STUDIES ON PRODUCTION AND MARKETING SYSTEMS OF LOCAL CHICKEN ECOTYPES IN BURE WOREDA, NORTH-WEST AMHARA

M.Sc. THESIS

FISSEHA MOGES ASSEGIE

HAWASSA UNIVERSITY, AWASSA, ETHIOPIA

FEB., 2009

STUDIES ON PRODUCTION AND MARKETING SYSTEMS OF LOCAL CHICKEN ECOTYPES IN BURE WOREDA, NORTH-WEST AMHARA

FISSEHA MOGES ASSEGIE

A THESES SUBMITTED TO THE

DEPARTMENT OF ANIMAL AND RANGE SCIENCES

HAWASSA COLLEGE OF AGRICULTURE, SCHOOL OF GRADUATE STUDIES

HAWASSA UNIVERSITY, AWASSA, ETHIOPIA

IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF

MASTER OF SCIENCE IN ANIMAL AND RANGE SCIENCE

(SPECIALIZATION: ANIMAL PRODUCTION)

MAJOR ADVISOR: ABERA MELLESSE (Ph.D)

CO-ADVISOR: TADELLE DESSIE (Ph.D)

FEB, 2009

ACKNOWLEDGEMENT

I would like to pass my great gratitude and thanks to those individuals, interviewed chicken producer farmers and institutions that were involved directly or indirectly in this work so that my study came to success.

First of all, my deepest appreciation and heart felt thanks goes to my major research advisor, Dr. Abera Melesse, for spending his precious time to give me constructive and regular advice, to visit the research area and to correct this document from the very beginning to end. I also would like to express my honest gratitude to my research co-advisor, Dr.Tadelle Dessie, for his invaluable support and constructive comments he has made on my research proposal and for the final thesis write-up.

My genuine thanks go my institute, Amhara Region Agricultural Research Institute for giving me a study leave and all round support. Many special thanks are due to Dr. Getachew Alemayehu, Director General; Dr. Eshete Dejen, Livestock Research Director and Ato Demis Teshager, administration head, in ARARI for overall facilitation and help in my thesis work.

I would also like to extend my thanks to the sponsor organization, the International Livestock Research Institute (ILRI), particularly to the improved productivity and market success (IPMS) project, for financing my study.

I wish to acknowledge and express my honest thanks to all surveyed chicken owner farmers of the study area, development agents of the selected farmer kebeles, Burie wereda livestock experts and IPMS-Burie staffs members for their great role they have played during research site selection, registration of chicken producer farmer and data collection.

I am grateful to Andassa Livestock Research Center (ALRC) staff members; Tekeba Eshete (M.Sc), centre manager, for his invaluable support and facilitation of my thesis work. I also would like to express my heart felt thanks to Dr. Halima Hassen, for her regular advises and spending her precious time to comment my thesis. I also appreciate the valuable assistance of colleagues, Eyaya Molla, Demelash Dagnew, Wondemeneh Mekonnen, Asresu Yitayew, Zelalem Kifle and Mesafint Bezabih during the course of field data collection.

I am greatly indebted to Awassa College Agriculture (ACA) staff members; Fassil Bekele, for his honest help in lending me all the equipments used for egg quality analysis and Kefeyalew Berihun (M.Sc), for his all round support during my study times. I am also grateful to all my friends and classmates for the good relationship we had during our study time.

Last but not the least; I owe special thanks to my wife, Degitu Alemu and children, Yome Fisseha and Mahilet Fisseha, for their patience and endurance during my absence from home.

Above all, I give glory to God Almighty for giving me strength and seeing me through this task successfully.

DECLARATION

I declare that this thesis is my original work and that all sources of material that are used for this thesis have been duly acknowledged. This thesis has been submitted in partial fulfillment of the requirements for an MSc degree at Hawassa University and is deposited at the university library to be made available to borrowers under rules of the library. I solemnly declare that this thesis is not submitted to any other institution anywhere for the awards of any academic degree, diploma or certificate.

Brief quotations from this thesis are allowable with out special permission provided that accurate acknowledgment of source is made. Request for this manuscript in whole or in part may be granted by the head of the major department or the dean of the School of Graduate Studies when in his or her judgment the proposed use of the material is in the interest of scholarship. In all other instances, however, permission must be obtained from the Author.

LIST OF ABBREVIATIONS

AH	Albumen height
ANRS-BoARD	Amhara National Regional State Bureau of Agriculture and Rural Development
ANRS-BoFED	Amhara National Regional State Bureau of Finance and Economic Development
CSA	Central Statistical Authority
EL	Egg length
ESAP	Ethiopian Society of Animal production
EW	Egg width
EWt	Egg weight
FAO	Food and Agriculture Organization of the United Nations
FAOSTAT	Food and Agricultural Organization Statistics
FRLC	Free range local chickens
g	gram
ha	Hectare
HH	Household
HU	Haugh unit
IBD	Infectious Bursal Disease
ILCA	International Livestock Research Center for Africa
ILRI	International Livestock Research Institute
IPMS	Improving Production and Marketing Success

Km	killo meter
masl	meter above see level
N	Number
NCD	New castle Disease
NS	Not significant
%	Percentage
PRA	Participatory Rural Appraisal
RIR	Rhode-Island Red chicken breeds
SD	Standard Deviation
SFRB	Scavengeable Feed Resource Base
SI	Shape index
SNNPRS	Southern Nations, Nationalities and Peoples Regional State
SPSS	Statistical Package for Social Sciences
TLU	Tropical Livestock Unit
WLH	White-Leg Horn chicken breeds
YH	Yolk height
YW	Yolk width

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF TABLES IN APPENDICES

DEDICATION

This thesis work is dedicated to the Almighty God, who gave me all the strength and courage.

ABSTRACT

A repeated and cross sectional survey together with egg quality analysis was conducted in seven selected farmer's kebele of Burie wereda, located in West Gojam administrative zone of Amhara National Regional State (ANRS), Ethiopia. The objective of the study was to assess the existing chicken production, quality of local egg and marketing systems of the wereda. A participatory rural appraisal (PRA) and a formal survey with structured questionnaire were used to collect all the relevant data, using a multi-stage sampling technique (purposive and random). Seven farmer kebeles (2 from high land, 3 from mid-altitude and 2 from low land agro-ecologies) and a total of 280 village chicken owner households were considered for the production system study. In addition; 30 middle men (chicken and egg collectors) and 600 local hen eggs, collected from markets and producers, were considered for marketing system and egg quality studies, respectively. The result of the study revealed that the dominant (83%) chicken production system of the study wereda was an extensive/traditional type of production, using a majority (97%) of local chickens ecotypes, managed mainly on scavenging with seasonal supplementation of homegrown grains and household food refusals. The purpose of village birds, in order of importance, were; sale for cash income (51.4%), egg hatching for replacement (45%), home consumption (44.3%), use of birds for socio-cultural and/or religious ceremonies (36.4%) and egg production (40.7%). Hatching for replacement (71.7%), sale for income (58%) and home consumption (68.6) were the purpose of eggs, in order of importance, identified in the study area. The average chicken flock size/household was 13 birds (ranged 1-57), with a hen to cock ratio of 3.7:1. Only 22.1% of village chicken owners prepared separate overnight houses to village birds and the rest (77.9%) kept birds in various night sheltering places. The current study revealed that 97.5% of village chicken owners of the study area experienced chicken disease problems in their vicinity, mainly Newcastle disease (98.2%). The study result indicated that 95% of village chicken owners used only traditional (Ethno-veterinary) means to treat sick birds. Provision of a mixture of local alcohol, lemon and onion was identified to be the most favored traditional treatment practiced by most chicken owners (42.9%) of the study area. The average age of local cockerels at first mating and pullets at first egg were 24.6 weeks and 27.5 weeks, respectively. The average number of eggs laid/clutch of local hens was 16 eggs (ranged 8-28) and the number of total clutch periods/hen/year was 4 (ranged 2-6). The annual egg production performance of local hens, under the existing farmer's management condition, is 60 eggs/hen (ranged 24-112). The average number of eggs incubated/hens was 13 and 11 chicks, on average, were hatched from it. The average hatchability performance of local broody hens, from the whole eggs set, was 81.7%. However, survivability of young chicks, up to grower age, was only 60.5% (ranged 0-100%). High hatchability performance of local hens (81.7%) and high mortality of young chicks (39.5%) were the two contradictory features of the existing village chicken production system of the study area. Seasonal outbreaks of diseases (84.3%) and predation (11.4%) were the major causes for loss of chicks in the study area. Women were the major responsible member of the household and involved in various village chicken husbandry activities like; cleaning bird's house (38.6%), feeding birds (80.7%), selling birds (82.9%) and selling eggs (54.6%). However, men were involved mainly on shelter construction (97.5%) & taking sick birds for treatment (89.3%).

Only 37.5% of chicken owners reported getting appropriate extension service related to chicken management practices. Producer-Consumer, Producer-Assembler, Assembler-Retailer (Local restaurants), Assembler-Consumer were the prevailing chicken and egg marketing channels of the study area. Village chicken owners traveled on average, a distance of 5.5 km and 15.9 km to reach to nearby local markets and urban markets, respectively. 49% of local hen eggs collected from of the study area were white shelled, 45% were light brown shelled and 6% were cream color shelled. The mean egg weight was 43g (ranged 34-60g) while the average width and length of eggs was 37.2mm and 50.8mm, respectively. Thus the average shape index percentage was calculated to be 73.2%. The mean Hough unit was calculated to be 66.5 (ranged 36.4-84.8). The mean shell thickness measurements for sharp region, equatorial region and blunt region of eggs were 0.27mm, 0.26mm and 0.24mm, respectively. Hence the average egg shell thickness was calculated to be 0.26 mm. A significant and positive correlation ($p<0.01$) was found between egg weight and other external egg quality traits like; egg width (0.49), egg length (0.45) and egg shell weight (0.52). Albumen height (0.41) and yolk height (0.38) showed a significant and positive correlation ($p<0.01$) with Hough unit. However egg weight (-0.13), egg width (-0.23) and egg length (-0.27) were negatively correlated ($p<0.01$) with Hough unit. The result of the study revealed that all interviewed chicken owners showed a great interest to boost up the existing village chicken production and productivity. This should be considered as an opportunity and prospective to design and implement interventions, aiming at improving production and productivity of chicken in the study area. Therefore; efforts have to be made to improve the productivity of village birds in sustainable ways and to shift the existing extensive production system to semi intensive one, focusing on market oriented production with a holistic and multi-disciplinary support of services like; health, husbandry, research, extension, training and credit interventions.

Key words: Village chicken production & marketing systems, local chicken's ecotypes, scavenging, internal and external egg quality traits, marketing channel.

1. Introduction

Animal production in general and chickens in particular play important socioeconomic roles in developing countries (Alders, 2004; Salam, 2005). Food securities, generation of extra cash incomes and religious/cultural considerations are amongst the major reasons for keeping village chickens by resource-poor rural communities. Nearly all rural and peri-urban families in developing countries keep a small flock of free range local chickens (Jens *et al*., 2004). However, most communities lack the required chicken husbandry skills, training and opportunity to effectively improve their household chicken production (Mlozi *et al.,* 2003).

Village chicken is also an integrated component of nearly all-rural, many peri-urban and some urban house-holds (Branckaert *et al*., 1999). The rural chicken population accounts for more than 60% of the total national chicken population in most African countries (Sonaiya, 1990). According to Robert *et al*. (1992) and Sonaiya (2005); small farming families, land-less laborers and people with incomes below the poverty line were able to raise chicken with low inputs and harvested the benefits of eggs and meat via scavenging feed resources.

In Ethiopia chickens are the most widespread and almost every rural family owns chickens, which provide a valuable source of family protein and income (Tadelle *et al.,* 2003). The total chicken population in the country is estimated to be 42.9 million (CACC, 2003). The majorities (99%) of these birds are maintained under a traditional system with little or no inputs for housing, feeding or health care. The most dominant chicken types reared in this system are local ecotypes, which show a large variation in body position, plumage color, comb type and productivity (Teketel, 1986; Tadelle *et al*., 1996; Halima *et al*., 2007).

Rural poultry in Ethiopia represents a significant part of the national economy in general and the rural economy in particular and contributes 98.5% and 99.2% of the national egg and chicken meat production, respectively (Tadelle and Ogle, 1996; Aberra, 2000). However, the economic contribution of the sector is not still proportional to the huge chicken numbers, attributed to the presence of many production, reproduction and infrastructural constraints.

About 99% of chicken owners of North-West Amhara provided supplementary feed to village birds once per day, mainly during feed shortage seasons (Halima, 2007). The greater part of the feed for village birds is obtained through scavenging, which includes; the household cooking waste, cereal and cereal by-products, roots and tubers, oilseeds, trees, shrubs, fruits and animal proteins (Tadelle *et al*., 1996).

The amount & availability of scavenging feed resource base (SFRB) per bird are significantly dependent on season, household grain availability, the time of grain sowing and harvesting and household flock size (Tadelle, 2004). According to Tegene (1992), these scavenging feed resources have their own nutritional values in terms of protein, amino acids and energy.

Based on measurement of household leftovers, SFRB could be estimated using the following equation as: SFRB = [H/P]*[n/T] where; SFRB = Scavengeable feed resource (g/chick/day), H = quantity of household leftover (kg/day), P = proportion of H in the crop content, n = total number of household in the village and T = total number of birds in the village (Roberts, 1992 and Sonaiya *et al*., 2002).

Similar to the national system; the major proportion of chicken production (98%) in Amhara region (ANRS) is a traditional sector, at small holder level, from which almost the whole annual meat and egg production is produced. Most rural families in the region kept village chicken and it has an important position in the rural house hold economy, supplying high quality food and generating income for rural farmers (ANRS-BoARD, 2006).

According to the recent agricultural census (CSA, 2005); there were around 13.4 million chicken population in Amhara region, accounting to 31.3% of the national chicken population. West Gojam administrative zone, where the study wereda is found, accounts to 15% of the regional chicken population (CSA, 2005).

According to Cumming (1992) and Panda (1987) only little research and development works have been carried out on village chickens, despite the fact that they are more numerous than commercial chickens in most developing countries and they have been marginalized by decision makers, which is certainly true in Ethiopia as well.

According to Gueye (1998) and Pedersen (2002); it is difficult to design and implement chicken-based development programs that benefit rural people with out understanding village chicken production and marketing systems. Hellin *et al*. (2005) also reported that understanding of village chicken functioning and marketing structure are a prerequisite for developing market opportunities for rural households and could be used to inform policy makers and development workers in considering the commercial and institutional environment in which village chicken keepers have to operate.

To date there were no any detailed studies conducted in the study wereda targeted on; a comprehensive description of the prevailing village chicken production and marketing systems, assessment of internal and external quality of marketable eggs, identification of economically important production and marketing constraints as well as assessment of appropriate technological interventions that could be affordable to the resource-poor with relation to the current chicken production systems of the study area.

Hence, study of the existing village chicken production and marketing system, productivity of local chicken ecotypes and identification of economically important production and marketing constraints of the study area will help to give important and feasible recommendation for further improvement of the system in a sustainable way.

The research results presented in this thesis work provided some detailed production, marketing and egg quality parameters in village chicken of Burie wereda. Moreover, some relevant management interventions needed to be considered to improve the system were presented. Therefore, this study was conducted with the following objectives;

General objective

- To assess the prevailing village chicken production and marketing systems of Burie wereda, North-West Amhara.

Specific objectives

1. To study the production and reproduction performance of local chicken ecotypes under the existing farmer's chicken management condition.
2. To asses the prevailing village chicken production and marketing constraints and suggest possible technological interventions.
3. To evaluate the external and internal qualities of local chicken eggs collected from different sources in the study area.

2. Literature Review

2.1. Agriculture in Ethiopia

Ethiopia is categorized as one of the poorest countries in the world with per capital income of 130 US Dollar (World Bank, 1996). The country has an estimated human population 82,544, 840 people, with annual growth rate of 3.2% (CSA, 2008). The human population is predicted to reach 114 million by 2030 (World Bank, 1999).

Agriculture is the dominant economic activity and way of life for the small and marginal farmer families and the main stay of the counter's economy and accounts for more than 80% of total employment. The contribution of the agriculture sector to country's GDP and export item is estimated to be 50% and 90% respectively (World Bank, 1999). In spite of its significant role, Ethiopian agriculture has been characterized with low level of productivity and growth rate especially as compared to the greater growth rate of the population.

The manufacturing sector relies heavily on the agricultural inputs (CSA, 2005). Development efforts are being hindered by rapid population growth, which negates the benefits of any economic growth (Winrock international, 1992). The present traditional and low input agricultural practices in Ethiopia, in the field of both crop and livestock production, not only results in poor agricultural productivity, but also in the degradation of the natural environment, upon which this productivity depends (Mohamed *et al.*, 1995).

According to Coppock (1994), Ethiopia could be roughly divided into two based on altitude namely; highland and lowland. Coppock (1994) also reported that pastoralism was the dominant farming system in the drought prone arid and semi-arid low lands of Ethiopia.

Ethiopian highlands were mainly characterized by mixed farming system, where favorable agro-climatic and low disease stress allows both crop and livestock production, which are complementary (Powell *et al.*, 1993; Deleeuw, 1997). Crop production is boosted by the use of draught power, manure and sale of livestock products to purchase agricultural inputs. On the other hand crop residues are important livestock feed resources. Ruminants, chicken and equines are the most important livestock species in this system due to their ability to utilize the resources, which might otherwise be wasted (Powell *et al.*, 1993). According to Steinback (1997) decreasing size of the land holdings/family, shrinking with generations has put huge pressure on the smallholder farmers for raising productivity in this system. Therefore, concentration of farmers on intensive and integrated agriculture seems to be the only option left to make agriculture a sustainable activity for livelihood & food security.

2.2. Livestock production in Ethiopia

Livestock is known to play an important role in social and cultural life of developing countries in general and in Sahelian countries in particular (Tadelle and Ogle, 1996). Ethiopia has the largest national total of ruminants and equines population in Africa including: 30 million cattle, 22million sheep and 23.4 million equines (FAO, 1999). On these resources; 20% of cattle, 25% of sheep, 73% of goats and 100% of camel were found in the low land pastoral areas of the country (Belachew *et al.*, 2003).

In Ethiopia the contribution of livestock and livestock product to the agricultural economy is about 30% and to export earning about 19%. The figure could even be higher if the non-monetary contributions are taken in to account (Azage & Alemu, 1998). Livestock play an important role in the livelihood of rural people by providing quality food (meet, eggs and milk) for household consumption and cash income, fiber, skin and wool. Hides and skins are important out puts, which are exported to earn foreign exchange (Getnet, 1999). In Ethiopia, the sales of livestock products represent the main sources of cash income for smallholder farmers (Mohamed and Fitzhugh, 1995; Gryseels, 1988).

Livestock promote livelihood security by diversifying risk and by generating cash through the sale of its products in time of need. Further more; livestock are closely linked to the social and cultural life of several million smallholder farmers for whom animal ownership ensures varying degree of sustainable farming and economic viability (Azage and Alemu, 1998). According to FAO (1995) livestock production system in Ethiopia is generally subsistence oriented and productivity is very low. The level of beef production productivity in the country (110 kg/head) was about 25-30% lower than East Africa (143 kg/head) or the continental overage of 156 kg/head. The annual off take rate was estimated as: 10% for cattle, 35% for sheep, 38% for goats and 6.5% for camel (Belachew *et al.*, 2003).

According to Zinash (1995) shortages of animal feed resources were the major bottleneck to livestock production in the high lands of Ethiopia, where natural pastors and crop resides were the major sources of feed to livestock. However, these feed resources were reported to be inadequate in quality and quantity to support reasonable livestock production.

Presence of poor genetic resources, prevalence animal disease, unfavorable socio economic factors and lack of appropriate livestock policy were the other most important key constraint affecting the productivity of livestock in Ethiopia (Mohamed and Abate, 1995).

Despite the low livestock productivity, the demand for animal products in developing country is likely to rise significantly as result of population growth, urbanization and raising family income. This increase in demand for livestock product raises profound implication for food security, poverty alleviation and the environment.

With this regard, several livestock projects have been implemented in Ethiopia to improve livestock productivity and fulfill the increasing demand. But a hard reality with respect to livestock development in the country is the fact that many formal livestock project have failed to meet their objectives. Many of the problems are the result of inability to identify and implement appropriate technologies and inability to define the livestock production practices and constraints (Beyene, 1998). Hence a careful planning is required for the generation of appropriate & demand driven technologies, in order to bring sustainable livestock development in the country.

2.3. Village chicken production in Ethiopia

The term poultry applies to a wide variety of birds of several species including; chicken, guinea fowls, pigeons, ducks, geese, turkeys, swans, peafowl, ostriches, pheasants, quails and other game birds. Chickens were originated in South-East Asia and introduced to the rest of the world by sailors and traders.

According to Koeslag (1992); village chickens were the result of centuries of cross-breeding with exotic breeds and random breeding within the flock and these different types are found in the smallholder chicken production systems of Africa, defined as family poultry.

According to Halima (2007) a substantial amount of phenotypic diversity for various traits in the indigenous chicken genetic resources of Ethiopia was expected because of presence of diverse agro-ecology, ethnic groups, socio-economic, religious and cultural considerations. In many developing countries the local gene pool still provides the basis for the poultry sector (Yakubu *et al.*, 2008).

Estimate on livestock in Africa shows that chicken population was the highest (Sonaiya *et al.*, 1998). Ethiopia is one of the few African countries with a significantly large population of chickens (Fikre, 2001). In sub-Saharan Africa, 85% of all households keep chicken under free range system, with women owning 70% of it, providing scarce animal protein in the form of meat and eggs as well as being a reliable source of cash income (Guéye, 1998; Sonaiya *et al.*, 2004; Bagnol, 2000; Ambali, 2007and Aklilu *et al.*, 2007).

According to Sonaiya (1990), Kitalyi (1998) and Reddy (1991) there are three chicken management systems in the world namely: intensive, semi-intensive and extensive, which are differentiated on the basis of flock sizes and input-output relationships. Alternatively, Bessei (1987) reported that family chicken were kept under a wide range of conditions, which could be classified into four broad production systems: free-range extensive, backyard extensive, semi-intensive and Intensive systems.

In many developing countries, chicken production is based mainly on traditional extensive production systems with local chicken ecotypes and low purchased-inputs (Gueye, 1998; Gueye, 2000 and Garcia, 2007). The extensive chicken production system in Africa, where birds are kept on free range, is different from the more recent extensive free range system coming up in developed countries, due to the hot chicken welfare issues (Thear, 1997).

In most part of Ethiopia, village chicken represents a significant component of the rural household livelihood as a source of cash income and nutrition. The birds scavenge in the vicinity of the homestead during daytime where they may be given cereal grains, cereal bran, broken grains and other house waste products as supplementary feed (Aklilu *et al.*, 2007).

The number of chicken flocks per household of most Ethiopian rural community is small in number and containing birds from each age group with an average of 7-10 mature birds, consisting of 2-4 adult hens, a male bird (cock) and a number of growers of various ages (Tadelle and Ogle, 1996).

2.4. Importance of village chicken production

The impact of village chicken in the national economy of developing countries and its role in improving the nutritional status and income of many smallholders has been very significant (FAO, 1997 and Ambali, 2007). According to John (1995) chicken were among the most adaptable domesticated animals and more people were directly involved in chicken production throughout the world than in any other single agricultural enterprise.

The local chicken sector constitutes a significant contribution to human livelihood and contributes significantly to food security of poor households and can be considered an initiative enterprise owing to its low cost (Gondwe, 2004; Abdelqader, 2007).

According to Moreki (2001) family chicken is rarely the sole means of livelihood for the family but is one of a number of integrated and complementary farming activities contributing to the overall well-being of the household. Village chickens were regarded as a walking bank by many families and were often sold to meet emergency cash needs.

