Q 21 and 22, what are the reasons?

_____

26. What are the main constraints in purchase of poultry products? (List and Rank)

List of constraints	Rank (1-3)
1.	
2.	
3.	
4	
5.	

27. How is the probability of getting spoiled eggs from purchased eggs?

a. high b. less c rare d. no

28. How many of it is spoiled_____?

Questionnaire for Poultry products utilization by Pastry

1. Who are your major sources of eggs?

   a. Producers b. retailer's c. whole seller's d. supermarkets

   e. others, specify_____.

2. Reasons for choosing this source?

   a. low price b. have confident on sellers c. regular client

   d. near the pastry e. others specify _____

3. Frequency of purchasing eggs?

   a. every day b. twice per week c. every week d. every 15 days

   e. every month f. others, specify_____

4. How many number of eggs you purchased at one time?_____

5. How much you purchased the eggs (price in birr/egg)?_____

6. How many number of eggs you used per day for making cakes?_____

7. Which type of egg is more preferred for making cake?

   a. Local chicken egg b. Exotic chicken egg c. equally preferred

8. Reasons for choosing exotic eggs?

   a. Bigger size b.Less chance of spoilage c. taste

   d. yolk color e. others, specify_____

9. What type of major cake produced from poultry eggs and it price?

Types of Cakes	Price
1.	
2.	
3.	

10. How is the probability of getting spoiled eggs from purchased eggs?

    a. high b. less c rare d. no

11. How many of it is spoiled_____?

12. What are the constraints in purchase of eggs? list and rank

List of constraints	Rank (1-3)
1.	
2.	
3.	
4	
5.	

Questionnaire for Poultry products utilization by Snacks houses

1. Who are your major sources of eggs?

   a. Producers b. retailer's c. whole seller's d. supermarkets

   e. others, specify_____

2. Reasons for choosing this source?

   a. low price b. have confident on sellers c. regular client

   d. proximity e. others specify _____

3. Frequency of purchasing eggs?

   a. every day b. twice per week c. every week d. every 15 days

   e. every month f. others, specify_____

4. How much you purchased the eggs (price in birr)

   Eggs local _____?

   Eggs exotic_____?

5. How much number of eggs you purchased at one time?)_____.

6. How many number of eggs you used per day for making food items?_____

   Eggs local _____

   Eggs exotic_____

7. Which type of egg is more preferred for making food items from poultry eggs?

   A.Eggs from local chicken b. Eggs from exotic c. equally preferred

8. If your answer is eggs from exotic what are the reasons eggs from exotic chicken is more preferred? If your answer is local what are the reasons?

   a. bigger size b. less chance of spoilage c. taste

   d. yolk color e. Others, specify

9. Which food item made from eggs is more preferred by customers? Give reason

   a. food form local eggs b. food from exotic eggs

10. For Q9, if your answer is exotic give reason_____

11. For Q9, if your answer is exotic give reason_____

12. Do you think making food items/menu from poultry eggs is profitable?

    a. Yes b. No

13. If no for Q 12, what are the reasons?

14. How is the probability of getting spoiled eggs from purchased eggs?

a. high b. less c rare d. no

15. How many of it is spoiled_____?

16. What type of food items produced from poultry eggs and it price

Food items form eggs	Price birr
1.	
2.	
3.	
4.	
5.	

17. What are the constraints in purchase of eggs? List and rank

List of constraints	Rank (1-3)
1.	
2.	
3.	
4	
5.	

Questionnaire for interviewing urban consumers at restaurants and snacks houses

1. Which types of chicken eggs you preferred for consumption?

   a. local eggs b. exotic eggs c. equally preferred

2. If you preferred exotic eggs, give reason

   -

   -

   -

3. Which types of chicken meat you preferred for consumption?

   b. Local chicken meat b. Exotic chicken meat c. equally preferred

4. If you preferred exotic chicken meat, give reason.

   -

   -

   -

5. How frequently you consumed food made of eggs?

   a. Once a week b. Twice a week c. Three times a week

   d. More than three times a week

6. How frequently you consumed food made of chicken eggs?

   a. Once a year b. Twice a year c. Three times a year

   d. More than three times a year

Questionnaire for interviewing collectors

1. Who are your suppliers of chicken meat and eggs?

Live Chicken = a. Farmers b. retailers c. others, specify_____

Eggs = a. Farmers b. retailers c. others, specify_____

2. Prices of chicken and eggs

	Christian festival	Muslim festival	Year round	New year festival
a. Exotic chicken	_____	_____	_____	_____
b. Local chicken	_____	_____	_____	_____
c. Exotic eggs	_____	_____	_____	_____
d. Local eggs	_____	_____	_____	_____

3. What are the main problems in getting chicken products?

-

-

-

-

4. Who are your major customers?

a. Private consumers b. hotels and restaurants

c. pastries d. others specify____

Questionnaire for interviewing Supermarkets

1. Who are your suppliers of slaughtered chicken meat and eggs?

   Chicken = a. producers b. whole sellers c. retailers d. others, specify_____

   Eggs = a. producers b. whole sellers c. retailers d. others, specify_____

2. Slaughtered chicken meat and eggs prices?

	Christian festival	Muslim festival	Year round	New year festival
a. Exotic chicken	_____	_____	_____	_____
b. Local chicken	_____	_____	_____	_____
c. Exotic eggs	_____	_____	_____	_____
d. Local eggs	_____	_____	_____	_____

3. What are the main problems in getting slaughtered chicken?

-
-
-
-
-

4. What are the main problems in getting exotic eggs?

-
-
-
-
-

5. Who are your major customers?

   a. Private consumers b. hotels and restaurants

   c. pastries d. others specify____

Questionnaire for key informants

1. Who are mostly engaged in urban poultry production in the sub-city?

-

-

-

2. Why people are engaged in urban poultry production?

-

-

-

3. What kind of government support is rendered to the urban poultry keepers and what would be

its future perspective? Particularly contribution of small and micro finance institutions.

- supports

- Future perspectives

- Contribution of small and micro-finance institution

4. What are the challenges faced by the urban poultry keepers in the process of production,

and marketing of the products?

5. What do you think about the solutions for those challenges faced by the urban poultry keepers?

-

6. What are the opportunities for urban poultry production in the sub city?

-

7. What are the challenges faced by the government offices that are working with poultry production?

-

8. What will be the future fate of urban poultry production versus the challenges faced by the sector now a days?