Rising income and urbanization in many parts of the developing world caused a growing demand for alternative food resources like animal products. There are only few alternative animal protein sources available in the tropics including chicken and chicken products (Odunsi, 2003). The per capita chicken meat consumption in the Ethiopia is reported to be 2.85kg per annum and chicken meat was relatively cheap, available and affordable source of animal protein in the country (Alemu and Tadelle, 1997; Kenea *et al.*, 2003). However, the prices of chicken is showing an increasing trend time to time like other livestock products and could not be easily affordable by the poor if the situation continues.

According to Alam (1997) family chicken meat & eggs were estimated to contribute 20–30% of the total animal protein supply in low-income and food-deficit countries. Both chicken meat and eggs were affordable sources of protein and contribute to a well balanced diet to satisfy human needs. Village chicken could be particularly important in improving the diet of young children in Sub-Saharan Africa (Alam, 1997).

Chicken provide major opportunities for increased protein production and incomes for smallholder farmers because of presence of small generation interval, high rate of productivity, the ease with which its products can be supplied to different areas, the ease with which its products can be sold due to their relatively low economic values, its minimal association of with religious taboos and its complementary role play in relation to other crop-livestock activities (Muchenje *et al.*, 2000).

Village chicken keeping has a symbolic importance with the context of many economic, social and cultural activities and/or religious ceremonies. A specific sex and color of chicken were prescribed for most of these socio-cultural activities and cocks were the most popular sacrificial animals for religious purposes in many African countries (Gueye, 2000).

Furthermore; chickens and eggs came in small packages and could be stored in hot climates under local conditions more easily than most foods of animal origin. Eggs keep their quality at room temperature without spoilage for at least 10 days to 2 weeks if stored in cool places. Refrigeration is also not required for preserving chicken meat, as individual chickens can be easily kept alive until slaughtered for consumption (John, 1995).

According to Anders (1997), some of the important factors contributing in the continuing growth of the chicken industry in many countries included: the ease and efficiency of chicken to convert vegetable protein into animal protein, the attractiveness and acceptability of its meat, their competitive cost and the relative ease with which new technologies such as, health care systems can be transferred between countries and between farmers.

2.5. Production performance of village chicken

The productivity of village chickens production systems in general and the traditional/free range system in particular is known to be low (Kondombo, 2005). The productivity of local scavenging hens is low not only because of low egg production but also due to high chick mortality (Nigussie *et al.*, 2003). Teketel (1996) and Aberra (2000) also reported that the low productivity of local chicken was expressed in terms the following parameters; low egg production performance, production of small sized eggs, slow growth rate, late maturity, small clutch size with long laying pauses, an instinctive inclination to broodiness and high mortality of chicks.

The productive potential of indigenous chickens under an improved nutritional regime and disease free situation is well unknown (Sandra et al., 2005). According to Pandey (1992); scavenging hens lay only 30 eggs/year while industrialized battery cage hens lay up to 300 eggs/year. Furthermore, it may take up to 12 months to raise a chicken for consumption.

In Ethiopia native chicken produced 40 eggs/year (Tadelle *et al.,* 2000). Bessei (1987) also reported that village chicken, in Nigeria, produced 20-30 eggs/year under scavenging system with poor night shelter and no regular feed and water supply. The average egg weight of local hens around Arsi, Ethiopia, was reported to be 38g (Brannang and Persson, 1990). The average number of eggs/clutch in Burkina Faso local hens was estimated to be 12 eggs (Salam, 2005), which is comparable to the range of 12-18 eggs indicated by Gueye (1998), but it is higher than that of 10 eggs/clutch reported by Mourad *et al.* (1997) in Guinea and 9 eggs/clutch in Mali (Kuit *et al.,* 1986).

Halima (2007) reported an average of 9-19 eggs/clutch with 2-3 clutches periods/hen/year and an average total egg production ranged 18-57 eggs/year/hen for eight chicken ecotypes found in North-West Amhara.

Moreki (2001) also reported an average number of clutch/year of 3, with an average of 15 eggs/clutch and a total egg production of 46 eggs/hen/year, in a study conducted on small-scale chicken production systems in Botswana. According to Khalafalla *et al.* (2001) the average number of clutches/hen/year and number of eggs/clutch of Sudan local chicken ecotypes were 3 (ranged 1-6) and 12 eggs (ranged 2-20), respectively. The study also showed that about 78% of incubated eggs were hatched and 75% of which survived the brooding period.

Egg production and feed conversion comparisons between local and improved exotic breeds have shown the superiority of the later even when tested under the climatic and management conditions of the local breeds (Teketel, 1986). Sazzad (1992) reported that the introduction of high yielding exotic chicken breeds and their crosses into the scavenging and semi scavenging system resulted in a higher egg yield of exotic breeds compared to indigenous hens under both scavenging and semi scavenging conditions, but this was accompanied by a high mortality rate in the scavenging situation.

According to Bessei (1987) some improved breeds have shown to do well or even better under extensive chicken management condition. Rahman *et al.* (1997) reported that RIR x Fayoumi had highest egg production and highest profit/hen under semi-scavenging condition among 8 breed combinations.

According to Sazzad (1992) the average egg production/hen/year, egg weight (g), number of eggs/clutch, number of clutch periods/year and hatchability (%) of Bangladesh local chickens of under indigenous management was ranged 35–45, 35–39, 3–4, 10–15, 84–87, respectively. According to Sonaiya *et al.* (1999), Aini (1999) and Gueye (2000) the annual egg production/hen of local hens in village conditions ranged 20-100 eggs, with an average egg weight ranged 30-50g.

According to Guèye (2000) the adult male and female weight of African village chicken ranged 1.2-3.2kg and 0.7-2.1 kg, respectively. Village chickens reached a market weight of 1-1.5kg at the age of 4-5 months in South-East Asia (Aini, 1999). The productivity of Guinea local chickens, as reported by Mourad *et al.* (1997), was presented in table 1.

Table 1. Productivity of local chickens in Guinea (N = 166)

Production parameters	Mean ± SE
Age at first laying (days)	180 ± 17
Number of egg/clutch	10.05 ± 0.15
Number of total clutches/year	3.78 ± 0.07
Hatchability performance (%)	83 ± 1
Average egg weight (g)	30.74 ± 0.03

- SE = standard error
- Source: Mourad *et al.* (1997)

2.6. Constraints of village chicken production system

The most striking problem in relation to village chicken production system is high mortality rate of birds, which might be as high as 80-90% within the first few weeks after hatching, due to diseases & predation (Wilson *et al.*, 1987). Newcastle disease (NCD) is highly infectious and causes more losses than any other diseases in the tropics which spread rapidly through the flock and mortality can reach up to 100% (John, 1995).

Newcastle disease (NCD) is believed to be the most devastating chicken disease in free-range systems and the main cause of the high chicken mortality irrespective of age and sex, which occurs almost any time of the year (Aini, 1999; Nigussie *et al.*, 2003; Serkalem *et al.*, 2005 and Nwanta *et al.*, 2008). Among the infectious diseases NCD, salmonelloses, coccidioses and fowl pox are considered to be the most important causes of mortality to local chickens while predators are an additional causes of loss (Eshetu *et al.*, 2001).

In Ethiopia chicken disease is considered to be the most important factor responsible for reducing both the number and productivity of village chickens. According to Tadelle *et al.* (2001) high mortality of chicks due to diseases, parasites, predation, lack of feed, poor housing and insufficient water supply was the major constraints on village chicken production in the central highlands of Ethiopia.

Poor availability of feed resources, in terms of both quantity and quality, is the other major constraints affecting production and productivity livestock including village chicken (Mohamed *et al*., 1995).

In addition to above mentioned constraints; Singh (1990) reported other vital problems affecting the productivity of village chicken including: low productivity of local breeds (attributed to low genetic potential, disease and poor chicken management practices), poor extension services and inadequate credit facilities, availability of few or limited research activities and lack of organized marketing and processing facilities.

2.7. Marketing systems of village chicken and egg in Ethiopia

The term marketing referred to all activities from the producer to the final consumer including processing and distribution systems. The type and amount of product, the size of producers, the marketing infrastructure and the policy/institutional environments all determine the type of marketing system and the effectiveness with which it operates (ILRI, 1995).

In Ethiopia selling of chickens and eggs is one of the functions of keeping free-range chickens by smallholder farmers. Village birds and eggs were taken by producer farmers to the local and urban markets and sold to traders (collectors) or directly to consumers depending on the location of the farm dwelling. Aklilu (2007) reported that market access was low with increased distance to the market for poorer households.

According to Assefa (2007) and Halima (2007); small holder chicken owner farmers found in different parts of Ethiopia sell chicken and eggs for the following objectives: to purchase food items, to cover school fees, grain milling services, purchase improved seeds and adjust the flock size. Tadelle *et al.* (2001) also reported that few chicken owner farmers, in central highlands of Ethiopia, exchanged their free-range chickens for food and household items.

Most consumers in Ethiopia prefer to buy eggs and chickens from producers of indigenous birds, since they are considered to be tasty and better suited to preparation of the traditional "Doro wot" (chicken sauce) and the deep yellow colored egg yolks were commonly favored. On the other hand, free-ranging local chickens were claimed to be on demand and fetch high market prices in urban markets of the country (ILRI, 1995). According to Halima (2007); the prices of chicken products was highly related to supply & demand, plumage color, size, age, sex, market site and the health status of the chicken.

The chicken and egg marketing channels in Ethiopia were described as informal and poorly developed and some of the marketing channels for local chickens included; selling of chickens and eggs at households within the villages, on roadsides during entertainment ceremonies and in local and urban markets (ILRI, 1995).

Construction of an established market structure of free-range chickens for developing family chicken requires a detail and organized study of the production & marketing systems. Studies on marketing of free range chickens can provide clues for management strategies of these birds especially in reducing chicken losses that small holder farmers experienced annually due to the threat of diseases, especially Newcastle disease (Aklilu, 2007).

According to Mlozi *et al.* (2003); information obtained from analysis of village chicken production & marketing system study was highly required to characterize, conserve and develop the chicken genetic resource and to justify resource allocation to rural poultry improvement and conservation projects.

An established market structure for free-range chicken is a pre-requisite for developing family poultry. The main advantages of chicken marketing research were: defining the needs and nature of customers and their ability & desire to buy, scanning the business environment, gathering needed information for decision-making, reducing risk, helping in production planning & monitoring and controlling marketing activities (Gondwe, 2005). Making farmer's get access to market affects the price of the product and transaction costs and is influenced by infrastructure and information (Aklilu, 2007).

2.8. Chicken egg quality aspects

Chicken eggs are an important and fundamental foodstuff for small holder farmers of developing countries. In addition to other substances with biological functions, eggs are main sources of various nutrients such as; proteins, lipids, vitamins and minerals. Egg proteins contain all essential amino acids and therefore egg protein is used as standard for measuring the nutritional quality of other food products (FAO, 2003).

Although eggs contain approximately 74% water, they are potentially important and balanced source of essential fatty acids and as well as some minerals and vitamins. A typical egg would contribute 3-4% of an adult's average energy requirement per day and has approximately 6.5g of protein (Sparks, 2006). The significance of the egg as a protein source for the nourishment of humans led the consumers to demand for some qualities in this nutrient (Uluocak *et al.*, 1995). For many years the most important external and internal egg quality traits have been shown to be; egg weight, egg shape, shell thickness, breaking strength, specific gravity, size of air cell, albumen height, albumen weight, yolk color and yolk index (Sparks, 2006).

External and internal qualities of eggs are of major importance to the egg industry worldwide. However, they are not being given a due attention in the developing world, where the majority of the eggs are coming from free scavenging village chicken, as compared to that of the developed world (Juliet, 2004).

2.8.1. External egg quality

Some of the external eggs quality traits included; egg shell color, shell thickness, dry shell weight, egg weight, egg shape index, which are highly affected by breed of chicken, age of chicken, molting, level of nutrition, stress, prevalence of disease, the type of chicken production system (Hamilton, 1982). Egg shell color may be monitored by visual comparison with a serious of graded standards and egg weight is easily measured by a suitable balance (Hammerle, 1969). According to Mohan *et al.* (1991); egg weight and shell thickness measurements were higher in birds housed in cages than in birds kept on deep litter.

Madkour *et al.* (1982) reported that the average egg weight of RIR and Fayoumi pullets were 56.9g and 45.9g, respectively. Lawrence (1998) also identified the average egg weight of the free range local Tanzanian chickens ranged 37.7g-45g. Similarly; Aberra *et al.* (2005) reported an average egg weight of 42g and 49g for Ethiopian naked neck chicken and their F_1 crosses with New Hampshire breeds, respectively, reared under improved management conditions.

According to Sezai (2008); the following equation, developed for Japanese quails, could be effectively used for predicting egg shell weight as: $Y = 0.573+0.01532 (X_3) + 0.0238 (X_4)$, where; Y = eggshell weight, X_3 = egg length and X_4 = egg weight.

2.8.2. Internal egg quality

Egg internal quality is measured in several ways including factors like; yolk color, albumen height, yolk height, Hough unit, yolk width and nutritive values. Egg's internal quality could be influenced by factors like; genetic factors, environmental factors (such as temperature, relative humidity and the presence of CO_2), hen age, nutrition status, egg storage condition and storage time (Juliet, 2004). A good quality egg should be free from internal blemishes such as blood spots, pigment spots and meat spots (Hamilton, 1982).

There are two components of yolk quality; the color of the yolk and the strength of the perivitelline membrane which surrounds the yolk, where yolk color is measured by using Roche color scale (Juliet, 2004). Samli (2005) and Kirunda *et al.* (2000) reported that the poultry industry identified albumen quality not only to judge the freshness of an egg but also considered it as important for the egg breaking industry because albumen and yolk have different markets. Although various measures of albumen quality have been proposed, the Hough unit is used most commonly today (Silversides, 1994).

Albumen height is usually converted into Hough units, a unit used for describing internal quality and egg freshness, based on the thickness of the albumen. The higher the egg's Hough unit value, the better the quality of the egg. Hough unit of eggs can be estimated based on albumen height and egg weight using the following equation: $HU = 100\log (AH - 1.7EW^{0.37}+7.6)$ where; HU = Hough unit, AH = Albumen height and EW = Egg weight (Eisen *et al.*, 1962, as sited by Aberra, 2000).

In United States egg grading system AA grade eggs scored 72 or higher HU, A grade eggs scored 60–72 HU and B grade eggs scored lower than 60 HU, measured at a temperature b/n 45°F & 60°F, (William *et al.*, 1995). According to Silversides (1994); eggs with Hough unit scores of 90 and above were considered as excellent, 70 is acceptable and buyers generally rejected eggs that score below 60 HU values.

Iposu *et al.* (1994) reported significant negative correlations between egg's Hough unit and egg weight. Pavlovski *et al.* (1981) reported that better albumen height and Hough unit was recorded in eggs from free-range birds than in battery cage conditions. According to the report of Shawkat (2002); both albumen height and Hough units decreased over time.

The color of the yolk is determined by the presence or absence of xanthophylls, some of which are precursor of vitamin A. If the feed has plenty of yellow-orange plant pigments, known as xanthophylls, it will be deposited in the yolk. Therefore, yolk color is influenced by nutrition and dark yellow yolks can be produced by feeding laying birds on green forage meal (Smith, 1996). According to Pavlovski (1981); hens fed mashes containing yellow corn and alfalfa meal lay eggs with yellow yolks while those eating white corn, sorghum, wheat or barley lay eggs with light-colored yolks. Birds in a free range system have a higher yolk color score than in birds kept in other conditions.

In most cases of the developed world the diet is altered to produce egg yolks of the correct color for a particular market. In any consumer survey of egg quality yolk color ranks high but preference varies among countries. Some consumers prefer white-colored yolks while others prefer light-colored or darker orange yolks (Smith, 1996).

2.9. Role of rural women in village chicken production system

Chicken production in most developing countries is based mainly on scavenging systems and rural women and children are traditionally believed to play an important role (John, 1995). They are generally in charge of most chicken husbandry practices, since small-scale animal production does not require heavy manual labor (Riise *et al.*, 2004). According to Bradley (1992); family poultry could be easily managed within homesteads and the management has been associated with women for various historical and social factors.

A Survey result in four African countries; Ethiopia, Gambia, Tanzania and Zimbabwe, showed that women dominated on most activities of village chicken husbandry except for shelter construction and marketing. The result also showed that various gender based constraints such as; poor access to information and heavy workloads on women should be addressed to meet the needs and opportunities of this gender category in this sector (Kitalyi, 1998).

According to Abubakar *et al.* (2007), in a study conducted on village chicken production in some parts of Nigeria and Cameroon; all gender categories were involved in village chicken management, with children having the highest responsibility of shutting down the birds at night and let them out in the morning. Based on the result of the study; women owned the majority of birds (52.7%) followed by children (26.9%) and lastly men (20.4%) in the Province of Cameroon; unlike the situation in Borno state, Nigeria, where majority of the birds are owned by men (55.6%) followed by women (38.9%) and lastly children (11.1%).

In Bangladesh's experiences, women are able to operate and manage technical enterprises like; broiler farming, layer farms and duck farms efficiently with a high economic return on the investment (Riise *et al.*, 2004). Halima (2007) also reported that rural women, in either male-headed or female headed households of North-West Amhara, were more responsible for chicken rearing, while the men were responsible for crop cultivation and other off-farm activities

According to Mcainsh *et al.* (2004) and Gueye (1998); approximately 80% of the chicken flocks in a number of African countries were owned and largely controlled by rural women. In the male-headed households the wife and husband were co-owners of the chickens but sometimes children owned some birds in the flock and were allowed to use their chickens for expenses at school or to purchase clothes.

3. Materials and Methods

3.1. Description of the study wereda

The study was conducted at Burie wereda found in West Gojam administrative zone of Amhara National Regional State (ANRS), located in the North-Western part of the country (Figure 1A). The study wereda shared boarders with Jabitehinan wereda in North-East, Dembecha wereda in South-East, Womberma wereda in West, Sekella wereda in North, Awi zone in North-West and Oromia region in the South (Figure 1B).

According to ANRS-BoFED (2007), the study wereda has an agricultural household size of 39,323 (6370 female and 32953 male) and he total human population was estimated to be 281,310 (141,683 males & 139,627 females). The population density is estimated to be 127.5 people/km^2. The study wereda has a total of 27 kebeles, from which 5 are urban and 22 are rural kebeles (figure 1b). From the total human population, 85 % were rural community and 15% were urban dwellers (Burie, 2007). Burie, the administrative and commercial center of the wereda, is located 420 kms North-West of Addis Ababa and 142 kms South-West from Bahir-Dar.

The study wereda has a total land area of 2207.2 km^2. The average altitude of the study wereda is estimated to be 1689 masl (ranged 728-2832). The average annual rain fall is estimated to be 1689.4mm (ranged 713-2832mm) and the average temperature is 18.97^{o}c (ranged 13-24 ^{o}c).

Livestock is considered as an important component of the prevailing crop-livestock mixed farming systems of the study wereda. Small holder farmers of the study area owned various livestock species such as; cattle, sheep, goat, chicken and equines. According to Burie (2007), the study wereda is reported to have a total population of 129265 for cattle, 39066 for sheep, 6895 for goats, 16335 for donkeys, 479 for mules, 188310 for chicken and 13329 bee hives. According to CACC (2003), the total livestock population of the study wereda, before its separation with the bordering Womberma wereda, was indicated in appendix table 7.2.1.

The study wereda was categorized as one of the administrative weredas of West-Gojam administrative zone of Amhara region known to have highest potential for crop and livestock production. Crop production is highly related to village chicken production of the study wereda, with high seasonal fluctuation of feeds availability, high prevalence of disease and other production and marketing constraints (Burie, 2007).

3.2. Selection of the study area and sampling techniques

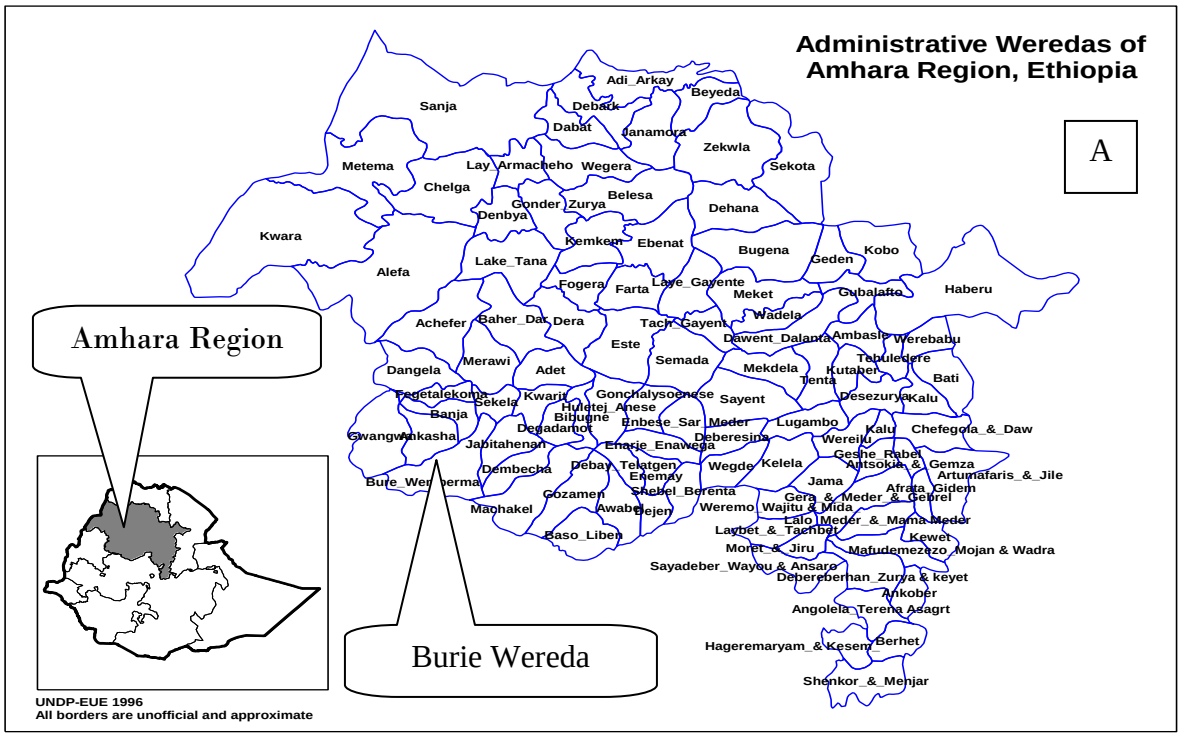
A Multi-stage sampling procedure (purposive & random) was applied for the current study, hence the study wereda was purposively selected and divided in to three agro-ecologies based on altitude as; highland (>2500masl), mid-altitude (1500-2500masl) and low-land (<1500masl). This agro-ecological classification of the study wereda was found relevant to investigate variation in village chicken production & marketing system, production and marketing constraints and suggest appropriate interventions.

Then two farmer kebeles from the highland, two farmer kebels from low-land and three farmer kebeles from mid-altitude were selected randomly. Therefore a total of 7 representative kebeles were selected purposively for the current study. The development agents and livestock experts of Burie wereda agriculture & rural development office were actively participated in selection of representative study kebeles. Agro-ecology representation, chicken production potential and accessibility were the main criterias considered in the selection of study sites.

All village chicken owner households found in all the selected kebeles were freshly registered. Then simple random sampling technique was applied to choose 40 chicken owner respondents in each of the selected kebeles by giving equal chance for those farmers having with different flock size, chicken husbandry systems and other related practices. Hence, a total of 280 village chicken owner households were interviewed using a pre-tested structured questionnaire in all seasons of the year. The percentage of interviewed chicken owners was presented in table 2.

In addition; all chicken and egg traders (collectors) acting on the study wereda were registered freshly and a total of 30 chicken and egg traders (collectors) were randomly selected and interviewed with a pre-tested structured questionnaire for this specific study. The traders were interviewed in all seasons of the year from all urban and rural markets.

The other component of the study was analysis of the internal and external quality of marketable eggs (eggs that are not used for hatching purpose) collected from different sources of the study area. A total of 600 eggs (300 from urban and rural markets and 300 directly from producer farmers) were purchased and used for the study. The eggs were collected in all seasons of the year and from all agro-ecologies of the study wereda.



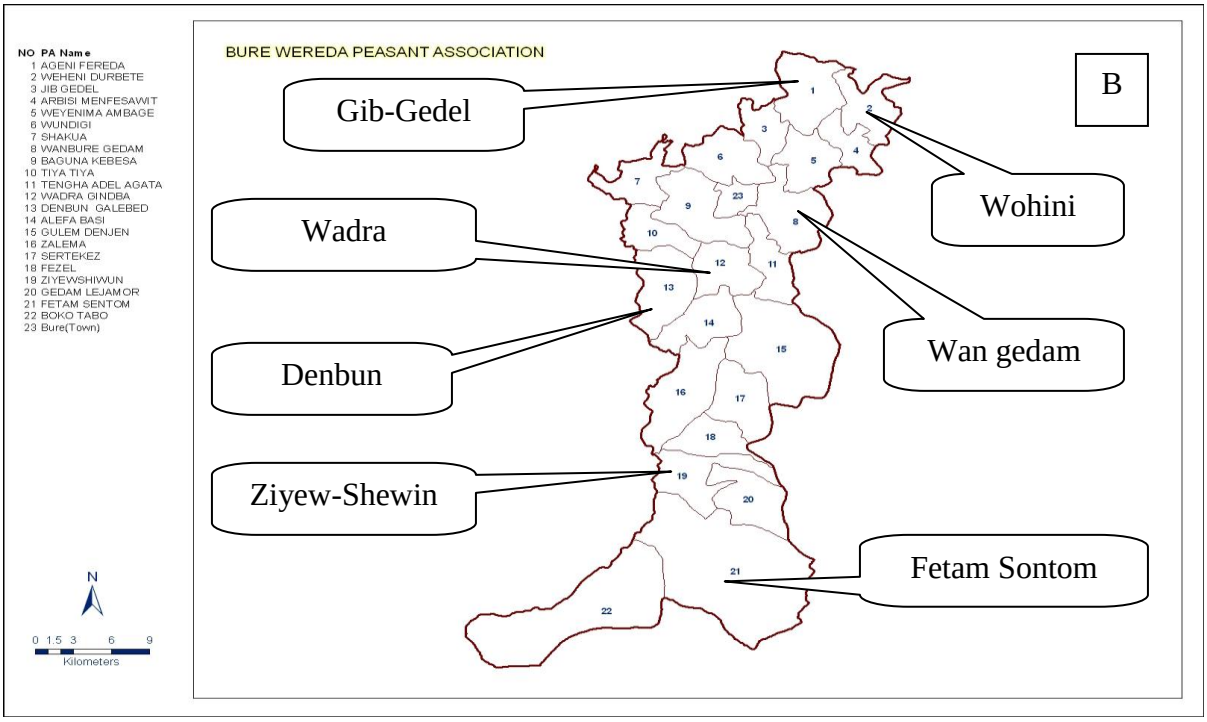


Figure 1.Map of the Amhara region showing administrative weredas (A) and map of Burie wereda showing the location of selected rural farmer kebeles in the present study (B).

Table 2. List of studied farmer kebeles and agro-ecology type, total number of households, total number of chicken owner households and number of interviewed households.

No.	Name of selected Kebele	Agro ecology	Total number of households			No. of chicken owner farmers			No. of chicken owner farmers inter-viewed	% inter-viewed from chicken owner farmers of the kebele	% inter-viewed from total house holds of the kebele
			M	F	T	M	F	T			
1	Denbun	Mid altitude	981	127	1108	717	73	790	40	5.06	3.6
2	Wohini	High land	1021	129	1150	576	110	686	40	5.83	3.5
3	Zeyew Shiwin	Low land	846	153	999	494	104	598	40	6.69	4.0
4	Fetam Sontom	Low land	1096	136	1232	691	116	807	40	4.51	3.3
5	Wan Gedam	Mid altitude	1464	191	1655	875	127	1002	40	4.0	2.4
6	Wadra Gindba	Mid altitude	725	92	817	680	59	739	40	5.41	4.9
7	Jib Gedel	High land	133	183	919	103	115	218	40	18.35	4.4
Grand Total			6266	1011	7880	4136	704	4840	280	5.8 %	3.6 %

- M= male headed households; F= female headed households;

3.3. Data Collection

Relevant secondary data were collected from various reports and sources including; Burie wereda office of agriculture & rural development, West Gojam zone department of agriculture & rural development, Amhara region bureau of agriculture & rural development (ANRS-BoARD) and Amhara region bureau of plan & economy development (ANRS-BoPED). Primary data were collected intensively through personal and house to house interviews using a well organized and pre-tested structured questionnaire. Participatory rural appraisal (PRA), mainly through transect walks and laboratory analysis were the other sources of primary data.

Direct observation was also made to assess available chicken feed resource, chicken feeding & housing practices, egg incubation & brooding procedures and egg handling & storage practices. Finally a transect walk was made involving 10 households in each of the seven selected farmer kebeles. Closer visits in and around the residential quarters of selected households was made in order to obtain first hand observation on all aspects of village chicken production of the study area.

All suitable data such as; type of chicken production system, flock characteristics and performance, chicken and egg marketing system, quality of eggs and constraints of the prevailing chicken production and marketing systems were gathered from individual chicken owner farmers, extension officers and key informants. Besides; data on chicken and egg marketing systems of the study area were collected from interviewed village chicken owners, middlemen on weekly bases for a year (2007/08). All the urban and rural markets were assessed once/month in all seasons of the year, including holydays.

Errors in data collection were minimized through the use of carefully trained enumerators (research technical assistants) and through the retention of their services through out the course of the field data collection. Various types of equipments were used for egg quality assessment study and some of these equipments were presented in Annex 2. Some of the internal and external egg quality traits measured in this study were:

I. External egg quality parameters identified in the study

1. Egg weight (g), (using digital balance)
2. Shell thickness (mm), (using digital caliper)
3. Dried Shell weight(g), (using drying oven)
4. Egg shape index (%), (calculated as: (egg width/egg length)*100)
5. Egg shell color (visual observation)

II. Internal egg quality parameters

1. Yolk height (mm), (using tripod micrometer)
2. Albumen height (mm), (using tripod micrometer)
3. Presence of blood spot and meat spot, (visual observation)
4. Yolk color (measured using color fun, ranged 1-15),
5. Hough Unit (HU), (calculated using albumen height and egg weight calculated using the formula: $HU = 100\log (AH - 1.7EW^{0.37} + 7.6)$ (Haugh, 1937). where; HU = Hough unit, AH = Albumen height and EW = Egg weight

3.4. Data management and statistical analysis

The qualitative and quantitative data-sets were analyzed using appropriate statistical analysis software (SPSS, 2002). The Duncan multiple range test and LSD were used to locate treatment means that are significantly different. Pearson correlation analysis was conducted to describe chicken production performance and egg quality indicators. More specifically descriptive statistics and General Linear Model (GLM) were used for this study. Tables and figures were used to present summary statistics such as mean, SD and percentages.

The phenotypic correlation values related to the internal and external egg quality traits were determined by the Pearson Correlation Analysis. The estimations are made by using SPSS soft ware program, version 12 (SPSS for Windows, 2002) and GenStat statistical software program, version 7.2 (Genstat. 2007). The following regression models were employed as applicable to each case: $Y = a + bx$ (simple linear regression); $Y = a + b_1X_1 + b_2X_2 + \ldots b_kX_k$ (multiple regressions), where; Y = dependent or response variable, a = intercept (the value of the dependent variable when the independent is zero), b = regression coefficient and x = the independent variable. The following linear models used during analysis of quantitative data:

1. Model statement regarding the effect of agro-ecological differences on various productive and reproductive parameter of the studied local chicken ecotype.

$Y_{ij} = \mu + m_i + \varepsilon_{ij}$

Where Y_{ij} is the chicken performance parameter estimate for bird j in agro ecology i, μ is the overall mean, m_i is the fixed effect of agro-ecology (i=3; Highland, Mid-altitude and Lowland) and ε_{ij} is the residual error.

2. Model statement regarding the effect of market type (ordinary weekly market days Vs major holyday markets) on prices of chicken products (different age & sex birds and eggs).

$Y_{ij} = \mu + m_i + \varepsilon_{ij}$

Where Y_{ij} is the market parameter (price) estimate for bird j on market i, μ is the overall mean, m_i is the fixed effect of market type (i=6; ordinary weekly market day, or selected major holyday market days, ie., Eves of Eth. new year, Meskel, Gena, Fasika, and Muslim holydays) and ε_{ij} is the residual error.

3. Model statement about the effect of agro-ecological differences on distance traveled by chicken owner households to the nearby local markets and urban markets.

$Y_{ij} = \mu + m_i + \varepsilon_{ij}$

Where Y_{ij} is the distance traveled by household j in agro ecology i, μ is the overall mean, m_i is the fixed effect of agro-ecology (i=3; Highland, Mid-altitude and Lowland) and ε_{ij} is the residual error.

4. Model statement about the effect of agro-ecology and season on the prices of different chicken products.

$Y_{ijk} = \mu + m_i + s_j + \varepsilon_{ijk}$

Where Y_{ijk} is the price of k^{th} chicken product (live bird or egg) during the j^{th} season in the i^{th} agro-ecology, μ is the overall mean, m_i is the fixed effect of agro-ecology (i=3; Highland, Mid-altitude and Lowland), s_j is the fixed effect of season (i=2; Dry season and Rainy season) and ε_{ijk} is the residual error.

4. Results and discussions

4.1. Household characteristics

The household characteristics of interviewed village chicken owner households were presented in table 3. Accordingly; from the total of 280 interviewed village chicken owners, 208 (74.4%) were males and 72 (25.6%) were females. 75% of interviewed chicken owners were household heads and 25% were other members of the household. The average age of respondents was 40.9 years (ranged 20-77). Regarding education level of respondents; 39.3% were illiterate, 31.1% had basic education (Reading & writing), 21.4% had primary education and 8.2% had secondary education & above. The number of illiterates observed in this study was lower than the reported 82.1% for North-West Ethiopia (Halima, 2007).

The result of the study indicated that 94.6 % of interviewed households were male headed and 5.4% female headed. Regarding marital status; 88.9% of interviewed households were married. The average family size per household of the study wereda was 6.2 (ranged 1-12). The average family size identified in the study wereda was higher than the national average of 5.2 persons (CSA 2003) and the reported 5.4 for North-West Amhara (Halima, 2007). Detail of the household age structure of the study wereda was presented in appendix table 7.3.1.

4.2. Land holding

The average total land holding per household of the study wereda, used for different farming activities, was 1.223 ha (ranged 0.84-1.52), with a SD of 1.23 ha. The result was similar with the reported 1.28ha land holding/household of North-West Amhara by Halima (2007), but higher than the national average of 1.02 ha (EEA, 2002).

Table 3.Socio-economic status of respondent chicken owners of the study area (N=280)

Variables	Agro-ecology of the study wereda			Grand mean
	High-land	Mid-altitude	Low-land	
Sex of Respondent households (%)				
Male	72.5	75.8	75	74.6
Female	27.5	24.2	25	25.4
Average age of respondents (years)	40.74 [a]	40.9 [a]	40.94 [a]	40.86
Education status of respondents (%)				
Illiterate	38.8	36.7	43.8	39.3
Reading & writing	31.3	38.3	20	31.1
primary education	21.3	16.7	28.8	21.4
secondary education & above	8.8	8.3	7.5	8.2
Average family size/hh (Mean±SD)	6.44±2.4 [a]	6.11±2.02 [a]	6.07 ±2.1 [a]	6.19±2.17
Marital Status of households (%)				
Married	85	90.8	90	88.9
Single	1.3	0.8	1.3	1.1
Divorced	2.5	6.7	5	5
Widowed	11.3	1.7	3.8	5
Land holding/household (ha)				
Total land holding (Mean±SD)	0.84 [a]±. 84	1.29 [b]±1.29	1.52[c]±1.52	1.23±1.23
Livestock Holding (No of animals)				
Cows	0.86	1.1	0.96	0.99
Oxen	1.36	1.75	2.05	1.73
Heifers & Steers	0.46	0.68	0.67	0.62
Calves	0.84	0.82	0.79	0.81
Total cattle size/hh (Mean±SD)	3.5 ±2.9 [a]	4.4 ±3.9 [a]	4.4 ±3.8 [a]	4.16±3.6
Sheep	2.71	2.34	1.61	2.24
Goats	0.6	0.1	0.1	0.25
Donkey	0.51	0.61	0.47	0.54
Muled	0.01	0.01	0.05	0.02
Horses	0.1	-	0.01	0.03
Total chicken size/hh (Mean±SD)	11.6 [a]±9.7	13.9 [a]±9.7	13.4 [a]±10.1	13.1±10

[a,b,c] Least square means with different superscripts within a raw are significantly different ($P < 0.05$); SD = Standard deviation

The average land holding/household identified and presented above did not include the communal grazing land, which was observed in each of the representative study farmer kebeles of the study wereda. The total land holding/household showed a significant difference with the type of agro-ecologies of the study area. The highest (1.52ha) land holding/household was recorded in the lowland agro-ecology and the lowest land holding/household (0.84ha) was recorded in the high land agro-ecology. It was attributed to the presence of low available arable land and relatively high population pressure in the highlands and vise versa in lowlands.

The result of the current study also showed that there was statistically important correlation between the total family sizes and other household characteristics like; total farm size of household, back yard size of household, total cattle size/hh and total chicken flock size/hh (appendix table 7.3.6). Because of the fact that crop production was the main occupation for farmers of the study area, the major proportion of the land was used for crop production activity. Maize was identified as the first major type of crop grown in the area. Teff, wheat and millet were the discovered as the other main crop types grown in the study area.

4.3. Livestock production and holding

Among the large livestock species, cattle were dominant in the study wereda and the majorities of the farmers used them as sources of draft power followed by milk and milk products. It was identified that 99.5 % of cattle kept in the study area were local zebu types and the sources of these animals were market purchase and gift from relatives during wedding. Appendix table 7.3.2 shows details of the purpose livestock in the area, other than chicken.

According to the result of the current study the average livestock holding/household of the study wereda was; 4.16 for cattle, 2.24 for sheep, 0.25 for goats, 0.54 for donkeys, 0.02 for mules, 0.03 for horses and 13.1 for chicken (Table 3). The number of cattle, sheep, donkey and chicken holding/household found in this study was higher than the findings of Adugna and Said (1992), in mixed production system of Wolyita Zone, which estimated; 3.6 cattle, 0.1 donkeys and 2.1 chickens. The livestock holding in TLU/household of the study wereda was presented in appendix table 7.3.3.

The result of the current study revealed that sale of animals and animal products was an important source of household cash income. In addition, livestock were identified to be vital sources of food (animal protein), prestige (determination of wealth status of households) and organic manure for soil fertility. Equines were mainly used as source transport (to carry people & harvested crops and to pull carts) and draft power (mainly horses in highland areas).

According to interviewed village chicken owner farmers; management (handling) of sheep was easier than that of goats, hence the population of sheep was found higher than that of goat's population. Though the proportion of the highland from the total area of the study wereda was low, the majority of sheep population was found in this agro-ecology. The proportion of donkeys in the study area was higher among the total equine population. The result of the study revealed that only few wealthy farmers owned mules and hence the proportion of mules in the herd was small. The comparison of different livestock groups according to their function and farmer's preference was presented in appendix table 7.3.4.

4.4. Village chicken management

4.4.1. Production system and flock size

The most dominant (82.9%) chicken production system identified in each agro-ecology of the study wereda was scavenging type of production system using a majority (96.8%) of local chicken ecotypes, with only seasonal/conditional feed supplementation. Village birds were left to search for their own feed, scratching and picking on the ground while only small amounts of grains or kitchen leftovers were supplemented, mainly during feed shortage seasons.

Similarly Safalaoh (2001) and Lwesya *et al.* (2004) reported that almost 83 % of the total chicken population in Malawi smallholder extensive chicken production system was indigenous chicken's ecotypes, forming the largest proportion of chickens kept. Huque and Paul (2001) also reported that chicken production systems of Bangladesh depend mainly on locally scavenging chickens that were reared in villages and they constituted more than 70% of the country's chicken population.

The major type exotic chicken breed (3.2%) reared by small holder farmers of the study wereda were Rhode Island Red (RIR) and their crosses with local chicken ecotypes. The result of the study indicated that village chicken owner farmers of the study area had, on average, 12.5 year of experience in chicken rearing activity. The result also revealed that 47.9% of village chicken owners started chicken rearing activity from their own interest and the major (93.9 %) source of birds for parent stock was market purchase. Table 4 shows different aged chicken flock size/household in the study wereda.

Table 4. Chicken flock size/household in Burie wereda, North West Amhara (N =280)

Agro Ecology	Chicken age group					Total flock Size/hh (Mean± SD)
	Hens (Mean± SD)	Cocks (Mean± SD)	Pullets (Mean± SD)	Cockerel (Mean± SD)	Young chicks (Mean± SD)	
High-land	3.4±2.1 [a]	0.8±1.3 [a]	1.6±3.3	0.7±1.8	5.1±6.2	11.6 [a] ± 9.7
Mid-altitude	3.4±2.1 [a]	0.9±1.1 [a]	2.0±3.4	0.9±2.5	6.7±7.1	13.9 [a] ± 9.7
Low-land	3.2±1.8 [a]	1.0±.83 [a]	3.3±5.4	1.0±2.4	4.6±5.4	13.4 [a] ± 10.9
Grand mean	3.3±1.97	1.0±1.1	2.3±4.1	0.9±2.3	5.6±6.5	13.1 ± 10.1

[a,b] Least square means with different superscript within a column are significantly different ($P < 0.05$)

The average chicken flock size/household of the study wereda for hens, cocks, pullets, cockerels and young chicks was 3.3, 1, 2.3, 0.9, 5.6, respectively with a total flock size of 13.1 birds and a hen to cock ratio of 3.7:1 (Table 4). The result was in line with Gueye (1997), who reported a flock sizes ranged 5-20 birds per each African village households. A similar flock size/household result (2-15) was reported by Chatterjee (2008) in India Nicorabi fowl breeds.

However, a relatively higher flock size of 18.8 birds/household, with a hen to cock ratio of 4.4:1, was reported in Sudan by Khalafalla *et al.* (2001). Similarly, 16 birds/household were reported in the central highlands of Ethiopia and South coast Kenya by Tadelle *et al*. (2003) & Njenga (2005), respectively. The result of the study revealed that the average flock size per household varied between seasons mainly due to availability of feed, the occurrence of diseases & predators as well as the economic status of chicken owners.

The majority of village chicken owner farmers (83.2%) in the study area kept village birds only during the dry season, when availability of feed is better and risk of predators was low. The result of the current study showed that there were no any cultural/religious taboos against rearing a special type of chicken, not to eat chicken products and not to sell chicken & eggs (Appendix table 7.3.5). This was similar with the findings of Tadelle (2003), who reported that there were no any cultural/religious taboos relating to consumption of eggs and chicken meat, like those for pig meat, in central high lands of Ethiopia.

4.4.2. Chickens ecotypes available

Most village chicken in the study area showed phenotypic heterogeneity in terms of plumage color, shank length, and comb type and growth performances. Figure 2 shows some type of plumage color and comb types of local chicken found in the study area The result of the study indicated that from the diverse plumage colors red was the dominant (53.9%) color of local chicken ecotypes in the study area, followed by white (46.1%) plumage color (figure 2).

Various research results on village chicken production system of many countries conducted by different authors, (Teketel, 1986; Guèye, 1998 and Abebe, 1992, as cited by Salam, 2005), also identified different local chicken ecotypes in terms of color, body size and productivity. Appendix table 7.3.7 showed details of some of the plumage colors of local chicken ecotypes identified by different authors.

Red (‘key’), Rose comb

“Tikur Gebsat”, Rose comb

Black (‘Tikur’)

Red (‘key’), Single comb

White (‘Nech’), Single comb

‘Nech Wosera’”, Rose comb

“Nech Gebsat”

‘Wesera’, single comb

White, Necked neck

“Teterima”

“Nech Gebsat”

‘Sinde melek’

Figure 2. Some plumage color and comb types of local chicken ecotypes found in Burie wereda, North-West Amhara.

However, the result of the current study was not similar with the findings of Halima (2007), who reported that the predominant plumage color of the local chicken ecotypes in the respective administrative zones of North-West Amhara was white (25.5 %), followed by a grayish mixture (22.2%) and red (16.5%). The presence of such large variations in plumage colors of local chicken ecotypes with in the region may be the result of their geographical isolation as well as long periods of natural selections.

This study revealed that red was the most preferred (83.6%) plumage color in the study area, followed by white (83.5%). Regarding comb types, both single and double (rose) comb types were found in the study area, while rose comb was the most preferred (81.1%). This was mainly attributed to the preference of consumers in the market (high demand) and presence of cultural attitude in favor of rose (double) comb.

Details of the purpose of village chicken rearing and eggs in the study wereda were presented in table 5. Sale of live birds as source of income was the first most important function (51%) of rearing chicken in the study. The other purposes of village chicken, in order of importance, were: egg hatching for breeding stock (45%), home consumption (44%), use of chicken for cultural and/or religious ceremonies (36.4%) and egg production (40.7%) (Table 5).

The result of the study indicates that sale for income was the first purpose of village chicken for farmers found both in highland and mid-altitude agro-ecologies, but sale for income was the second purpose for farmers found in lowland agro-ecology (Table 5). This might be attributed to the poor access of available local and urban market to village chicken producer farmers found in lowlands (Table 14).

Table 5. Function/purpose of village chicken rearing and eggs in Burie wereda, North-West Amhara, (N=280).

Variables	Agro-ecology												Total (Study Wereda)			
	High-land (N=80)				Mid-altitude (N=120)				Low-land (N=80)							
	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st (%)	2nd (%)	3rd (%)	4th (%)
Purpose of chicken (%)																
Sale for income	52	40.5	-	-	67.5	27.5	-	-	33.8	62.5	-	-	51	**43.5**	-	-
Hatching (Breeding)	48	47	5	-	32.5	59.2	8.3	-	66.2	28.7	5	-	**49**	45	**6**	-
Home consumption	-	5	47.5	30	-	8.3	31.7	31.7	-	5.0	52	12.5	-	**6.1**	44	**24.8**
Egg production	-	7.5	5	25	-	5.	15	26.5	-	3.8	10.5	42.2	-	**5.4**	**10**	**31.2**
Cultural/religious ceremonies	-	-	42.5	39.3	-	-	45	40	-	-	32.5	30	-	-	**40**	36.4
To entertain guests	-	-	-	5.7	-	-	-	1.8	-	-	-	15.3	-	-	-	**7.6**
Grand total	100	100	-	100	-	100	100	100	100	100	100	100	100	100	100	100
Purpose of eggs (%)																
Sale for income	15	60	17.5		18.3	42.9	27.5		7.5	70	18.8		**14**	58	**21.4**	
Hatching	70	25	12.5		70.8	31.3	9.2		75	22.5	6.3		72	**26**	**9.6**	
Home consumption	15	15	70		10.8	25.8	63.3		17.5	7.5	75		**14**	**16**	69	
Grand total	100	100	100		100	100	100		100	100	100		100	100	100	

1st = First purpose; 2nd = Second purpose; 3rd = Third purpose; 4th = Forth purpose

Similarly, Tadelle & Ogle (1996) reported that the major uses eggs in rural societies of central Ethiopian high lands were: hatching for replacement (51.8%), sale for cash income (22.6%) and home consumption (20.2%). Similar study indicated that the major purposes of production of village birds in central Ethiopian high lands were: sale for income (26.6%), use of sacrifice or healing ceremonies (25%), replacement (20.3%) and home consumption (19.5%).

The study of Tadelle & Ogle (1996) also showed that chicken owner farmers in central highlands of Ethiopia, in some cases, gave live birds (8.6%) and eggs (5.4%) as a gift to visitors and relatives, as starting capital for youths and newly married women. However, Sonaiya *et al.* (2004) reported that giving of live birds as sacrificial offerings in traditional worship was not practiced anymore in many chicken producers of developing countries.

The result of the current study was also in line with the findings of Sonaiya *et al.* (2004), who stated that sale of live birds for income generation was the primary goal of keeping family chicken in developing countries. Veluw (1987) also reported similar results with regard to the purpose of chicken in traditional poultry production of Northern Ghana.

The study revealed that eggs produced from village chicken could also provide a regular, though small, incomes while the sale of live birds provided a more flexible source of cash as required. According to interviewed village chicken owner farmers use of eggs for hatching/replacement was the first most important (71.7%) function of eggs in the study wereda. The second and the third purpose of eggs in the study wereda were sale for cash income (58%) and home consumption (68.6%), respectively (Table 5).

The result of the current study showed that from the total of 280 chicken owners interviewed 78% consumed chicken meat only during religious/cultural holidays, 20.3% every time when needed/available and only 0.7% reported that they never eat chicken meat. Regarding consumption of chicken eggs, it is identified that 52.8% of village chicken owners of the study wereda consumed eggs only during religious/cultural holidays, 42.5% every time when needed & available, 2.5% when only they got sick and only 2.2% reported that they never eat eggs.

Chicken producers farmers of the study wereda also mentioned some of the major advantages and dis-advantages of village chicken rearing, as compared to keeping other livestock species. Accordingly, the first major advantage of chicken rearing mentioned was its easiness to start with relatively low initial capital (47.1%). Ability of chicken to be an important source of cash income in relatively short period of time (28.9%) and its easiness to be handled with minimum labor, mainly by woman and children (23.9%) were the other special advantages of village chicken rearing identified from the current study.

Regarding the dis-advantages of rearing village chicken, susceptibility of village birds to disease and predators, which resulted in high mortality of birds, was the first major limitation as far as chicken production was concerned in the study wereda. Impact of bird's on newly growing seedlings at back yard, especially during planting season (24.6%) and their behavior of creating disturbances at and around the house (7.5%) were the other side effects of scavenging birds as mentioned by chicken producers of the study area.

The finding of this study was similar with the report of Anders (1997), who stated that the ease and efficiency of chickens to convert vegetable protein into important animal protein, the attractiveness and acceptability of chicken meat and eggs, their competitive cost and the relative ease with which new technologies, such as health care systems, can be transferred between countries and between farmers were important factors in the continuing growth of the poultry industry in many countries.

4.4.3. Village chicken husbandry

4.4.3.1. Feed and Feeding system

Although scavenging was the major feeding system encountered in all agro-ecologies of the study wereda, 97.5% of chicken owners provided supplementary feed to village chicken, especially during feed shortage seasons (Table 6). July, August and September were the most critical months of the year that majority of chicken owners (84.3%) provided supplementary feed. Home produced grains and household leftovers were the major kinds of feeds stuffs (56.4%) supplemented by farmers. Halima (2007) also reported that 99.28% of chicken owners in North-West Amhara provided supplementary feeds to village birds.

Wheat (70.4%), maize (61.1%) and millet (55 %) were the first, second and third types of grains provided as supplementary feed in the study wereda, respectively, though the primary use of these crops was for human consumption. Spreading the grain on the floor, with out feeder, was the major (91.4%) way of providing supplementary feed. Mapiye *et al.* (2005) also reported that only 11.4% of village chicken growers in Rushinga district of Zimbabwe prepared feeding trough for village chicken.

Table 6. Provision & type of supplementary feeds for village chicken in the wereda (N=280)

Parameters (%)	Agro-ecology			Total (Study area) (%)
	High land (%)	Mid altitude (%)	Low land (%)	
Provision of supplementary feed (%)	95	100	96.3	97.5
Most critical season of the year for provision of supplementary feed (%)				
▪ July-Sep	92.5	84.2	75.3	84.3
▪ April-June	-	-	4.7	1.4
▪ All months (year round)	2.5	15.8	15.0	11.8
Major types of supplementary feeds that farmers provided to birds (%)				
▪ Grains only	52.5	29.2	41.2	37.2
▪ House hold leftovers only	-	-	5	3.9
▪ Grains & household leftovers	42.5	70	50	56.4
▪ Left only scavenging	5	-	3.8	2.5
Ways of provision of supplementary feed in the area (%)				
▪ With feeder	5.0	8.3	5.0	6.1
▪ Spreading on the floor	92.5	90.8	91.3	91.4

The amount of supplementary feed provided/flock was not known by majority (95%) of village chicken producers. The result of the study identified that matured birds were provided with the grain it self, where as young chicken were provided with crushed/water socked feed, depending on the age of birds. Appendix table 7.3.8 showed months of the year where availability of chicken feed is sufficient, surplus and shortage in the study wereda.

The present study revealed that 97.5% of chicken owners provided supplementary feed to village chicken, especially during feed shortage seasons and 87.1% these farmers used crop harvest (self produced feeds). Mapiye *et al.* (2005) also reported that 95.5% of the farmers in Rushinga district of Zimbabwe produced their own supplementary feeds and only 4.5% used purchased feed. The result of the current study indicated that all chicken eco-types/breeds were treated equally towards supplementary feed. However, young chicks were the first chicken age groups (82.9%) given priority towards supplementary feed.

All village chicken owners (100%) of the study wereda provided water to village chicken; 85.4% only during the dry season and 14.3 % through out the year. Concerning the frequency of watering, most chicken producers (78.9%) used adlibtum type (making water available every time). Halima (2007) also reported that 99.5% of chicken owners in North-West Amhara provided water to village birds. The current study revealed that the major sources of water for village chicken in the study area were river water (30.4%), spring water (28.5%), locally constructed underground water (21.4%) and hand operated pipe water (19.7%).

The recurrent study indicated that majority of chicken owners (98.2%) had watering trough. Broken clay material, locally called *"shekila"*, (37.3%), wooden trough (32.7%) and plastic made trough (28.2%) were the most widely used types of watering troughs in the study wereda. Regarding the frequency of cleaning watering trough, 50% of chicken owners cleaned sometimes when they remembered it and 23.9% cleaned every day. However, 24.3 % of chicken owners having watering trough responded that they never cleaned watering trough. Appendix tables 7.3.9 showed details of watering and other related issues of village chicken.

4.4.3.2. Housing system of village chicken

From the total of 280 chicken owners interviewed, only 62 farmers (22.1%) prepared separate overnight houses for village chicken (Table 7). Regarding the housing type observed, 14.7% were wooden houses with corrugated iron and 7.4% were wooden made houses with grass roof. The majority (77.9%) of village chicken owners did not prepare over night houses and kept birds on various night sheltering places (some indicated in figure 3) including; perches inside the house (45.7%), on the floor covered by bamboo made materials (27.1%), on ceilings of the house (3.6%) and under locally constructed sitting place (*'medeb")* (1.4%).

Lack of attention to village birds, mainly due to presence of small flock size/household (34.6%), lack of construction materials (25%), lack of knowledge and awareness (19.6%), risk of predators (12.1%) and shortage of labor & time (5.4%) were some of the major reasons mentioned by chicken owner farmers for not preparing a separate house for village chicken.

Table 7. Housing condition of village chicken in Burie wereda, North-West Amhara, (N=280).

Parameters	Agro-ecology			Total
	High land (%)	Mid altitude (%)	Low land (%)	(Study area) (%)
Preparation of separate chicken house	15.0	24.2	26.3	22.1
Type of night sheltering (%)				
▪ Perch inside the house	47.5	37.5	56.3	45.7
▪ Ceilings of the house	5.0	1.7	5.0	3.6
▪ Floor covered by containers	32.5	33.3	12.5	27.2
▪ Under sitting place (‘medeb’)	-	3.3	-	1.4
▪ In separate chicken houses	15	24.2	26.3	22.1

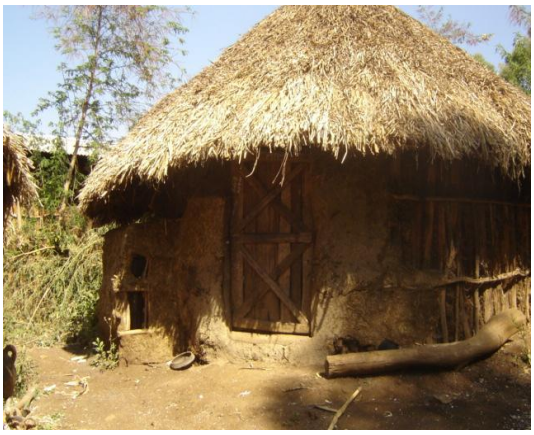
Keeping birds on perches inside the house

Perches inside the house

Keeping birds on the floor, covered

Separate chicken house (Out door)

Separate chicken house (Out door)



Separate chicken house (Out door)

Figure 3. Some pictures on night sheltering of village chicken in Burie wereda

4.4.3.3. Chicken health and disease control measures

The current study indicated that 97.5% of village chicken owners in the study area experienced chicken disease problems in their locality. According to interviewed farmers Newcastle disease (NCD) was the most prevalent and economically important (98.2%) disease problem affecting village chicken production in the study wereda (Table 8).

Similarly, Halima (2007) reported that the major causes of death for local chicken ecotypes in North-West Amhara were seasonal outbreaks of chicken diseases, specifically Newcastle disease. Yongolo (1996) and Spradbraw (1993) also supported the argument that NCD was the most devastating disease and considered to be a major constraint to the development of both village and commercial chicken industry in Africa.

According to interviewed chicken owner farmers, occurrence of white/yellow color diarrhea (54.6%), dullness of birds (locally termed as *'kufif malet'*) (24.4%) and poor appetite (18.9%) were some of the main symptoms of village chicken when infected with Newcastle disease. Chicken owners also reported that the prevalence of the disease (NCD) and chicken mortality were higher at the start of rainy season, mainly April to June.

It is also identified that NCD affected every chicken breed and age group. However, hens lying and incubating eggs were the most affected and sensitive age groups in the flock. According to the result of the study provision of traditional (ethno-veterinary) treatments was the major type of treatment used by majority of village chicken owners (95%) against NCD. Only few chicken owners (3.9%) found used modern treatment from agriculture office for sick birds affected by Newcastle or other diseases.

Table 8. Most common chicken diseases, prevalence season, genotypes affected and major traditional treatments used in Burie wereda, (N=280).

Variables	(%)
Most prevalent disease affecting village chicken in the area (%)	
▪ Newcastle (locally called '*Fengil or Kofes'*)	98.2
▪ Other unknown chicken diseases	1.8
Chicken genotypes affected by NCD in the study area (%)	
▪ Cross breed chicken only	1.5
▪ Pure exotic chicken breed only	10.0
▪ All chicken breeds affected equally	88.5
Months of the year when prevalence of NCD is higher in the area (%)	
▪ March	1.8
▪ April	66.8
▪ May-June	31.4
Major types of traditional control measures used by village chicken owner farmers against NCD in the study area (%)	
▪ Use of Tetracycline capsule (TTC) with water	11.8
▪ Use of a mixture of ; local alcohol *('Arekie')*, lemon & white onion	42.9
▪ Use of some plant materials (herbs) like; 'semiza' and 'endod'	33.2
▪ Cutting around the wing of chicks to remove 'infected' blood	7.1
▪ No cultural medicines used	5.0

The result of the study revealed that provision of a mixture of local alcohol (‘*Arekie’*), lemon and onion to sick birds against NCD was the most widely used (42.9%) type of traditional treatments in the study area (Table 8). Other common types of traditional treatments observed in the study area were; use of some plant materials (herbs like *‘semiza’* & *‘endod’*) (33.2%), use of tetracycline capsule (11.8%) and cutting around the wing of chicks to remove ‘infected’ blood (7.1%). The result showed that further research activities focusing on identifying the effectiveness of those ethno-veterinary medications could be vitally important.

96.4 % of interviewed village chicken owners of the study wereda had no any culture of vaccinating birds against chicken diseases. It is recognized that lack of awareness about the presence of vaccines (71.4 %), lack of attention to village chicken (13.6 %) and low availability of vaccines in the study wereda (15 %) were the major reasons mentioned by chicken owner farmers for lack of vaccination against chicken disease.

The current study indicated that 91.1% of interviewed village chicken owners had no any culture of taking sick birds to veterinary offices for modern treatment. Lack of awareness about presence of modern treatment for sick birds (59.1%), lack of attention to village chicken (21.2 %), low availability of treatments in the study wereda (19.3%) and non effectiveness of treatment (0.4%) were some of the major reason mentioned by chicken owners for lack of culture to treat sick birds with modern medicaments. Regarding the fate of sick birds, 74.3% of village chicken owners reported that they left sick birds either to die or survive.

4.4.3.4. Risk aversion strategies followed by village chicken owners

The result of the current study indicated that 83.2% of village chicken owners reared village birds only during the dry season, when the risk of disease out break and predation impact is low. Only 16.8% of village chicken owners reared village birds throughout the year (both dry and rainy seasons).

It is discovered that 96.4% of those chicken owners, who reared birds through out the year, used various types of risk aversion strategies during high risky seasons (Table 9). Accordingly, reduction of flock size & keeping only some productive hens and cocks at hand (83.6%) was the most preferred strategy implemented by those chicken owners. Other identified strategies included; housing all birds and treat them at home until the good season comes (7.5%), housing some birds & send the rest to other places sharing eggs and chicks hatched in the mean time (5.3%).

Table 9. Farmer's risk aversion strategy to stay in chicken rearing activity year round (N=47)

Parameters	Agro-ecology			Total (Study area) (%)
	High land (%)	Mid altitude (%)	Low land (%)	
Presence of risk aversion strategy (%)	98.75	98.3	91.2	96.4
Type of risk aversion strategies used to stay in chicken rearing (%)				
▪ Reduce flock size & keep some hens and cocks at home	75	86.7	87.5	83.6
▪ Housing all birds	15	5.0	-	7.5
▪ Housing some birds & send the rest to other places	2.5	2.5	3.8	5.3

4.4.4. Production and reproduction performance of village chicken

The egg production and reproduction aspects of village birds were evaluated under the existing farmer's chicken management condition, as set out in the structured questionnaire. The production and reproduction history of at least two local broody hens per each household was collected during the repeated survey activity. Table 10 shows the production performance of local chicken ecotypes in Burie wereda.

The average age of local cockerels at first mating and pullets at first egg were 24.6 weeks (5.74 months) and 27.5 weeks (6.42 months), respectively (Table 10). The study also revealed that there was no any significant different in maturity age of local cockerels found in different agro-ecologies of the study area. However, pullets found in highland agro-ecology matured relatively faster than birds of other agro-ecologies. This might be attributed to presence of better awareness on highland farmers on management of village chicken such as feeding.

Similarly, Halima (2007) reported that 77.4 % of cocks of local chicken ecotypes in North-West Ethiopia reached maturity at 20-24 weeks of age. Mourad and Gbanamou (1997) also reported that the average age of village chicken pullets at first lying in Guinea was 25.7 weeks. Similar studies by various authors also indicated that sexual maturity age of female village birds were; 28 weeks in Tanzania (Katule, 1992), 24 weeks in Mali (Kassambara, 1989) and Nigeria (Sonaiya & Olori, 1998), 32 weeks in Sudan (Wilson, 1979), 28-36 weeks in Benin (Assan, 1990) and 25 weeks in Senegal (Sall, 1990).

Table 10. Production performance of local chicken in Burie wereda, North-West Amhara.

Variables	Agro-ecology			Grand total (Mean±SD)
	High-land (Mean±SD)	Mid-altitude (Mean±SD)	Low-land (Mean±SD)	
Average age of cockerels at 1st mating (weeks) (N=280 hh)	24.6 ± 2.0 [a] (12) *	24.5 ±1.6 [a] (12)	24.6 ±2.0 [a] (12)	24.6±1.9 (12)
Average age of local pullets at 1st egg (weeks) (N=280 hh)	26.9 ± 2.5 [a] (8)	27.6±2.5 [b] (12)	27.9±2.3 [b] (8)	27.5±2.4 (12)
Average eggs/hen/clutch (N=560 hens)	16.7±3.2 [b] (18)	16.1±3.1 [b] (18)	14.4±3.0 [a] (16)	15.7±3.21 (20)
No of clutch/hen/year (N=560 hens)	3.6±0.7 [a] (3)	3.8±.752 [a] (4)	4.1±0.8 [b] (3)	3.83±0.8 (4)
Total egg production/hen/year (N=560 hens)	60±9.3 [a] (44)	61±11.4 [a] (80)	59±11.9 [a] (72)	60±11 (88)

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

* Numbers in bracket are range

According to the result of the current study, it is possible to conclude that local chicken ecotypes found in the wereda were late maturing types. Teketel (1996) and Aberra (2000) also reported that one of the expressions of the low productivity of local chicken ecotypes was late maturity.

The average number of eggs/hen/clutch and the number of total clutches/hen/year were estimated to be 15.7 and 3.83, respectively. The total egg production/hen/year of local hens, under existing farmer's chicken management condition, was estimated 60 eggs (Table 10). The current study did not show any significant difference in between different agro-ecologies of the study area in terms of annual egg production performance of local hens. The average number of eggs/clutch identified in this study (15.7 eggs) was similar with the reported 9-19 eggs in North-West Ethiopia by Halima (2007), 12-18 eggs in Nigerian local hens by Gueye (1998) and 6-20 eggs in Tanzania by Aichi (1998).

However, the number of total clutches/hen/year (2-3) and total egg production/hen/year (18-57 eggs) reported by Halima (2007) was lower than the findings of this study. Similarly; Brannang and Persson (1990) reported a relatively lower (34) total annual egg production/hen of local breed hens around Arsi, Ethiopia. Khalafalla (2001) also reported a relatively lower average number of clutches/hen/year of 3.1 and average eggs/clutch of 12 eggs in Sudan local breed hens. Correspondingly, 11.8 eggs/clutch observed in Burkina Faso local hen reported by Salam (2005) was lower than the findings of this study. This might be attributed to presence of improvement in village chicken husbandry activities in the study area.

Table 11 shows hatchability performance local broody hens in the study wereda. The current study showed that local broody hens were the only means of egg incubation and brooding young chicks in the study wereda. It is identified that the average number of eggs incubated per broody hens was 13 eggs (ranged 7-22 eggs) and reasonably high (11) (ranged 0-19) numbers of chicks were hatched. Accordingly, the average hatchability percentage of local hens was calculated and found to be 82.6 % (Table 11).

Table 11. Hatchability performance of local hens in Burie wereda, (N=560 hens).

Variables	Agro-ecology			Grand total (N=560)
	High-land (N=240)	Mid-altitude (N=240)	Low-land (N=240)	
Average number of eggs incubated (Mean±SD)	14±2.2[b] (10-21) *	13±1.9[a] (8-20)	13±2.2 [a] (7-20)	13±2.2 (7-21)
Average number of eggs hatched (Mean± SD)	12±2.2[b] (5-16)	11±2.2[b] (0-19)	10±2.4[a] (5-19)	11±2.3 (0-19)
Average number of eggs wasted (Mean±SD)	2±1.3[a] (0-6)	2±1.7[a] (0-12)	3±1.6[a] (0-8)	2.3±1.6 (0-12)
Average number of birds reached grower stage (Mean±SD)	6.9±2.5[a] (3-15)	6.8±2.2[a] (2-14)	6.3±2.3[a] (0-14.3)	6.7±2.4 (0-15)
Average percent of birds reached grower stage (Mean±SD)	60.4±13.8[a] (25-92)	60.8±15.9[a] (22-100)	60.2±19.3[a] (0-100)	60.5±16.4 (0-100)
Average hatchability performance of local hens (%) (Mean±SD)	85.7±10[a] (47-100)	84.6±12.6[a] (0-100)	76.9±11.2[a] (53-100)	82.6±11.5 (0-100)

[a,b,c] Least square means with different superscript within a raw are significantly different ($P < 0.05$)

* Numbers in bracket are range

Referring to Amhara bureau of agriculture and rural development, Zelleke (2005) reported that the average hatchability performance of the modern incubators found in governmental poultry breeding and multiplication centers of Amhara region, under standard breeding conditions, was estimated to be 69 %, which is lower than the hatchability performance of local broody hens of the study wereda identified in this study.

Similar hatchability performance results of village hens were reported by different researchers as follows: a hatchability performance of 83 % was reported in Guinea local breed chicken by Mourad *et al.* (1997); a hatchability percentage of 50–100% and 60–90% were also reported in United Republic of Tanzania and Burkina Faso local chicken, respectively by Minga *et al.* (1989) and Bourzat *et al.* (1990), as sited by Aichi *et al.* (1998). Likewise, an average hatchability of 82 % was reported in communal area of Zimbabwe by Kusina *et al.* (2000). However, Kitalyi (1998) reported a hatchability percentage of village hens, which was lower than the findings of this study, in a number of African countries. On the other hand, Bakst and Bahr (1993) reported a hatchability performance of 90 % in commercial layers and broilers.

From the total number (11) of chicks hatched, 6.7 chicks (ranged 0-17) were reached to grower stage (12 weeks of age) and hence the average percent of chicken survivability was 60.5%. The average number of eggs incubated was relatively lower in low-land agro-ecology of the study area. This might be attributed to minimizing the risk of high temperature on hatchability of eggs. However, average percent of chicken reached grower stage and average hatchability percentage of hens found in different agro-ecologies were similar.

According to Kitalyi (1998), the reasons for the differences in hatchability performance of local broody hens might be attributed to the time or season of the year when the study was conducted, since hatchability of eggs using broody hens was highly affected by season of incubation. In this regard, all chicken owners found in different agro-ecologies of the study area were asked to mention the non-preferred months of the year for eggs incubation and brooding of young chicks using broody hen.

The result of the current study indicated that April (78.9%) and July (63.2%) were the first and second most non-preferred months of the year for eggs incubation & brooding of chicks in the study area, respectively. Poor hatchability of eggs, due to high solar temperature in April and poor survivability performance of young chicks due to mud, rain (cold stress) and predators in July were some of the main reasons mentioned by chicken owner farmers for refusal of egg incubation and brooding of young chicks in the above mentioned months of the year.

Though broodiness is an important trait and sole means of egg incubation and brooding of young chicks, it is believed to be one of the major reasons for the low egg productivity of local hens. In this regard, chicken owner farmers were asked if they had any indigenous practices used to reduce broody nature of local hens. The result showed that 98.6% of interviewed chicken owners used various indigenous practices to reduce broodiness, especially when they used the eggs for different purposes other than incubation. Accordingly, changing the hen's house was found the most preferred practice implemented by most chicken owners (68.2%) of the study area. Other identified practices included; hanging the hen upside down for a day or two (24.3%) and spraying water on hen's body and its place (6.1%).

It is recognized that all the above practices were implemented with the aim of creating stress on the hen, to let it forget broodiness and bring in to production with relatively short period time. However, it is documented that some of the practices like, hanging hen upside down were dangerous and might result in death of the hen. Appendix table 7.3.10 shows the various indigenous practices implemented by village chicken owners of the study area to reduce broody nature of local hens.

Concerning frequency of egg lying, the majority of local hens (99.3%) and cross breed hens (90%) lay eggs every day (daily) during feed surplus season. However, during feed shortage season the majority of local breed hens (76.4%) and cross breed hens (61.1) reported to lay eggs every other day and every three days, respectively. The result showed that local hens are more preferred, resistant and productive than cross breed hen during stress seasons.

Regarding culling of birds, 93.9% of chicken owners of the study area had their own indigenous knowledge of culling chicken purposely. The main identified type of culled birds from the flock were; old aged birds (51.4%), lower producers (23.6%), sick birds (16.8) and chicken more than need, mainly cockerels, to reduce cannibalism (8.2%).

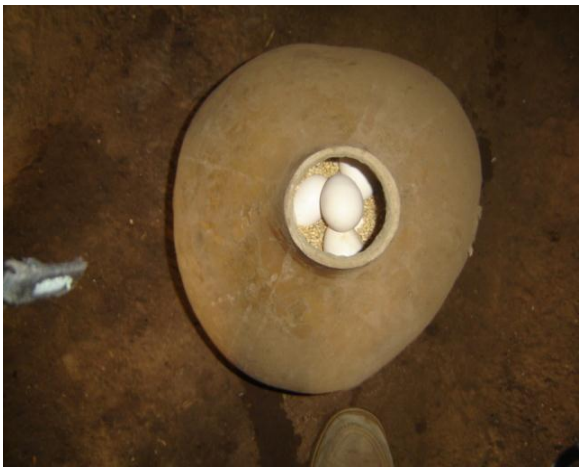
The average culling age of matured cocks was 2.7 years and there was no any significant difference among different agro-ecologies in average culling age of cocks (Appendix table 7.3.11). The average culling age of cocks observed in this study was longer than the culling age of exotic breed cocks found at poultry breeding and multiplication center's of the region, which is 1 year. The fate of culled cocks were; sale at market or in the surrounding (48.2%), consumption and/or sale (48.2%) and home consumption only (3.6%).

70.7% of chicken owner farmers of the study wereda had their own cocks for reproduction purposes and the rest (29.3%) used cocks coming from their neighbors. 50% of those cock owners used local breed cocks and the rest (20.7%) used either pure exotic/cross breed cocks or a combination of local and exotic breed cocks. The major sources of local cocks were; home hatched/grown (36.8%) and purchased from market (13.2%). Appendix table 7.3.12 showed details on breed type and source of cocks for reproduction purposes in the study area.

Regarding selection of cocks 92.2% of chicken owner farmers of the study wereda had the tradition of selecting cocks for replacement stock. It is discovered that observing plumage color (45.4%), looking its physical stand and shank length (37.1%), looking the type of comb (8.6%) and looking parents performance or pedigree (1.1%) were some of the major criteria's observed by village chicken owner farmers for selection of cocks as a replacement/breeding stock (Appendix table 7.3.12).

Related selection of broody hens, the result of the current study revealed that 86.4% of village chicken owners of the study wereda had a culture of selecting broody hens used for breeding/ egg incubation purposes. According to interviewed farmers; looking hen's past egg incubation performance (73.9%), presence of big body size (7.9%), presence of thick feather (2.1%), size of eggs laid (2.5%) were some of the major criteria's observed by chicken owner farmers in selection of broody hens, respectively.

Concerning storage of eggs for incubation, sale and consumption purposes, 71.4% of village chicken owner farmers, mainly women, stored eggs inside earthen material (clay) together with grains or straws. Figure 4 showed some pictures of various locally made containers used for egg storage. Regarding duration of egg storage, it is observed that 95 % of village chicken owners in the study wereda stored eggs until the hen finished laying and started broodiness. Appendix table 7.3.13 shows details on egg storage conditions of the study wereda.



Egg storage inside clay with grain

Egg storage inside clay with straw

Egg storage in mud made container with grain

Egg storage in bamboo made container

Egg storage in grass container with grain

Figure 4. Some pictures of egg storage systems in Burie wereda, North-West Amhara

It is discovered that 56.1% of chicken owners of the study area did not select eggs for incubation purposes and used all eggs laid. Lack of awareness about the use of grading eggs (29.6%), shortage of eggs and inability to select from it (14.7%) and lack of attention (11.8%) were some of the major reasons identified for absence of grading eggs before incubation.

Majority of chicken owner (54.3%) in the study wereda had a tradition of mixing eggs, obtained from different or similar breed hens, during incubation. According to interviewed chicken owners, mixing of eggs was done mainly when the number of eggs laid and stored is few in number to be incubated by a single hen or when they needed to use eggs from improved breed hens or cocks. Regarding egg setting position during incubation, 67.5% of chicken owners did not mind about the egg sitting position during incubation and responded that they put it randomly (Appendix table 7.3.14). It is known that eggs are set in broad-end up position inside modern incubators for incubation.

Concerning container types used for egg incubation; broken earthen material (locally called *'dist'*) was the most preferred type of container (57.9%) used in the study area. In addition; grass made material (locally called *'kuna')* and bamboo material (locally called '*Kirchat*') were the second and third preferred type of containers used for egg incubation, respectively. Some pictures of container types used for incubation of eggs were presented in figure 5.

Regarding bedding materials during egg incubation, it is identified that every chicken owner (100%) of the study area used various types of bedding materials during egg incubation. Straw (like; teff, wheat and barley) and dry grass (hay) were the first and second preferred type of bedding materials used during egg incubation, respectively (Appendix table 7.3.15).

Egg incubation on grass made container, with dry grass

Egg incubation on the ground, with dry straw

Egg incubation on wood made container, (‘gebete’), with dry grass

Egg incubation on earthen container (‘dist’), with straw

Egg incubation on grass made container (‘kuna’), with straw

Egg incubation on bamboo made container (‘kirchat’), with straw

Figure 5. Some pictures of container types & bedding materials used for egg incubation with local broody hens in Burie wereda, North-West Amhara.

4.4.5. Records and record keeping in village chicken production system

The result of the current study showed that 97.9% of chicken owners in the study area had no culture of keeping records related to village chicken production activities. Lack of awareness and knowledge about the use of records and record keeping (65.7%), lack of attention, due to presence of small flock size and productivity (25%) and lack of time (7.2%) were some of the major reasons mentioned by village chicken owners for lack of records and record keeping.

4.4.6. Division of household labor in village chicken production system

The result of the current study showed that family labor for village chicken husbandry practices was provided by all family members of the household. Table 12 showed details of family labor allocation with relation to village chicken husbandry and marketing.

Men were responsible for activities like construction of shelter (97.5%) and taking sick birds for treatment (89.3%). However, women were highly responsible for many activities like cleaning bird's house (38.6%), provision of supplementary feed to birds (80.7%), selling of chicken (46.8%) & selling of eggs (54.6%). Children also participated, alone and together with other family members, in various village chicken husbandry activities like cleaning of bird's house, provision of supplementary feed and water to chicken.

The result was similar with the findings of Bradley (1992), who declared that management of village chicken had been highly associated with women for various historical and social factors. Riise *et al.* (2004) and Kitalyi (1998) also reported that women and children were generally in charge of rural village chicken husbandry practices in developing countries.

Table 12. Households labor allocation for village chicken husbandry activities in Burie wereda, North-West Amhara (N=280)

Responsible member of the household	Type of village chicken husbandry activity						
	Shelter construction (%)	Cleaning chicken house (%)	Provision of supplementary feed (%)	Provision of water (%)	Selling of chicken (%)	Selling of eggs (%)	Treatment of sick birds (%)
Men	97.5	-	-	-	1.1	-	95.4
Men & Children	2	-	-	-	42	-	4.6
Women	0.5	38.6	80.7	82.9	46.8	54.6	-
Children	-	46	-	-	1.1	1.1	-
Women &Children	-	15.4	12.9	17.1	1.1	43.2	-
Men & Women	-	-	1.4	-	7.9	1.1	-
All family	-	-	5	-	-	-	-
Grand Total	100	100	100	100	100	100	100

Abubakar (2007) also reported that women & children involvement was by far the highest on village flocks management labor profile activities included; sheltering birds (shut down & let out), cleaning bird's house, feeding and watering of birds in some parts of Nigeria and Cameroon. Mapiye *et al.* (2005) also reported that women, in Rushinga district of Zimbabwe, were dominated in most of the activities on village chicken production like; feeding (37.7%), watering (51.2%) and cleaning of bird's house (37.2%) where as men were dominant in shelter constructions (60%) and treatment of chickens (40%).

Regarding decision making, the result of this study revealed that both men & women together were decision makers in various village chicken production and marketing activities including: selling eggs (78.2%), selling chicken (69.3%), consumption of eggs (93.2%) and consumption of chicken (92.9%). However, men alone were found to be decision makers of the household: to buy drugs for sick birds (88.6%) and to buy replacement stock (67.9%).

Although women and children were the major responsible members of the household for various village chicken husbandry practices of the study wereda, they could not pass any critical decision in men-headed households with related to village chicken husbandry, marketing and consumption alone. Table 13 showed decision makers of the household members with relation to chicken husbandry, marketing and consumption of chicken products.

The result of the current study revealed that purchasing of birds for replacement stock was the major important type of village chicken production activity on which the majority of chicken producers (49.6%) of the study area invested money. Appendix table 7.3.17 showed type of village chicken production activity where chicken owner farmers of the study area pay cost.

Table 13. Decision maker of household members in village chicken production and marketing activities of Burie wereda, North-West Amhara, (N=280).

Chicken production and marketing activity needed decision making	Decision maker of the household member (%)		
	Men alone (%)	Women alone (%)	Men & Women (%)
Selling of eggs	21.1	0.7	78.2
Selling of chicken	30	0.7	69.3
Home consumption of eggs	6.4	0.4	93.2
Home consumption of birds	6.8	0.3	92.9
Purchasing of drugs	88.6	-	11.4
Purchasing of replacement stock	67.9	-	32.1

4.4.7. Challenges of village chicken production in the study wereda

4.4.7.1. Prevalence of disease and inadequate health care

High incidence of chicken diseases, mainly Newcastle disease, was the major and economically important constraint for the existing village chicken production system of the study wereda resulting in reduction in number and productivity of village birds. The current study revealed that the first major causes of chicken death/loss over the study area were seasonal outbreaks of diseases, mainly Newcastle disease. According to interviewed chicken owners, mortality of village birds due to disease outbreaks was usually higher during the start rainy season, mainly on April (66.8%) and May (31.4%). Gueye (1998) also reported that one of the major causes of chicken loss and constraints to village chicken production in Africa was the prevalence of diseases.

Serkalem *et al.* (2005) also reported that NCD was one of the major infectious diseases affecting productivity and survival of village chickens in central high lands of Ethiopia. Similarly, Kusina *et al.* (2000) reported that NCD was identified and accepted as the greatest danger to the expansion of chicken production in Zimbabwe. Various studies estimated the mortality of village chickens due to NCD disease as followed: 50% up to eight weeks of age in Burkina Faso and Northern Ghana (Wilson, 1986; Veluw, 1987), 66% in 12 weeks of age in Senegal (Gueye, 1998) and 80% in rural Africa (Spradbrow, 1993). Gueye (2000) also reported that mortality of village chicken was high and could reach up to 53% until four weeks of age in Africa.

According to the result of the study village birds kept mainly on scavenging systems of the study wereda were exposed to NCD virus due to contact between birds during scavenging. Exchange of birds from a flock where the disease is incubating at market was also identified as the other way of spreading NCD disease from village to village in the study area.

The availability of vaccines and veterinary drugs to village chicken producers of the study area was generally poor. Lack of awareness about vaccines and vaccination and lack of attention were the major reasons identified for the prevalence of NCD in wide range. It is also discovered that the available vaccines and drugs were relatively expensive and sold in large quantity batches (for example, in 50 doses for NCD vaccines) that they were uneconomic for farmers, who generally keeps a small sized flock.

Chicken ecto-parasites, like mites were the other economically important chicken health constraints affecting both village chicken & producer farmers, inside the house. Permin and Pedersen (2000) also reported that intestinal & ecto-parasites were economically important constraints in village chicken production, causing high mortality.

The other economically important and newly introduced disease in to village chicken production system of the region, which seriously affected the two poultry breeding and multiplications centers of the region, is Gumboro or Infectious Bursal Disease (IBD). It has an immuno-suppressive effect, resulting in a poor response to vaccination and increased susceptibility towards other pathogens. The disease was believed to be transmitted through distribution improved breeds of day old chicks. Some veterinary research reports conducted in the region showed that there were some indications that IBD is being introduced in to some villages out side the breeding and multiplication centers. This will be very disastrous for village chicken production system unless some actions could be made on evaluation of its prevalence rate, preparation and distribution of effective vaccines.

The result of the current study identified that there is a need for serious intervention in disease control so as to improve chicken production and productivity in the study wereda. With this regard, Javed *et al.* (2003) reported that village chicken vaccinated against diseases like Newcastle (NCD) and Fowl-Pox performed better than others. Control of chicken diseases in the study area could be achieved through improvement in veterinary and advisory services. It is also found vitally important to conduct further detailed studies focusing on identification NCD virus strain and prevalence rate of IBD in the study area so that preventive and control programs could be formulated.

4.4.7.2. Predation (impact of predators)

Predation was the other economically important constraint for village chicken production system of the study area. Halima (2007) also reported that predation was one of the major village chicken production constraints in North-West Ethiopia. Bell and Abdou (1995) also reported that a large proportion of village birds were being lost due to predators in some African countries.

According to village chicken owners, wild birds (locally called *"chilfit")* were the first major and dangerous type of predators (59.3%) affecting village chicken in the study area. The attack of wild birds was very serious on young chicks (73.2%). In addition to wild birds, *"Aner"* (36.8%) and wild cats (3.9%) were the other economically important predators affecting village chicken production in the study wereda. The prevalence of wild birds in the study area was severe in all seasons of the year. However, other types of predators were dominant mainly during the rainy season, when vegetation was higher around the home stead.

According to interviewed chicken owners, keeping birds at home by providing feed and water (47.9%) and killing predators using toxins, dog and other materials (33.9%) were the most preferred control mechanisms of predators. Appendix table 7.3.16 showed details on causes of chicken loss, type of predators & control mechanisms. The problem of predators dictated that preparation of 'predator proof' chicken houses could help to reduce losses, especially during the night. Chicks also needed to stay in protected areas for the first 4–5 weeks of life as a way to avoid predators and accidents. Protection of young chicks, especially from wild birds was found critical, as this is the time when they are most vulnerable to predators.

4.4.7.3. Poor productivity of local chicken ecotypes

The result of the repeated survey study revealed that the productive performance of village chickens in the study area was relatively low. However they were more adapted to the adverse climatic and management conditions of the study area. Most chicken owners of the study area showed a great interest towards improved chicken breeds, so as to upgrade the blood levels of their local birds and improve their productivity.

Distribution of 3 month old chicks and day old chicks of improved chicken breeds, mainly RIR & WLH, has been one of the livestock extension packages accomplished by the regional bureau of agriculture, since the last 20 years, aiming at improving chicken production & productivity of the region, including the study wereda. The package is being implemented in many ways like 5 pullets & 1 cockerel, 1 cock, 15 pullets & 2 cocks and 50 day-old chicks.

However, Halima (2007) reported that such a random distribution of exotic chicken breeds was believed to dilute the local genetic stock. FAO (1999) also reported that the main cause of the loss of indigenous animal genetic resources (AnGRs) was the random introduction of exotic genetic resources with out proper characterization, utilization and conservation of indigenous genetic resources.

Therefore, it is highly advisable to re-consider the package of random distribution of exotic chicken breeds so as to reduce dilution and extinction of our local genetic resources. Further studies should be conducted on identification of how, when and where the distribution of these improved breeds should be done.

4.4.7.4. Poor chicken management (feeding, housing and health care)

According to the response of interviewed chicken owner farmers and visual observation through various villages; production losses due to poor chicken management was discovered as one of the main village chicken production constraint of the study area.

4.4.8. Provision of agricultural extension services

The Ministry of agriculture and rural development has given a due attention towards improving agricultural productivity and thus assigned 3 development agents per each farmer kebeles of most administrative districts of the region, including the study wereda. The extension agents were specialized in animal science, crop science or natural resources conservation and found acted mainly on their profession. Most interviewed chicken owner farmers of the study area reported that the present extension approach was better than the former system, where only one development agent had been assigned per each kebele.

The study reveled that only 37.5% of chicken owner farmers of the study area have been getting proper agricultural extension service related to village chicken production like; advisory service, trainings, credit & input facilities. On the other hand, agricultural extension was identified as the main source of information about improved chicken production system for only small proportion (37.5%) of chicken owners (Appendix table 7.3.18).

Lack of access to get extension agents was the main reason (31.8%) identified for absence of proper extension service with regard to village chicken production. The proportion of farmers who obtain extension service (37.5%) was lower than the reported 52.5% in North-West Ethiopia by Halima (2007).

4.5. Chicken and egg marketing systems of the study wereda

4.5.1. Characteristics of chicken and egg markets

The result of the current study revealed that there was no any formal chicken and egg marketing operation in the study wereda. Village chicken producers, consumers, middle men (chicken & egg collectors) and local restaurants/hotels were some of the main actors involved in the system. Marketing of chicken and eggs in the study wereda was practiced in various places including farm gates, village/primary markets and main markets (urban market).

Two types of market days namely; conventional (fixed) & non-fixed (random) were identified in the study wereda. Saturday was known as a conventional market day in the study wereda. In addition to Saturday, other weekly days were also used as fixed market days in various local & urban markets of the study area. For example, Tuesday & Wednesday, in addition to Saturday, were used as a fixed market day at Burie & Kuch areas, respectively. Alternatively, the random markets, locally called *"Arada markets"*, became strong when the date lied on the monthly memorial holyday of Ethiopian Orthodox church.

4.5.2. Chicken marketing

The current study showed that 99.6% of interviewed village chicken owner farmers involved in marketing of live chicken since sale of birds as source of income is the major reason for them to keep village chicken. The sale of live birds takes placed in various places including: urban market (Burie town), local markets (Kuch market, Alefa market, Derekua marketm, Sontom market) and around the villages (farm gates). Burie open market was the only big urban market available for chicken marketing in the study wereda.

The major groups of village chicken sold more frequently were; surplus males (especially cocks), old and non productive hens and some times sick birds. Young and productive birds were often sold just before the onset of high risk period of Newcastle disease, mainly during the start of the rainy season.

Chicken prices were not similar and fluctuated during the year, generally low in the rainy season and high in the dry season. Bargaining was common in chicken marketing system of the study wereda and price of birds is fixed by negotiations. Similar to prices, supply and demand of chicken were not similar through out the year and affected by various factors.

Women and children were the major members of the household involved in marketing of live birds. According to the result of the study, urban market (Burie) was the first priority place to sale birds for most village chicken producers (64.7%) of the study area. The rest of chicken marketing and exchange was takes placed in local markets and farm gates around the village.

Regarding the marketing channel of village chicken, most chicken owners (37.9%) sold their birds directly to consumers & middle men (chicken collectors), who are involved in chicken marketing. The rest of the birds were usually sold to other urban and rural chicken producers and retailers (hotels and restaurants). Chicken collectors in turn sold birds either to consumers or to other chicken traders, who often found at important crossroads and well-known spots on main truck roads like Tillili town. Figure 6 showed details of the marketing chain of live birds and eggs in the study wereda.

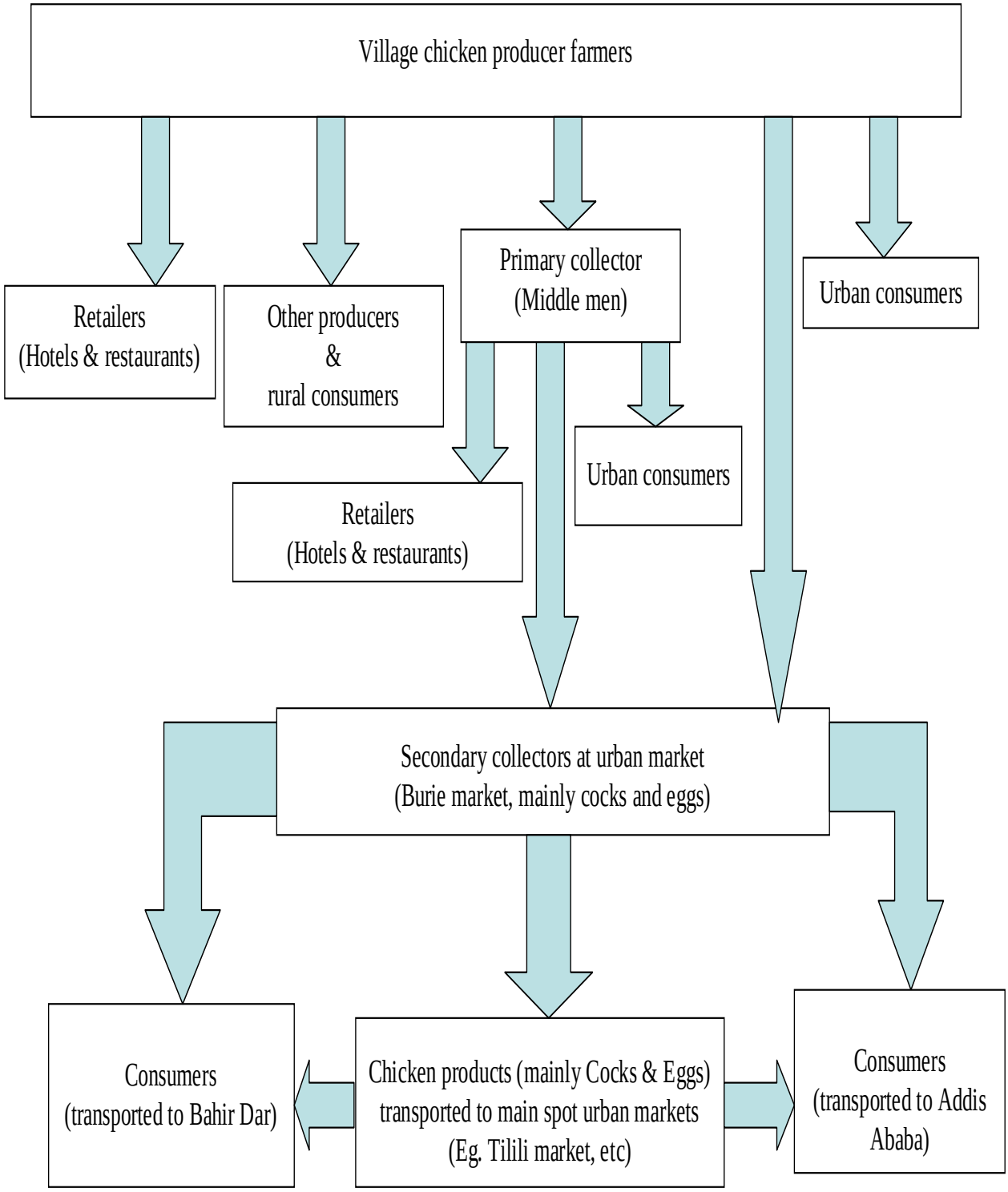


Figure 6. Marketing chain of chicken and eggs in Burie wereda, North-West Amhara.

Concerning means of transportation of chicken to urban and rural markets, it is identified that the majority (59.3%) of chicken owners used both hand carrying (hanging birds with a piece of stick) and carrying birds with bamboo-made containers. The bamboo-made container (locally called *'kirchat'*) was mainly carried by women and used for transportation of different farm products, including live birds. Figure 7 showed some observed pictures of chicken transportation to local and urban markets in the study area. In spite of the fact that such means of transportation was believed to cause discomfort and little welfare to birds, only 11% of chicken owners reported chicken death during transportation, especially during the rainy and disease out break seasons.

The result of the current study revealed that village chicken owner farmers traveled, on average, a distance of 5.5 km (ranged 2.5-15 km) and 15.9 km (ranged 3-35 kms) to reach to nearby local markets and urban markets, respectively (Table 14). The current study showed that village chicken owners found in lowland agro-ecologies are having poor access to local and urban markets as compared to those farmers found in highland and mid-altitude areas. Chicken owners farmers found in mid-altitude areas were more fevered in getting the nearby Burie urban market for chicken and egg marketing. This was due to the high concentration of local markets and urban market around the mid altitude and highland area and poor road accessibility of roads in remote lowland areas.

Access to markets, which greatly influences chicken and egg marketing system of the study wereda, was mainly determined by distance to the market, which agrees with the reports of Holloway and Ehui (2002). The result of the study also showed that.

Carrying of birds hanging with stick

Transport of birds with bamboo container

Hand carrying of birds

carrying of birds hanging with stick

Transport of live birds with bamboo container

Collection of cocks at local markets

Figure 7. Some pictures of transportation of live birds to local and urban markets

Table 14. Average distance travel (km) by village chicken owners to reach market places of the study area (N=280).

Variables	Agro-ecology			Grand mean (%)
	High-land (N=80)	Mid-altitude (N=120)	Low-land (N=80)	
Average distance travel (kms) to reach the nearby local markets (Mean±SD)	4.5 ±1.5[a] (5.5)*	5.0 ±1.7[a] (9.5)	7.3±3.7[b] (12.5)	5.5 ±2.6
Average distance travel (kms) to reach Burie urban market (Mean± SD)	14.7 ±3.8[b] (15)	7.9 ±2.7[a] (12)	29.0±3.1[c] (10)	15.9 ±9.3

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

* Numbers in bracket are range values

4.5.3. Egg marketing

As discussed above, selling of eggs for income generation was identified as a second major important function of chicken eggs in the study area next to incubation/hatching. The result of the current study indicated that 69.3 % of village chicken owners of the study area were involved in selling of eggs. Similar to chicken marketing, selling of eggs takes placed in various places of the study area including: urban markets, local markets and farm gates. Women & children were the most important members of the household that involved in marketing of eggs. Most consumers preferred to buy local eggs from producers as they were considered to be tasty and the dark colored yolk was commonly favored.

Urban market was the first priority place for most chicken owners of the study area (70%) to sale eggs followed by nearest local markets and farm gate sales. The price of eggs, like that of birds, was not similar during the year; generally low during the Orthodox Christian fasting months. Similarly, the supply & demand of eggs were not similar through out the year, generally higher in dry seasons and relatively low in rainy season.

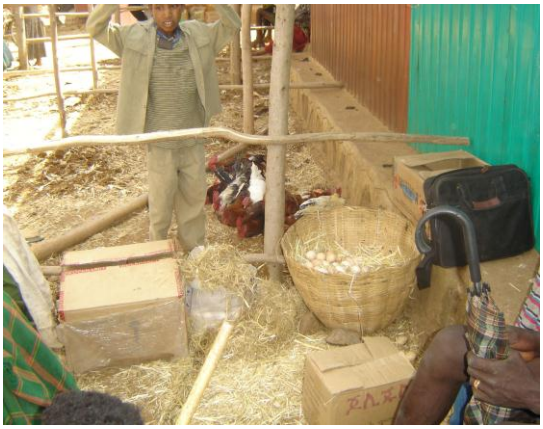
The marketing of eggs in the study area followed a similar root (channel) to that of the chicken marketing. Most chicken owners (45%) of the study area sold their eggs directly to consumers and/or egg collectors. Retailers, mainly involved in hotels & cafeteria services, were also involved in marketing of eggs, as indicated in Figure 6. In addition to selling, exchange of fertile eggs obtained from improved chicken breeds, with other village chicken producers was common in the study area.

The result of the current study revealed that majority of chicken owners (66.4%) used hand carrying (using piece of cloths with grains/straw) to transport eggs to urban & local markets. In addition to its use in storage of eggs until incubation/marketing, the grain/straw also used to protect eggs from breakage during transportation to markets. Plastic containers and local grass made bags (locally called *'kofeda'*) were also used to transport eggs to markets. Egg collectors/traders used mainly big cartoons and bamboo-made containers (locally called 'kirchat') to collect eggs and transport to its final destination. Figure 8 shows few observed pictures of egg transportation and collection in the study wereda.

Transport of eggs with a piece of cloth, with grain

Transport of eggs with a piece of cloth, with straw

Transport of eggs with a plastic bag



Egg collection with cartoon and bamboo made container

Transport of eggs with a piece of cloth using straw

Transport of eggs with grain

Figure 8. Pictures of eggs transportation and collection in Burie wereda, North-West Amhaera.

4.5.4. Prices and factors that control the price of chicken products

The result of the current study revealed that the price of chicken products varied between months of the year and were determined by a number of driving factors. Some of these determinant factors affecting prices of chicken products in the study wereda included: demand and supply of chicken products, agro-ecology (highland, mid-altitude and lowland), product type (sex, age, breed, comb type, etc), season of the year (dry and rainy), market type (urban vs local markets), market day types (holyday vs ordinary market days), fasting seasons (eg. Pre-Easter fasting season) and the dramatic increase in price of large and small ruminants (sheep, goats and cattle). Table 15 shows the mean price of chicken products in different seasons and agro-ecologies of the study wereda for the year 2007/2008.

As discussed above the price, demand and supply of chicken products were highly related with religious festivals, mainly Christian festivals. For instance; the price, supply and demand of live birds increased in the high-sale periods like Easter (‘Fasika’) and Christmas (‘Gena’). On the other hand periods of low prices coincided with times of low sales (demand) such as, the pre-Easter fasting period. Table 15 showed the average price of chicken products during ordinary market days and on eves of festivals of the study area for the year 2007/2008.

According to the result of the study, a significant difference in market price of chicken products was recorded in between ordinary market days and festival market days. The percentage increase in market prices of chicken products in festival market days as compared to ordinary market days was presented as follows; 19.2% for matured male birds, 15.3% for matured female birds, 24.2% for pullets/cockerels and 16% for eggs.

Table 15. Mean prices of chicken and eggs in ordinary market days and on eves of festivals in Burie, Ethiopia (2007/2008) (N=280)

Market time	Price in birr of birds (by age and sex) and eggs (No of eggs/1 birr)			
	Mature male (mean ± SD)	Mature female (mean ± SD)	Growers (mean ± SD)	Eggs (No of eggs/1 birr)
Ordinary weekly market days	21.8±3.3[a] (14)*	17.9±3.1[a] (15)	13.3±2.7[a] (13)	2.4±0.4[b] (1)
Market days of eves of festivals				
Eth. new year (Sept 12)	27.5±2.7[e] (9)	21.9±3.1[f] (11)	17.6±2.7[f] (11)	2±0.2[a] (1)
Meskel (Sep. 30)	25.6±3.1[c] (12)	20.7±2.9[d] (11)	16.4±2.5[d] (11)	2±0.2[a] (1)
X−mass (“Gena”)	25.8±2.9[dc] (12)	20.4±3.0[cd] (11)	16.2±1.8[cd] (11)	2±0.2[a] (1)
Easter (“Fasika”)	26.7±2.6[f] (12)	21.3±2.6[e] (12)	16.8±2.1[e] (11)	2±0.2[a] (1)
Muslim holydays	24.3±2.1[b] (9)	19.2±2.6[b] (13)	15.6±1.8[bc] (11)	2.1±0.2[a] (1)
Festival mean (Birr)	26±1.2	20.7±1.02	16.5±0.74	2±0
Overall mean (Birr)	25.3±2.02	20.2±1.46	16±1.47	2.1±0.16
Mean increase of prices in festival markets (%)	19.2	15.3	24.2	16

[a,b,c,d,e,f] Least square means with different superscripts within a column are significantly different ($P < 0.05$), using LSD

* Numbers in bracket are range values

- 8.60 Eth. Birr was equivalent to 1 USD

As discussed above, agro-ecology and season were important factors affecting the price of chicken products in the study wereda. With regard to agro-ecological location, the lower prices of chicken products were reported from village chicken producers living in the lowland areas. This was because of the fact that chicken producer farmers found in lowland agro-ecologies are living very far from the only urban market of the study wereda and forced to sell their chicken products in the nearest local markets with relatively lower prices.

Relating to season, lower prices of chicken products were recorded in rainy seasons as compared to that of dry season. This was highly correlated with the demand and supply of chicken products in different seasons. Due to the negative impact of diseases and predators, the supply of chicken products during the beginning of the rainy season was very high and that reduces the demand and price of products. However the interaction effect of season and agro-ecology on chicken and egg prices was not significant. Table 16 and table 17 showed the effect of agro-ecology and season on prices of chicken products respectively.

Productive birds and fertile eggs were also involved in the marketing system of the study wereda. The price of fertile eggs was higher than that of table eggs, may be doubled. The marketing of fertile eggs was usually pre-arranged between the buyer and seller for timely collection and proper pre-incubation storage and mostly done at the farm gate. The result of the study revealed that intermediaries were not involved in fertile egg marketing. The study indicated that 85% of chicken producers in the study area obtained information, about the current prices of chicken products, from other farmers (neighboring farmers). All village chicken owners reported that the price of chicken products was doubled over those ten years and they also explained that the price trend was still increasing.

Table 16. Effect of agro-ecology on prices of chicken products in dry and rainy seasons at Burie, Ethiopia (2007/2008) (N=280)

Agro-ecology	Price in birr of birds (by agro-ecology, season, age and sex of birds) and eggs (No of eggs/1 birr)							
	Matured male bird (Cocks)		Matured female bird (Hens)		Pullets and Cockerels		Eggs (No of eggs/1 birr)	
	Marketing season		Marketing season		Marketing season		Marketing season	
	Dry (mean±SD)	Rainy (mean±SD)	Dry (mean±SD)	Rainy (mean±SD)	Dry (mean±SD)	Rainy (mean±SD)	Dry (mean±SD)	Rainy (mean±SD)
High-land	25.6 ±3.2 [a] (14)*	21 ±2.6 [a] (14)	22.4 ±2.7[b] (11)	16 ±1.5[b] (10)	15 ±1.9 [b] (9)	10 ±1.6 [a] (9)	3 ±0.2[b] (1)	2 ±0.2 [a] (1)
Mid-altitude	25.7 ±3.4 [a] (16)	20 ±3.7 [a] (18)	22.8 ±3.2[b] (15)	16 ±2.4[b] (15)	14 ±2.9 [a] (14)	10 ±2.7 [a] (12)	2 ± 0.3[a] (1.5)	2 ± 0.3 [a] (1.5)
Low-land	24.6 ±3.7 [b] (15)	19.7 ±3 [a] (14)	21 ±3.5[a] (17)	15 ± 1.9[a] (10)	14 ±2.4 [a] (9)	10 ±1.9 [a] (9)	2 ±0.3[a] (1)	2 ± 0.3 [a] (1)
Total (Study area)	25.4±3.4 (19)	20.2 ±3.3 (18)	22.2±3.3 (17)	15.9±2.0 (15)	14.2±2.5 (14)	10.2±2.2 (12)	2.4±0.3 (1.5)	2 ±0.3 (1.5)

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

* Numbers in brackets are ranges values;

- 8.60 Eth. Birr was equivalent to 1 USD

Table 17. Effect of season on prices of chicken products in different agro-ecologies at Burie, Ethiopia (2007/2008) (N=280)

Agro-ecology	Price in birr of birds (by agro-ecology, season, age and sex of birds) and eggs (No of eggs/1 birr)							
	Matured male bird (Cocks)		Matured female bird (Hens)		Pullets and Cockerels		Eggs (No of eggs/1 birr)	
	Marketing season		Marketing season		Marketing season		Marketing season	
	Dry (mean±SD)	Rainy (mean±SD)	Dry (mean±SD)	Rainy (mean±SD)	Dry (mean±SD)	Rainy (mean±SD)	Dry (mean±SD)	Rainy (mean±SD)
High-land	25.6 ±3.2[b] (14)*	21 ±2.6 [a] (14)	22.4 ±2.7[b] (11)	16 ±1.5[a] (10)	15 ±1.9[b] (9)	10 ±1.6[a] (9)	3 ±0.2[b] (1)	2 ±0.2[a] (1)
Mid-altitude	25.7 ±3.4[b] (16)	20 ±3.7[a] (18)	22.8 ±3.2[b] (15)	16 ±2.4[a] (15)	14 ±2.9[b] (14)	10 ±2.7[a] (12)	2 ± 0.3[a] (1.5)	2 ± 0.3[a] (1.5)
Low-land	24.6 ±3.7[b] (15)	19.7 ±3[a] (14)	21 ±3.5[b] (17)	15 ± 1.9[a] (10)	14 ±2.4[b] (9)	10 ±1.9[a] (9)	2 ±0.3[a] (1)	2 ± 0.3[a] (1)
Total (Study area)	25.4±3.4[b] (19)	20.2 ±3.3[a] (18)	22.2±3.3 (17)	15.9±2.0[a] (15)	14.2±2.5[b] (14)	10.2±2.2 [a] (12)	2.4±0.3[b] (1.5)	2 ±0.3[a] (1.5)

[a,b]Least square means with different superscripts within a row of each product type are significantly different ($P < 0.05$)

* Numbers in brackets are range values;

- 8.60 Eth. Birr was equivalent to 1 USD

4.5.5. Plumage color and comb type of birds in chicken marketing

As discussed above, type chicken (sex, age, color, comb type, etc) played an important role on market price of village birds of the study area. In addition, most chicken owner farmers considered plumage color and comb type as main determinant factors in selection of birds for production, consumption and marketing purposes.

During the survey, various types of plumage colors and comb types were recorded in different villages & markets of the study wereda. Red & white were most preferred and dominant colors and covered more than half of the chicken population of the study area. The selection of plumage colors was attributed to; attractiveness by the public (presence of high demand) and high sale price in marketing. Regarding comb type, double (rose) comb was more privileged than single comb types in terms of preference, market price and demand.

Concerning price of birds related to color & comb type, the average market price of red and white color local cocks was estimated in different market days. The result revealed that red and white colored matured cocks having a double (rose) type of comb fetched the higher market price as compared to cocks with single type of comb, as indicated in table 18. The highest market prices were recorded in red and white color cocks with double type of comb during Ethiopian new year and Easter holydays. It was attributed to the high demand of those type of cocks by consumers and producer farmers.

Table 18. Market prices of matured male cocks with red and white plumage colors and different comb types in ordinary market days and market days on eves of festivals in Burie, Ethiopia (2007/2008) (N=280).

Type of matured male (cock)		Price in birr of male mature birds (by market type, plumage color and comb type)					
		Ordinary	Market days of eves of festivals				
Plumage color	Comb type	market days (mean ± SD)	Eth. New year (mean ± SD)	Meskel (Sep. 30) (mean ± SD)	X−Mass (mean ± SD)	Easter (mean ± SD)	Muslim holyday (mean ± SD)
Red (‘*Key*’)	Double	24.7 ± 2.9^{a}	29.3 ± 2.7^{f}	27.8 ± 2.9^{d}	27.7 ± 2.9^{cd}	28.4 ± 2.7^{e}	25.5 ± 2.1^{b}
	Single	21.8 ± 2.9^{a}	25.4 ± 2.6^{f}	24.5 ± 2.7^{c}	24.4 ± 2.7^{dc}	25.2 ± 2.4^{ef}	22.6 ± 2.3^{b}
	Mean (Birr)	23.25	27.35	26.15	26.05	26.8	24.05
White (‘*Nech*’)	Double	24.8 ± 24.8^{a}	29.8 ± 2.5^{f}	28.4 ± 2.8^{d}	28.3 ± 2.8^{cd}	28.9 ± 2.7^{ed}	25.6 ± 1.7^{b}
	Single	22.3 ± 2.9^{a}	25.8 ± 2.4^{f}	25.1 ± 2.4^{d}	25.0 ± 2.4^{cd}	25.6 ± 3.7^{ef}	22.9 ± 2.0^{b}
	Mean (Birr)	23.55	27.8	26.75	26.65	27.25	24.25

^{a,b,c,d,e,f} Least square means with different superscripts within a raw are significantly different ($P < 0.05$), using LSD

- 8.60 Eth. Birr was equivalent to 1 USD

4.5.6. Chicken and egg marketing constraints of the study area

The result of the current study indicated that religious/cultural holydays were highly associated with increased chicken products consumption/sales. Orthodox Christian fasting periods were highly related with decreased consumption/demand and caused strong price elevation at the onset of festivities and decrease in fasting periods. Fluctuation (seasonality) in prices of chicken products was the most and prevailing chicken and egg marketing constraint of the study area. Other chicken and egg marketing constraints identified in the area included:

- Low supply (out put) of marketable chicken products due to disease outbreak, predator attack and low productivity of local birds.
- Presence of only few/limited market out-lets, especially on lowland agro-ecologies.
- Lack of appropriate chicken and egg marketing information to producer farmers.
- Lack of storage facilities for chicken products (especially for local eggs) to keep them safe for a long period time and to sale during high demand period.
- Lack of enough space for chicken products marketing in urban markets, Burie market.
- Lack of credits and capital to expand chicken production marketing activities.

With response to the seasonality of chicken prices, planning of village chicken production with careful consideration of high demand seasons could be very important. If village chicken production could be carefully planned and managed to match the fluctuating market demand, economic benefits of the sector might be higher. Formation of marketing plan could be implemented by chicken owners by identifying where and when chicken products would be sold to receive reasonable prices.

Development of market information system at farmer's level and strengthening of agricultural extension services, through trainings and advisory services, to village chicken owners could also be important to alleviate the above mentioned chicken marketing constraints, which in turn resulted in improvement in village chicken production sector of the study area.

4.5.7. Role of middle men (chicken and egg collectors) on marketing system of the study area

The role of chicken and egg collectors was very important in the marketing system of the study area. Depending on the location of the farm dwelling, chicken owners sold their chicken and eggs either to middle men or consumers. The result of the current study revealed that the average age of the chicken and egg collectors involved in the marketing system of the study area was 22.8 years. In addition, most of the traders (60%) were educated (grade 1-6) and un-married. Some of the traders were involved in either chicken or egg marketing and others involved in both egg & chicken marketing.

The result of the marketing study revealed that there were special places for marketing of chicken products in each of the available local and urban markets of the study area. However interviewed traders declared that these special market places were not large enough for proper marketing. Most chicken & egg traders used the activity as part time work to get additional income and purchased chicken and eggs twice per week in all formal & informal market days. According to interviewed chicken and egg collectors, the average profit that they made on selling matured cocks/hens and pullets/cockerels were Eth. Birr 4.25 and 3.88, respectively.

4.6. Egg quality study

4.6.1. External egg quality

A variety of egg quality parameters were considered and analyzed for this specific study. Some of these internal and external egg quality parameters identified included: egg weight, shell thickness, shape index, shell color, yolk color, Hough unit, albumen height and yolk height. All the external egg quality results evaluated in this study was presented in table 19.

Primary external egg quality parameters like, egg shell color, shell cleanness and presence of cracks on shells were evaluated during egg collection. Egg shell color is believed, primarily, to be a breed characteristic although there is often variation among individual hens in a particular flock even if all are of the same breed and ecotype. Though it is not a guide to egg quality, there is usually a consumer preference to either white or brown, which needs to be given a due consideration in marketing eggs.

The result of the study revealed that 49% of eggs collected from the study wereda were white shelled, 45% were light brown shelled and 6% were cream color shelled (Table 19). Similarly, Halima (2007) reported that the shell color of eggs collected from local hens of North-West Amhara were a mixture of white, light brown and cream colors. All the eggs (100%) collected for the study wereda were free from any cracks. Most eggs were believed to be clean when they are laid, but they could be contaminated with manure or other foreign materials later. With this regard eggs were tested with visual observation and the result indicated that only 34% the eggs collected from the study area were with clean shells.

Table 19. External qualities of eggs collected from Burie wereda in 2007/08, (N=600).

parameters	Egg Source		Grand mean (N=600)
	Market purchase (N=300)	Farm gate (Producers) (N=300)	
Shell color (%)			
▪ White (W)	50	48	49
▪ Light Brown (LB)	44	47	45
▪ Cream (C)	6	5	6
Sanitary status of eggs (%)			
▪ Clean	22	45	34
▪ Dirty	88	55	66
Crackness of eggs (%)			
▪ Broken	0	0	0
▪ Normal	100	100	100
Egg weight (g) (Mean ± SD)	43.2±5.0[a] (35-60)*	43.2±3.5[a] (34-54)	43.2±4.3 (34-60)
Dry shell weight (g) (Mean ± SD)	2.3±0.1[a] (2-2.6)	2.2±0.2[a] (2-2.7)	2.3±0.2 (2-2.7)
Egg width (mm) (Mean ± SD)	37.9±2.8[b] (31.6-45.9)	36.3±3.2[a] (31.6-54.5)	37.2±3.1 (31.6-54.5)
Egg length (mm) (Mean ± SD)	51.8±3.5[b] (42.9-59.8)	49.8±4.1[a] (39.0-59.8)	50.8±3.9 (39.0-59.8)
Shape index (%) (Mean ± SD)	73.3±3.2[a] (63.9-82.4)	73.1±4.9[a] (64.7-100)	73.2±4.2 (63.9-100)
Average shell thickness (mm)			
▪ sharp region (Mean ± SD)	0.30 ±.04	0.27±.03	0.27 ±03
▪ equatorial region (Mean±SD)	0.26 ±.03	0.27 ±.03	0.26 ±.03
▪ blunt region (Mean ± SD)	0.24 ±.03	0.24±.03	0.24 ±.03
❖ Average egg shell thickness (Mean ± SD)	0.25 ±.03[a] (0.18-0.34)	0.26 ±.03[a] (0.20-0.34)	0.26 ±0.03 (0.18-0.34)

[a,b]Least square means with different superscripts with in a raw are significantly different ($P < 0.05$)

* Numbers in brackets are range values.

Regarding egg weight, the result of the current study showed that the average weight of eggs collected from different sources of the study wereda was 43g (ranged 34-60g). The result also revealed that there was no any significant difference in average weight of eggs collected from different sources of the study area. The result was similar with the reported 42.9g by Hallima (2007), for eggs collected from seven chicken ecotypes of North-West Amhara. Teketel (1986) also reported an average egg weight of 46g for Ethiopian local breed chicken.

Similar results were also reported by Asuquo *et al*. (1992) for eggs of Nigerian local breed chicken, which was 40.6g. Olori & Sonaiya (1992) also reported an average egg weight of 38.9g, 37.1g, & 37g for Brown, Light Brown & White Nigerian local chicken, respectively. The average egg weight result (43g) obtained from this study was lower than the reported 53.4g by Halima (2007) for RIR chicken breed eggs, but higher than the reported 35-39g by Ahmed (1994) for Bangladesh indigenous scavenging chicken eggs.

Dry shell weight of eggs collected from local hens of the study wereda was estimated using drying oven. Accordingly; the average dry shell weight of local hen eggs collected from different sources of the study area was 2.3g. However, a relatively higher average dry shell weight of 3.95g and 5.7g were reported by Halima (2007) for eggs collected from intensively managed local hens of North-West Amhara and RIR chicken breeds, respectively.

The egg width and egg length measurements were carried out using digital caliper and the result indicated that the mean width and length of local hens eggs collected from different sources of the study wereda were 37.2 mm and 50.8 mm, respectively.

Egg shape index (SI) percentage was calculated using egg width (EW) and egg length (EL) measurements; using the formula [SI = (EW/EL)*100]. Accordingly, the average shape index percentage of eggs collected from different sources of the study area was 73.2 %. The result did not show any significant difference between eggs collected from different sources with related to average shape index percentage. The shape index percentage result (73.2%) obtained from this study was higher than the reported 66.9% for eggs of Nigerian Fulani chicken ecotypes (Fayeye *et al.,* 2005).

Eggs with higher shape index percentages are more circular in shape than that of eggs with lower shape index percentages. The "normal" chicken eggs are supposed to be elliptical (oval) in shape and eggs that are unusual in shape such as; long/ narrow, round and flat-sided could not be placed in grades AA or A in developed world (Silversides, 1994).

The other important external egg quality parameter evaluated in this thesis work was egg shell thickness and it was measured by digital caliper, taken from the narrow side (sharp region), the middle side (equatorial region) and the broad-end side (blunt region) of eggs. Accordingly, the average shell thickness measurements of eggs collected from the study wereda for sharp region, equatorial region and blunt region were 0.27 mm, 0.26 mm and 0.24 mm, respectively. The result of the study also revealed that the sharp region shell was relatively thicker than both the blunt region and equatorial region shell.

Based on the above shell thickness measurements; the average shell thickness of eggs collected from different sources of the study wereda was calculated and found to be 0.26 mm. The result obtained was lower than the reported 0.71 mm & 0.69 mm by Halima (2007) for eggs collected from intensively managed local chicken ecotypes of North-West Amhara and RIR chicken breeds, respectively. Similarly, Teketel (1986) reported an average egg shell thickness of 0.35 mm for Ethiopian local breed chicken eggs. Asuquo *et al.* (1992) also reported an average egg shell thickness of 0.30 mm and 0.35 mm for Nigerian local breeds and Isa-Brown breed chicken eggs, respectively.

The result of the current study also showed that there was no any significant difference between eggs collected from different sources of the study area, with respect to average egg shell thickness. The recognized lower average shell thickness (0.26 mm) might be attributed to deficiency of calcium and phosphorus sources in scavenging feed resource basis, which was the major feed source for village birds of the study area.

4.6.2. Internal egg quality

All the internal egg quality parameter results evaluated in this study are presented in table 20. Haugh unit (HU) was the first important internal egg quality trait identified in this study and it was calculated using the formula: $HU = [100\log_{10} (AH - 1.7EW^{0.37} + 7.6)]$ (Eisen *et al.*, 1962, as sited by Aberra, 2000) where; HU = Haugh unit, AH = albumen height and EW = egg weight. Albumen height & yolk height was measured by using tripod micrometer, and the weight of eggs was measured using electronic balance. Some pictures of the equipments used for egg quality study are presented in annex 2.

The average yolk height and albumen height of eggs collected from different sources of the study area were 15.1mm and 4.1mm, respectively. Accordingly, the average Hough unit was calculated to be 66.5, with a standard deviation of 7.2. The result revealed that there was no any significant difference between eggs collected from markets and farm gates with related to average Hough unit values.

The average Hough unit value obtained from this study was higher than the reported 61.1 by Halima (2007) for eggs collected from local chicken ecotypes of North-West Amhara and lower than the reported 81.0, by the same author for eggs collected from intensively managed RIR chicken breeds. Asuquo *et al*. (1992) also reported higher Hough unit values of 79.8 and 89.9 for eggs collected from Nigerian local hens and Isa-Brown chicken breeds, respectively.

The study indicated that the marketable eggs collected from the study wereda were not best in quality based on the obtained average Hough unit value (<72). This might be attributed to poor handling and storage of eggs until sale, since egg Hough unit value is highly correlated with storage condition and duration of eggs. Therefore interventions focused on increasing awareness of farmers in proper handling of eggs could be important,

The other most important internal egg quality traits considered in this study was yolk color and it was estimated using roach color fun (ranging 1-15). The yolk color of each egg collected from the study wereda was examined by 3 observers and the average value was calculated and recorded. The result revealed that the average yolk color of local hen eggs collected from different sources of the study wereda was 8.6.

The mean yolk color result (8.6) obtained from this study was higher than the reported 3.48 and 4.0 by Halima (2007) for eggs collected from intensively managed local hens of North-West Amhara and RIR chicken breed hens, respectively. Pavlovski *et al.* (1981) also reported that the yolk color score of free range local hens was higher compared to eggs collected from hens managed under intensive chicken management condition. The higher yolk color value obtained from the current study indicated that scavenging feed resource bases of the study wereda were rich in xanthophylls, some of which are precursors of vitamin A.

Table 20. Internal qualities of eggs collected from Burie wereda in 20o7/08, (N=600).

Internal egg quality parameters	Egg Source		Grand mean (N=600)
	Market purchase (N=300)	Farm gate (Producers) (N=300)	
Yolk height (mm) (Mean ± SD)	15.1±1.2 [a] (8.4-18.4)*	15.2±1.4 [a] (11.3-17.5)	15.1±1.3 (8.4-18.4)
Albumen height (mm) (Mean±SD)	3.9±0.74 [a] (2.3-6.7)	4.2±2.60 [a] (2.1-7.6)	4.1±1.93 (2.1-7.6)
Haugh Unit (HU) (Mean±SD)	66.2±6.8[a] (45.2-84.8)	66.9±7.5 [a] (36.4-81.7)	66.5±7.2 (36.4-84.8)
Average yolk color (1-15)	8.5±1.5 [a] (5.3-11.3)	8.7±1.4 [a] (6-11.7)	8.6±1.5 (5.3-11.7)

[a,b]Least square means with different superscript with in a raw are significantly different ($P < 0.05$)

*Numbers in brackets are range values.

4.6.3. Phenotypic correlation of egg quality traits

4.6.3.1. Phenotypic correlation of external egg quality traits

The results of this study revealed that egg weight was significantly and positively correlated ($P<0.05$) with most of other external egg quality traits like; egg width, egg length, egg shape index, egg shell thickness and dry shell weight (table 21). The result was inline with the findings of Farooq *et al.* (1989) and Abanikannda *et al.* (2007), who reported positive correlations between egg weight and other external egg quality traits like; shell weight, egg width, egg length, shape index and shell thickness. However, the significant positive correlation value (0.12) between the egg weight & egg shape index obtained in this study were in disagreement with the negative correlation reported by Iscan and Akcan (1995).

Table 21. The phenotypic correlations between external egg quality traits, (N=600).

External egg quality traits	EWt (g)	EWd (mm)	EL(mm)	SI (%)	ST(mm)	SW(g)
EWd (mm)	0.49**					
EL (mm)	0.45**	0.78**				
SI (%)	0.12	0.44**	-0.22**			
ST (mm)	0.16	0.04	0.1	-0.05		
SW (g)	0.52**	0.09	0.09	0.12	0.38**	

- EWt = Egg weight, EWd= Egg width, EL= Egg length, SI= Shape index, SD= Shell density, ST= shell thickness, SW= Shell weight
- ** Correlation is significant at the 0.01 level (2-tailed).

Egg width was also positively correlated with other external egg quality traits like; egg length, egg shape index and dry shell weight. Egg length was negatively correlated with shape index and positively correlated with shell weight. Shell thickness showed a significant positive correlation with dry shell weight.

4.6.3.2. Phenotypic correlation of internal egg quality traits

A detail of the phenotypic correlation b/n internal and external egg quality traits is presented in table 22. Statistically significant positive correlation ($P<0.05$) was observed in between the albumen height and other egg quality traits like; yolk height and Hough unit. Similarly, statistically significant positive correlation was recorded between yolk height and Hough unit.

Akbas *et al.* (1996) also reported statistically significant positive correlations between internal egg quality traits including; yolk height and the albumen height (0.48), yolk height and Hough unit (0.52) and albumen height and Hough unit (0.97). Similarly, Ozcelik (2002) also reported statistically significant positive correlation between albumen height and the Hough unit (0.97).

Table 22. The phenotypic correlations between internal egg quality traits, (N=600).

Internal egg quality traits	Albumen height (mm)	Yolk height (mm)	Hough unit (HU)
Albumen height (mm)	1.0		
Yolk height (mm)	0.19**	1.0	
Hough unit (HU)	0.41**	0.38**	1.0

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

4.6.3.3. Phenotypic correlation between internal and external egg quality traits

A statistically significant negative correlation was obtained between egg weight and Hough unit (-0.13) and between egg width and other internal quality traits like, yolk height (-0.27) and Hough unit (-0.23) (Table 23). Similarly, Ozcelik (2002), Iposu *et al.* (1994) and Shawkat (2002) reported significant negative correlations between Hough unit and egg weight.

Positive correlation was observed in between egg weight and other internal egg quality traits including; albumen height (0.1), yolk height (0.1) and yolk width (0.65). Similarly, Silversides (1995) & Zhang *et al.* (2005) reported statistically positive correlation between egg weight and albumen height. Egg shape was statistically significant and negatively correlated with the yolk height. In this study, statistically important negative correlation value was observed between egg length and other internal egg quality traits including; yolk height (-0.24) and Hough unit (0.27).

Table 23. The phenotypic correlations b/n external and internal quality traits of eggs, (N=600).

Traits	EWt (g)	EWd (mm)	EL (mm)	SI (%)	AH (mm)	YH (mm)
EWd (mm)	0.49**					
EL (mm)	0.45**	0.78**				
SI (%)	0.12	0.44**	-0.2**			
AH (mm)	0.1	0.02	0.01	0.01		
YH (mm)	0.1	-0.27**	-.24**	-0.069	0.19**	
HU	-.13**	-0.23**	-.27**	0.034	0.41**	0.38**

- EWt = Egg weight, EWd= Egg width, EL= Egg length, SI= Shape index, AH = Albumen height, YH= Yolk height, HU= Hough Unit.
- ** Correlation is significant at the 0.01 level (2-tailed).

4.6.4. Prediction equations of selected egg quality traits

Prediction equations involving selected egg variables are presented in Table 24. Egg weight was predictable from egg length and egg width singly with sufficient reliability (R^2 = 20.3% and 24.3 %; $p<0.05$). However, a better and more reliable estimate was obtained when both egg length and egg width were fitted into the model (R^2 = 25.4 %). The results of the present study agree with the findings of Yakubu *et al*. (2008) on the positive estimation of egg weight from egg length and egg width. Egg Hough unit was predictable from albumen height with sufficient reliability (R^2 = 16.5%; $p<0.05$). Egg width was predictable from egg length with sufficient reliability (R^2 = 60.8%; $p<0.05$).

Table 24. Prediction equations of selected egg variables, (N=280).

Functions	R^2 (%)	Significance
$Y_1 = 0.69X_1 + 18.03$ *	20.3	* (+ve)
$Y_1 = 0.5X_2 + 17.55$ *	24.3	* (+ve)
$Y_1 = 0.18X_1+0.51X_2+14.98$ *	25.4	* (+ve)
$Y_2 = 1.51X_4 + 60.39$ *	16.5	* (+ve)
$X_2 = 0.61X_1 + 6.0$ *	60.8	* (+ve)

- Y_1 = Egg weight; Y_2 = Hough unit; X_1= Egg length; X_2=Egg width; X_4 = Albumen height; X_5 = Egg weight;
- R^2 = Coefficient of determination;
- *$p < 0.05$

5. Summery and Recommendation

5.1. Summery

Most research efforts on village chicken tend to focus on production aspects (Rushton *et al.*, 2002). However, village chicken production is a chain of interrelated economic activities undertaken within a social context, ranging from the rearing of chicken to marketing of its products. Therefore, understanding the production and marketing systems and quality assessment of its products will be crucial to develop appropriate strategies and design future interventions towards improving the system.

Similar to most parts of the country, village chicken production plays a strategic role and occupies a unique position in terms of its contribution to the provision of high quality protein foods and additional income to rural smallholder farming families of the study wereda. This is mainly because of its low capital investment requirement, its complementary role in relation to other crop-livestock activities and high rate of productivity. In addition there were no any cultural or religious taboos that stand against the consumption and marketing of chicken products in the study wereda.

The results of the study showed that the dominant (82.9%) chicken production system of the study area was a free range system using majority (96.8%) of local chicken ecotypes managed mainly on scavenging with seasonal/conditional feed supplementation. The mean chicken flock size per household of the study wereda was 13 birds (ranged 1-57), with a male to female ratio of 1:3.7.

Sale of chicken as source of cash income, egg hatching for breeding stock, household consumption, use of birds for socio-cultural and/or religious ceremonies and egg production were the major reasons for village chicken owners to keep village birds. Regarding purpose of eggs; hatching for replacement stock, sale for cash income and home consumption were the major uses of eggs in the study wereda.

Although scavenging was the major source of chicken feed reported in all agro-ecologies of the study area, most village chicken owners (97.5%) provided supplementary feed to their chicken, especially during feed shortage seasons (mainly during the rainy season) and the major source of these supplementary feed (87.1%) was crop harvest (self produced). All chicken owners of the study area provided water to birds, especially during the dry season. The major source of water (30.4%) for village chicken in the study area was river water.

Only 22.1% of village chicken owners interviewed prepared separate overnight housing for birds. Lack of attention to village birds due to small flock size per household was the major reason (34.6%) for not preparing a separate chicken house. Other reasons mentioned included: lack of construction materials (25%), lack of knowledge and awareness (19.6%), risk of predators (12.1%) and shortage of labor (5.4%).

97.5% of interviewed village chicken owners of the study area experienced chicken disease problems in their locality. Newcastle Disease (NCD) (locally called *"kofis"* or *"fengil"*) was identified as a major and economically important health constraint that hinders the expansion of chicken production in the study area. None of the respondents followed proper vaccination program and proper disease prevention mechanism to their chickens.

The average ages of local cockerels at first mating and pullets at first egg were 24.6 weeks (5.74 months) and 27.5weeks (6.42 months) respectively. The average number of eggs laid per clutch of local hens was 16 (ranged 8-28) and the number of total clutch periods/hen/year was 3.8 (ranged 2-6). The mean annual egg production of local hens under the existing management condition was 60 eggs (ranged 24-112).

Broody hens were the sole means of egg incubation and chick brooding in the study wereda. The average number of eggs incubated once per broody hen was 13 eggs (ranged 7-22) and reasonably high numbers of chicks (11) were hatched (ranged 0-19). Accordingly, the mean hatchability performance of local hens was 82.6% (ranged 0-100%). However, because of the high prevalence of diseases, predators and poor management of young chicks the average survivability percent of young chicken to grower stage was only 60.5% (ranged 0-100%).

92.2% of chicken owner in the study area had the tradition of selecting cocks for replacement stock. It is discovered that observing plumage color (45.4%), looking its physical stand and shank length (37.1%), looking the type of comb it has (8.6%) and looking parent's performance/pedigree (1.1%). Similarly, 86.4% of chicken owners in the study area had a culture of selecting broody hens before using for incubation and brooding. Looking hen's past performance (73.9%), presence of big body size (7.9%), presence of thick feather (2.1%), size of eggs laid (2.5%) were some of the major criteria's observed by chicken owner farmers in selection of broody hens, respectively.

Regarding mortality (loss) of village chicken, seasonal disease outbreaks (84.3%) and predation (11.4%) were the first and second major causes of death/loss for chickens in the study wereda, respectively.

Women involved in different village chicken production activities like; cleaning chicken house (38.6%), provision of supplementary feed (80.7%), selling of chicken (82.9%) and selling of eggs (54.6%). Children alone and together with other family members were also found participated in various village chicken production activities like; cleaning of chicken house, selling of chicken & eggs and provision of supplementary feed and water to birds. Men on the other hand, were mostly involved in crop cultivation and other off-farm activities including; shelter construction (97.5%) and taking sick birds to get treatment (89.3%), mainly at wereda veterinary health office.

Concerning family decision making on village chicken husbandry practices, both men and women were decision makers of the household member to sell eggs (78.2%), to sell chicken (69.3%), to consume eggs at home (93.2%) and to consume chicken at home (92.9%). However men only were decision makers of the house hold member to buy drugs for sick birds (88.6%) and to buy replacement stock (67.9%).

A seasonal disease outbreak, mainly NCD, was identified as the most important constraints affecting chicken productivity in the study wereda. Other village chicken production constraints identified in this study included; predation, poor chicken management, feed shortage (both in quality and quantity), presence of poor/no chicken marketing information and poor production performance of local chicken ecotypes.

The result of the current study revealed that there was no any formal chicken and egg marketing operation in the study wereda. Village chicken producers, consumers, middle men (chicken and egg collectors), local restaurants were some of the key actors involved in the system. Farmers sell birds mainly to obtain cash income for household needs, but middle men operate to make profits.

The major group of birds sold from the village flocks were surplus males (cockerels and cocks), pullets, old (non productive) hens and some times sick birds. Young birds and productive hens were often sold just before the onset of the high risk period of Newcastle disease, mainly around the start of the rainy season. The supply and demand chicken products in the study area were not similar and fluctuated during the year. Generally, the supply marketable of chicken products was low during the rainy season and relatively high during the onset of the rainy season and the dry seasons.

Similar to supply & demand, the price of chicken products were not similar through out the year and found affected by various factors. Some of these determinant factors affecting prices of chicken products in the study wereda included: demand and supply of chicken products, agro-ecology (highland, mid-altitude and lowland), product type (sex, age, breed, comb type, etc), season of the year (dry and rainy), market type (urban vs local markets), market day types (holyday vs ordinary market days), fasting seasons (eg. Pre-Easter fasting season) and the dramatic increase in price of large and small ruminants (sheep, goats and cattle).

The current study revealed that village chicken owners of the study area traveled, on average, a distance of 5.5km (ranging 2.5-15) and 15.9km (ranging 3-35) to reach the nearby local and urban markets, respectively.

Regarding the marketing constraints, fluctuation (seasonality) in prices of chicken products was the most and prevailing chicken and egg marketing constraint of the study area. Other chicken and egg marketing constraints identified in the area included: Low supply (out put) of marketable chicken products due to disease outbreak, predator attack and low productivity of local birds, presence of only few/limited market out-lets, especially on lowland agro-ecologies, lack of appropriate chicken and egg marketing information to producer farmers, lack of storage facilities for chicken products (especially for local eggs) to keep them safe for a long period time and to sale during high demand period, ack of enough space for chicken products marketing in urban markets, Burie market and lack of credits and capital to expand chicken production marketing activities.

Relating to external quality of eggs, 49% of eggs collected in the study wereda were white shelled, 45% were light brown shelled and 6% were cream color shelled. The average weight of eggs was 43g (ranged 34-60g) and the average dry shell weight of was 2.3g. The average width and length of eggs were 37.2mm and 50.8mm, respectively. Accordingly, the average shape index percentage of eggs was calculated using the formula: SI (%) = [(EW/EL)*100], where; SI = egg shape index, EW= egg width and EL = egg length and the result indicated that the average shape index was 73.2 %.

The average shell thickness measurements of narrow side, middle side and broad end side of eggs were 0.27mm, 0.26mm and 0.24mm, respectively. Accordingly the mean shell thickness was calculated and found to be 0.26 mm.

Concerning the internal quality of eggs collected in the study area, the average yolk height and albumen heights of eggs were 15.1mm and 4.1mm, respectively. The Hough unit was calculated using the formula: $HU = [100 \log_{10} (AH - 1.7EW^{0.37} + 7.6)]$, where; HU = Hough unit, AH = albumen height and EW = egg weight and the result indicated that the average Hough unit was 66.5 (ranged 36.4-84.79). The result also showed that there was no any significant difference between eggs collected from different sources with related to average measure of egg's Hough unit.

The yolk color of eggs collected from different sources of the study area was estimated using roach color fun (ranged 1-15) and each egg was examined by three observers and the average yolk color value was calculated. The result indicated that the mean yolk color of eggs collected from local hens of the study area was 8.6 (ranged 5.3-11.7).

All the phenotypic correlation values related to the internal and external egg quality traits were determined by the Pearson correlation analysis and the estimations were made by using SPSS soft ware program, version 12 (SPSS for Windows, 2002) and GenStat statistical software program, version 7.2 (Genstat. 2007). All the correlation results were presented in this document and most of the results were inline with the findings of some other researchers who conducted similar egg quality studies, collected from scavenging local chicken ecotypes.

5.2. Recommendations

The following recommendations are suggested based on the result of the current study:

- For the existing scavenging system of the study wereda, local birds are preferred and their productivity could be enhanced by relatively simple changes in management interventions such as housing, feeding, health care, etc, which will promote their productivity and reduce mortality.
- The result of the current study revealed that there is strong need for appropriate intervention in diseases and predator control activities so as to reduce chicken mortality and improve productivity of village flock of the study wereda. Control of diseases, mainly NCD, could be achieved through improvement in veterinary and advisory services. Introduction and utilization of the newly coming thermo-stable vaccines against NCD could also be important to reduce heavy mortalities.
- Since several traditional (ethno-veterinary) medicines are being widely used in the study area against NCD, studies under controlled conditions are needed to determine the efficacy and veterinary properties of these medications.
- The problem of predators could be reduced by convincing farmers to construct predator proof' separate chicken houses and housing birds, especially during the night. Young chicks needed to stay in protected areas for the first 4–5 weeks of life, as this is the time when they are most vulnerable to predators and other accidents. Introduction and utilization of locally made hay−box brooders should be encouraged to provide extra care for young chicks and reduce mortality.

- Improvement in feed and feeding systems should be the other area of intervention. Provision of proper trainings to chicken producers on how to formulate supplementary rations to village birds, using locally available feeds ingredients, could be important. Further studies to determine the nutrient composition and amount of inclusion of the locally available feed stuffs and quantify the economic importance of supplementation needs to be carried out.
- As most of village chicken production activity of the study area is managed by women, provision of successive trainings on modern chicken husbandry practices to women would be essential for the improvement of chicken production and productivity.
- Provision of appropriate marketing information to village chicken producers could be important for the improvement of chicken and egg marketing system of the study wereda.
- Provision of credit facilities to village chicken producers and linking the production with marketing will encourage chicken owners and contribute to the improvement of the sector.
- Similar to the interest of the regional government, almost all interviewed village chicken producers of the study wereda need to pursue boosting up the chicken production and productivity levels. This perhaps considered as an opportunity and potential for chicken production and development intervention activities in the study wereda.

6. References

Abanikannda, O.T.F., O. Olutogun, A.O. Leigh and L.A. Ajayi. 2007. Statistical modeling of egg weight and egg dimensions in commercial layers. International Journal of Poultry Science 6 (1): 59-63,

Abdelqader, A., C.B.A. Wollny & M. Gauly. 2007. Characterization of local chicken production system & potential under different level of management practice in Jordan. Journal of Tropical animal health and production. Volume 39. pp155-164.

Aberra Melesse, S. Maak and G. Von Lengerken. 2005. The Performance of Naked Neck and their F_1 crosses with Lehman White and New Hampshire chicken breeds under long-term heat stress conditions. Ethiopia Journal of Animal Production 5(1): 91-106

Aberra Melesse. 2000. Comparative studies on performance and physiological responses of Ethiopian indigenous (”*Angete-melata”)* chicken and their F_1 crosses to long term heat stress. Ph.D Thesis. Martin-Luther University, Halle-Wittenberg, Berlin. pp: 4-5.

Abubakar, M.B, A.G. Ambali and T. Tamjdo. 2007. Rural Chicken Production: Effects of Gender on Ownership, and Management Responsibilities in Some Parts of Nigeria and Cameroon. International Journal of Poultry Science 6 (6): 413-416.

Adugna Tolera & A N. Said. 1992. Prospects for Integrating food and feed production in Welayita Sodo, Ethiopia. The complementary of feed resources for animal production in Africa. Proceedings of the joints feed resources networks workshop held in Gaborone, Botswana, 4-8 March 1991. African Feeds Research Network. ILCA, Addis Ababa. Ethiopia. pp: 309- 318.

Agajie Tesfaye, Chilot Yirga, Mengistu Alemayehu, Elias Zerfu and Aster Yohannes. 2002. Smallholder livestock production system and constraints in the high land of North and West Shewa zones. In: proceeding of the 9th Annual conference of the Ethiopian society of Animal production (ESAP) held in Addis Ababa, Ethiopia, August 30-31 2001 pp. 49-71.

Ahmed, N. 1994. Backyard poultry feeding systems in Bangladesh. Asian Livestock, 7: 73-79.

Aichi J. & Kitalyi Andre. 1995. Village chicken production systems in rural Africa household food security & gender issues. Mayer Research Fellow (1994–1995) Editing, design, graphics and desktop publishing management group, FAO Information Division.

Aichi J. and Kitalyi Andre. 1998. Village chicken production systems in rural Africa household food security and gender issues. FAO animal production and health paper 142. Food and Agriculture Organization of the United Nations, Rome.

Aini, I. 1990. Indigenous chicken production in South-East Asia. World's Poultry Science Journal (46): 51–57.

Akbas, Y.O. Altan and C. Kocak. 1996. Effects of hen's age on external and internal egg quality characteristics. Turk. Journal of Veterinary and Animal Science (20): 455-460.

Aklilu H. A., C. J. M. Almekinders, H. M. J. Udo & A. J. Van der Zijpp. 2007. Village poultry consumption and marketing in relation to gender, religious festivals and market access. Published online: Springer Science + Business Media.

Alam, J. 1997. Impact of small holder livestock development in some selected areas of rural Bangladesh. Livestock Research for Rural Development. *http://www.cipav.org. co/lrrd/lrrd9/3/bang.*

Alders, R. 2004. Poultry for profit and pleasure. FAO Diversification Booklet 3. Rome.

Alemu Yami and Tadele Dessie. 1997. The Status of Poultry Research and Development in Ethiopia, Research Bulletin No. 4. Poultry Commodity Research Program Debre Zeit Agricultural Research Center, Alemaya University of Agriculture, Ethiopia. 62 p.

Ambali A.G., M.B. Abubakar and T. Tamjdo. 2007. Rural Chicken Production: Effects of gender on ownership and management responsibilities in some parts of Nigeria and Cameroon. Int. Journal of Poultry Science 6 (6): 413-416.

Amhara National Regional State, Bureau of Agriculture and Rural Development (ANRS-BoARD). 2006. Poultry Development and Marketing Strategy. Bahir Dar, Ethiopia.

Amhara National Regional State, Bureau of Plan and Economy (ANRS-BoPE). 2007. Annual report, Bahir Dar, Ethiopia.

Amir P. and H.C. Knipscheer. 1989. Conducting On-Farm Animal Research: Procedures and Economic Analysis. Winrock International, Institute for Agricultural Development and International Development Centre. Singapore National Printers Limited. pp 143-162.

Anders Permin. 1997. Helminthes and Helminthosis in poultry with special emphasis on *ascaridia galli* in chickens. Ph.D Thesis. Danish Centre for Experimental Parasitology & Department of Veterinary Microbiology. The Royal Veterinary and Agricultural University Copenhagen, Denmark. 1997.

Assan, B.E. 1990. Lelevage villageois de la volaille en Republique du Benin: Situation actuelle. CTA Seminar, proc. on smallholder rural poultry production, Thessaloniki, Greece, 2:17-26.

Assefa Tadesse. 2007. Poultry management practices and on farm performance evaluation of Rhode Island Red, Fayomy and Local chicken in Umbulo Wachu water shade in Sidama zone. M.Sc Thesis. Hawassa University, Ethiopia. 126 p.

Asuquo, B.O., B.O. Okon & A.O. Ekong. 1992. Quality parameters of Isa-Brown and Nigerian local chicken eggs. Nigerian Journal Animal Prod (19): 1-5.

Azage Tegene & Alemu Gebrewold.1998. Prospects for peri-urban dairy development in Ethiopia. In: proceeding of fifth national conference of Ethiopian society of Animal production. Addis Ababa, Ethiopia.

Bakst, M.R. & J.M. Bahr. 1993. Reproductive cycle of poultry. Reproduction in Farm Animals, 6th edition, Philadelphia.

Bangol, B. 2000. The social impact of Newcastle disease control. A paper presented at a SADC Planning workshop on Newcastle disease control in village chickens held in Maputo, Mozambique.

Belachew Hurrissa & Jemberu Eshetu. 2003. Challenges and Opportunities of livestock marketing in Ethiopia. Proceeding of the 10th annual conference of the Ethiopian society of animal production (ESAP). pp 1-13.

Bell J.G. & I. Abdou. 1995. Dynamics of village poultry production in the Keita region of Niger. Nigerian Journal of Animal Production (22): pp 141-144.

Bessei, W. 1987. Tendencies of world poultry production. In: Paper presented at the 3rd International DLG-Symposium on poultry production in hot climate, Hameln, Germany.

Beyene Kebede. 1998. Looking a head for sustainable livestock development. In: proceeding of the 5th national conference of Ethiopian society of Animal production, 15-17 may 1997, Addis Ababa, Ethiopia.

Bradley, F.A. 1992. A historical review of women's contributions to poultry production and the implications for poultry development process. In: Proceedings of the 19th World's Poultry Congress, Amsterdam, the Netherlands. pp. 693-696.

Branckaert, R.D.S. and Gueye. 1999. FAO's Programme for Support to family poultry production. In: Proceedings workshop on poultry as a tool in poverty eradication and promotion of gender equality. Tune Landboskole, Denmark.

Brannang, E. & S. Persson. 1990. Ethiopian Animal husbandry, Uppsala, Sweden. 127 p.

Branckaert, R.D.S. and Guéye. 1999. FAO's Programme for Support to family poultry production. In: Proceedings workshop on poultry as a tool in poverty eradication and promotion of gender equality held March 22 to 26, 1999. Denmark.

Central Agricultural Census Commission (CACC). 2003. Ethiopian Agricultural Sample Enumeration, 2001/2002. Statistical report on farm management practices, livestock & farm implements part II, Addis Ababa, Ethiopia. 233 p.

Central Statistical Authority (CSA). 2005. Agricultural Sample Survey Vol. II; Statistical Bulletin No. 331, Addis Ababa, Ethiopia.

Central Statistical Authority (CSA). 2008. Addis Ababa, Ethiopia.

Chatterjee R.N. and S.P. Yadav. 2008. Farming system of Nicobari fowl-an independent breed of Andaman and Nicobar Islands, India. World Poultry Science Journal, vol. 64, June 2008. pp 245-256.

Coppock, D.L. 1994. The Borana plateau of Southern Ethiopia: synthesis of pastoral research, development and change 1980-91. ILCA (International livestock center for Africa) Addis Ababa, Ethiopia.

Cumming, R.B. 1992. Village chicken production: Problems and potential. In: Proceedings of an International Workshop on Newcastle disease in village chickens, control with thermo stable oral vaccines 6-10 October, 1991, Kuala Lumpur, Malaysia. pp 21-24.

Deleew, P.N. 1997. Crop residues in tropical Africa. Trends in supply, demand and use. In: crop residues in sustainable mixed crop livestock farming systems.

Donald, D. Bell and D. William Weaver. 2001. Commercial chicken meat and egg production. 5th edition. Kluwer Academic Publisher.

Doyon, G., M. Bernier-Cardou, R.M.G. Hamilton, F. Castaigne and C.J. Randall. 1986. Egg quality. Albumen quality of eggs from five commercial strains of White Leghorn hens during one year of lay. Poultry Science, 65: 63-66.

EEA (Ethiopia Economic Association). 2002. Land tenure and agricultural development in Ethiopia. Ethiopia Economic policy Research Institute, Addis Ababa.

Eshetu Y., E. Mulualem, H. Ibrahim, A. Berhanu & K. Aberra. 2001. Study of gastro-intestinal helminths of scavenging chickens in four rural districts of Amhara region, Ethiopia. Rev. sci. tech. Off. Int. Epiz. 20 (3), 791-796.

Farooq, M., M.A. Mian, Murad Ali, F.R. Durrani, & A. Asghar Poyraz. 1989. Egg traits of Fayomi birds under subtropical conditions. Sarhad. Journal of Agriculture, 17:141-145.

Fayeye T.R, A.B. Adeshiyan and A.A. Olugbami. 2005. Egg traits, hatchability and early growth performance of the Fulani chicken ecotype. Livestock Research for Rural Development 17(8). Faculty of Agriculture, University of Ilorin, Nigeria.

Fikre Abera. 2001. Baseline data on chicken population, productivity, husbandry, feeding, breeding, health care, marketing and constraints in four peasant associations in Ambo Wereda. In: proceeding of the 9th national conference of Ethiopian society of Animal production (ESAP).

Food and Agriculture Organization of the United State Nations (FAO). 1995. FAO Production year book 1994. FAO, Rome.

Food and Agriculture Organization of the United State Nations (FAO). 1997. Guidelines for the inclusion of improved household poultry production. Diversification component of the special programme for food security, Rome. pp: 86.

Food and Agriculture Organization of the United State Nations (FAO). 1999. Animal genetic resources information, No. 25, Rome, Italy.

Food and Agriculture Organization of the United State Nations (FAO). 2003. Egg marketing. A guide for the production and sale of eggs. Rome.

Garcia, J.C., M.E. Lopez, Suarez-Oporta, J.M. Pinos-Rodriguez and G.A. Warez-Fuentes. 2007. Egg components, Lipid fraction and Fatty acid composition of Creole and Plymouth Rock x Rhode Island Red Cross hens fed with three diets. World Poultry Science Journal, 63 (3): pp 473-479.

Gausi, J.C.K., A.C.L. Safalaoh, J.W. Banda and D.H. Ng'ong'ola Ntcheu. 2007. Characterization of the smallholder poultry marketing systems in rural Malawi. A case study of Malingunde extension planning area. Livestock Research for Rural Development 16 (12).

GenStat. 2007. Statistical soft ware program. 7th edition (DE3).Supplied by VSN International Ltd. www/http: vsni.co.uk

Getenet Assefa. 1999. Feed resource assessment and evaluation of forage yield, quantity and in take of oats and in mixtures in the high lands of Ethiopia. M.Sc. Thesis submitted to the Swedish University of Agriculture, Sweden.

Gondwe, T.N., C.B.A. Wollny and W. Kaumbata. 2005. Marketing system and channels for scavenging local chickens in Lilongwe, Malawi. Livestock Research for Rural Development 17 (3).

Gondwe, T.N.P., 2004. Characterization of local chicken in low input-low output production systems: is there scope for appropriate production and breeding strategies in Malawi? Ph.D Thesis. Georg-August-Universität Göttingen, Germany.

Gorm Pedersen, Anders Permin and M. Uswege Minga. 2000. Possibilities for smallholder poultry projects in Eastern and Southern Africa. In: Proceedings of a workshop Morogoro, Tanzania, 22-25 may 2000.

Gryseels, G. 1988. Role of livestock on mixed smallholder farms in the woreda near Debre-Berhan. Ph.D Thesis. Agriculture University Wageningen, the Netherlands.

Guèye, E F. 1998. Village egg and fowl meat production in Africa. World's Poultry Science Journal, 54: 73-86.

Guèye, E F. 2007. Evaluation of the impact of highly Pathogenic Avian Influenza on family poultry production in Africa. World Poultry Science Journal, 63 (3): pp 391-400.

Gueye, E. F., 1997. Diseases in village chickens: Control through ethno-veterinary medicine. ILEIA Newsletter.13 (2): 20-21.

Gueye, E.F.2000. Women and family poultry production in Africa. Development in Practice 10: 98-102.

Halima Hassen Mogesse. 2007. Phenotypic and genetic characterization of indigenous chicken populations in North-West Ethiopia. Ph.D Thesis. Submitted to the faculty of natural and agricultural sciences department of animal, wildlife and grassland Sciences. University of the Free State, Bloemfontein, South Africa.

Halima Hassen, F.W.C. Naser, Tadelle Dessie, A. De Rock and E.Van Marle Koster. 2006. Studies on the growth performance of native chicken eco-types and RIR chicken under improved management system in North-West Ethiopia. Livestock Research for Rural Development 18 (6).

Hamilton, R.M.G. 1982. Methods and factors that affect the measurement of egg shell quality. Poultry Science, 61: 2002-2039.

Hammerle, J.R. 1969. An Engineering Appraisal of egg shell strength evaluation techniques. Poultry Science, 48: 1708-1717.

Harry, K. Swatson, Jane Tshovhote1, Edward Nesamvumi1, N.E. Ranwedzi1 and Cobus Fourie. Characterization of indigenous free-ranging poultry production systems under traditional management conditions in the Vhembe district of the Limpopo province, South Africa. Accessed on 16th August, 2007.

Haugh, R.R. 1937. The Haugh unit for measuring egg quality. U.S. Egg Poultry Magazine, No. 43. pp 552-555 & 572-573. USDA Egg Grading Manual. Agricultural Handbook No. 75. Washington: USDA, July 2000. *www/http: \poultry\haugh unit.mht*

Hellin, J., A. Griffith & A. Mike. 2005. Mapping the market: Market-literacy for agricultural research & policy to tackle rural poverty in Africa. In: Proceedings of an International Seminar, 28th February –1st March 2005, Westminster, London, UK, 110–150.

Holloway, G. and S. Ehui. 2002. Expanding market participation among smallholder livestock producers. Socio-economics and Policy Research Working Paper 48; International Livestock Research Institute, Nairobi, Kenya.

Huque, Q.M.E. & D.C. Paul. 2001. Strategies for family poultry production with special reference to women participation. Paper presented in 1st SAARC Poultry Conference held on 24−26, September. Pune, India.
http:www.cipav.org.co/lrrd/lrrd9/3/bang931.htm.

Huque, Q.M.E. 1999. Nutritional status of family poultry in Bangladesh. Livestock Research for Rural Development, 11(3).

ILRI (International Livestock Research Institute). 1995. Livestock Policy Analysis, ILRI Training Manual 2. Nairobi, Kenya.

Iposu, S.O., C.F.I. Onwuka and D. Eruvbetine. 1994. The relationship between selected quality traits and egg size. Nigerian Journal of Animal Production, 21: 156-160.

Iscan, K.M. and A. Akcan. 1995. Broyler parent yumurtalarinda yumurta agirligi, yumurta ozgul agirligi ve bazi yumurta kisimlari arasindaki iliskiler. J. Central Anim. Res. Inst., 5: 49-52.

Javed, K., M. Farooq, M. A. Mian, F. R. Durrani and Shah Mussawar. 2003. Flock size and egg production performance of backyard chicken reared by rural woman in Peshawar, Pakistan. Livestock Research for Rural Development, 15 (11).

Jens Christian Riise, Anders Permin, Charlotte Vesterlund, M.C. Ainsh and Lone Frederiksen. 2004. Keeping Village Poultry. A technical manual for small-scale poultry production. Copenhagen, Denmark.

John Bishop P. 1995. Chickens: Improving small-scale production. Echo technical note.

Juliet Roberts, R. 2004. Factors affecting egg internal quality and egg shell quality in laying hens. Journal of Poultry Science, 41: 161-177.

Kassambara, A.I. 1989. La production avicole au Mali: problems et perspectives. In : Proceeding of International workshop on rural poultry in Africa, 13-16 November 1989, IIe-Ife, Nigeria. pp: 140-150.

Katule, A.M. 1992. Study on the potential value of indigenous chickens in Tanzania. Rural Poultry Development Newsletter. 2:4.

Kenea Yadeta, Legesse Dadi and Alemu Yami. 2003. Poultry Marketing: Structure, Spatial Variations and Determinants of Prices in Eastern Shewa Zone, Ethiopia. In: Proceeding of the 10th annual conference of the Ethiopian society of animal production.

Khalafalla, A.I., S. Awad and W. Hass. 2001. Village poultry production in the Sudan. Department of Microbiology, Faculty of Veterinary Science, University of Khartoum, Khartoum North, Sudan. Department of Microbiology, Faculty of Veterinary Science, University of Khartoum, Khartoum North, Sudan. Accessed on 25th August, 2007.

Kirunda, D.F.K. and S.R. McKee. 2000. Relating quality characteristics of aged eggs and fresh eggs to vitelline membrane strength as determined by texture analyze. Poultry Science Journal, 79: 1189 - 1193.

Kitalyi Aichi, J. and Andre Mayer. 1998. Village-chicken production systems in rural Africa: Household food security and gender focus. FAO Animal Health and Production Series, Paper 142.

Koeslag, G. 1992. The role of poultry in the rural areas. In: Proceedings of the Introductory Seminar on Poultry Development Policy, Barneveld College.

Kondombo, S.R. 2005. Improvement of village chicken production in a mixed (chicken-ram) farming system in Burkina Faso. Ph.D Thesis. Wageningen Institute of Animal Sciences, Animal Nutrition Group, Wageningen University, the Netherlands.

Kuit, H.G., A. Traore, R.T.Wilson. 1986. Livestock production in Central Mali: Ownership, management and productivity of poultry in the traditional sector. Tropical Animal Health and Production, 18: pp: 222-231.

Kusina J., N.T. Kusina and J. Mhlanga. 2000. A Survey on Village Chicken Losses: Causes and Solutions as perceived by farmers in communal area of Zimbabwe. Accessed on 27th August, 2007.

Lawrence, P. 1998. Ecotypes and natural resistance among local chickens of Tanzania. M.Sc.Thesis.The Royal Veterinary & Agricultural University, Copenhagen, Denmark.

Lwesya H., R.K.D. Phoya, A.C.L. Safalaoh and T.N.P. Gondwe. 2004. Rearing chicks in enclosures under village conditions: effect on growth and reproductive performance of hens. Livestock Research for Rural Development, 16 (11).

Madkour, Y.H., T.H. Mahmoud and N.Z. Mohanna. 1982. A comparative study on egg cycle in relation to egg production of the Fayoumi and RIR fowl. Agricultural Research Review, 57: 127-134.

Mapiye, C. and S. Sibanda. 2005. Constraints and opportunities of village chicken production systems in the smallholder sector of Rushinga district of Zimbabwe. Livestock Research for Rural Development, 17 (10).

Mcainsh, C.V., J. Kusina, J. Madsen and O. Nyoni. 2004. Traditional chicken production in Zimbabwe. World's Poultry Science., 60: 233-246.

Mekonnen G/Egziabher Muhiye. 2008. Characterization of the small holder poultry production and marketing system of Dale, Wonsho and Loka Abaya weredas of SNNPR, Ethiopia. M.Sc Thesis. Hawassa University, Ethiopia.

Mlozi, M.R.S., A.V.M. Kakengi, U.M Minga, A.M Mtambo and J.E Olsen. 2003. Marketing of free range local chicken in Morogoro and Kilosa urban markets, Tanzania. Livestock Research for Rural Development, 15(2).

Mohamed Saleem, M.A. and Abate Tedla. 1995. Feed improvement to support intensification of ruminant production system in Ethiopian high lands. In: proceeding of the 3rd Annual conference of the Ethiopian Society of Animal production (ESAP), held in Addis Ababa, Ethiopia, April 27-29.

Mohan, B., V. Mani & S. Nagarajan. 1991. Effect of different housing system on the physical qualities of commercial chicken eggs. Indian Journal of Poultry Science, 26: 130-131.

Mohanty, S.C., H. Kanungo and M. Mishra. 1986. Effect of age at laying on the quality of egg of WLH hens. Indian Journal of Animal Production & Management, 2: 184-186.

Moorthy, M., K. Sundaresan and K. Viswanathan. 2000. Effect of feed and system of management on egg quality parameters of commercial WLH breed layers. Indian Veterinary Journal, 77: 233-236.

Moreki J.C., R.J. Petheram and L. Tyler. 2001. A Study of Small-scale Poultry Production Systems n Serowe-Palapye Sub-district of Botswana. In: Proceedings INFPD Workshop, M. Bour, Senegal, Decmber, 9-13, 1997.

Mourad, M. B. A. S. and G. Gbanamou. 1997. Evaluation de la productivité et de la mortalité de la poule locale sur le plateau de Sankaran, Faranah, Guinée, en 1993-1994. Révue d'élevage et de Médécine Vétérinaire des Pays Tropicaux 50: 343-349.

Muchenje, V., M.M. Manzini, S. Sibanda and S. M. Makuza. 2000. Socio-economic and biological issues to consider in smallholder poultry development and research in Southern Africa, in the new millennium. *

Nigussie Dana, Alemu Yami, Tadelle Dessie and Samuel W/Hana. 2003. On-station and on-farm evaluation of the 'Hay-Box chick brooder using different insulation materials at Debre Zeit agricultural research center and Denbi village, Adaa Woreda.

Njenga, S. K. 2005. Productivity and socio-cultural aspects of local poultry phenotypes in coastal Kenya. M.Sc.Thesis. The Royal Veterinary and Agricultural University, Copenhagen, Denmark.

Nwanta, J.A, S.C. Egege , J.K. Alli-Balogun and W.S. Ezema. 2008. Evaluation of prevalence and seasonality of Newcastle disease in chicken in Kaduna, Nigeria. World's Poultry Science Journal, Vol. 64, September 2008. p 416.

Odunsi, A.A. 2003. Assessment of Lablab leaf meal as a feed ingredient and yolk coloring agent in the diet of layers. International journal of poultry science, 2 (1): 71-74.

Olori, V. E. and E. B. Sonaiya. 1992. Composition and shell quality of white and brown eggs of the Nigeria Indigenous chicken. Nigerian Journal Animal Production, 19:12-14.

Ozcelik, M. 2002. The phenotypic correlations among some external & internal quality traits in Japanese quail eggs. Veterinary Journal of Ankara University, 49: 67- 72.

Panda, B. 1987. Role of poultry in socio-economic development of small farmers in India. Asian Livestock, 12: pp 145-148.

Pandey, V.S. 1992. Epidemiology and economics of village poultry production in Africa. In: Conference Proceedings. Rabat, Morocco, pp: 124-128.

Pavlovski, Z., B. Masic and N. Apostolov. 1981. Quality of eggs laid by hens kept on free range and in cages. In: proceedings of first European Symposium by World Poultry Science Association. pp: 231-235.

Pavlovski, Z., B. Hopic, S.Vracar & B.Masic. 1994. Effect of housing system on internal egg quality traits in small layer flocks. Biotehnologija u stocarstvu, Yugoslavia, 10:37-43.

Pedersen, C.V. 2002. Production of semi-scavenging chickens in Zimbabwe. Ph.D Thesis. Royal Veterinary and Agricultural University, Copenhagen, Denmark.

Permin A. and G. Pedersen. 2000. Problems related to poultry production at village level. In: workshop on possibilities of smallholder poultry projects in Eastern and Southern Africa, 22-25 May, 2000, Morogoro, Tanzania.

Powell, J.M. and T.O. Williams. 1993. An overview of mixed farming in sub-Saharan Africa. In livestock and sustainable nutrient cycling in mixed farming systems of sub-Saharan Africa volume II. Technical papers. In: Proceeding of an international conference in International Livestock Center for Africa (ILCA), Addis Ababa., Ethiopia.

Prabakaran, R., P. Muthusamy and I.A. Jayaprasad. 2001. Inclusion of natural pigment products in layer mash to improve egg yolk color. Indian Vet. Journal, 78: 416-419.

Rahman, M., M.N. Islam, N.R. Sarker and M.M. Islam. 1998. Effect of supplementary feeding on production performance of RIR, Fayoumi and their crossbred chicken in rural Bangladesh. Bangladesh Journal of Livestock research 1: 184-193.

Rahman, M.H., P. Sorensen, H.A. Jensen and F. Dolberg. 1997. Exotic hens under semi-scavenging condition in Bangladesh. Livestock Research for Rural Development 9 (3).

Reddy, D.C. 1991. Poultry production in developing versus developed countries. World Poultry-Misset 7 (1): 8-10.

Riise J.C., A. Permin & K.N. Kryger. 2004. Strategies for developing family poultry production at village level. Experiences from West Africa & Asia. Network for Smallholder Poultry Development, Dyrlaegevej 2, 1870 Frederiksberg, Denmark.

Roberts, J.A. 1992. The scavenging feed resource base in assessment of the productivity of scavenging chickens. Newcastle disease in village chickens, control with thermo stable oral vaccine. In: Proceedings of ACIAR, No. 39, Canberra, Australia. pp: 29-32.

Rushton, J. and S Ngongi. 2002. Poultry, Women and Development: Old Ideas, New Applications and the Need for More Research. Department of Agriculture, University of Reading, UK. FAO World animal review 91-1998/2

Safalaoh, A.C.L. 2001. Village Chicken Upgrading Programme in Malawi. World's Poultry Science Journal, 57: 179−188.

Salam Kondombo, R. 2005. Improvement of village chicken production in a mixed (chicken-ram) farming system in Burkina Faso. Ph.D Thesis. Wageningen Institute of Animal Sciences, Animal Nutrition Group, Wageningen University, the Netherlands.

Saleh, K. and N.M. El-Naggar. 1983. The effect of breed and dietary calcium levels on the performance of laying hens under subtropics conditions. Agricultural Research Review, 61: 125-143.

Sall, B. 1990. Contribution a l'etude des possibilites d'amelioration de la production en aviculture traditionnelle: mesure du potentiel de la race locale et des produits d'un croisement ameliorateur. M.Sc. Thesis.

Sandra Maria de Gonçalves, J.A. 2005. The impact of improved housing and early nutrition on the productivity of local chickens in Mozambique. M.Sc Thesis. Danish Institute of Agricultural Sciences, Department of Animal Health, Welfare and Nutrition, Research Centre Foulum, P. O. Box 50, 8830 Tjele. Denmark.

Sazzad, M.H. 1992. Comparative study on egg production and feed efficiency of different breeds of poultry under intensive and rural conditions in Bangladesh. Livestock Research for Rural Development (4) 3.
http://www.fao.org/ag/aga/agap/frg/feedback/lrrd/lrrd4/3/bangla1.htm

Scott, M.L., M.C. Nesheim and R.J. Young. 1982. Nutrition of the chicken. 3rd edition. Published by M.L. Scott and Associates, Ithaca, New York. 302 p.

Serkalem Tadesse, Hagos Ashenafi and Zeleke Aschalew. 2005. Sero-prevalence study of Newcastle disease in local chickens in central Ethiopia. International Journal of Applied Research. Vet. Med. Vol. 3, No. 1.

Sezai Alkan, Kemal Karabag, Askin Galic and M. Soner Balcioglu. 2008. Predicting Yolk Height, Yolk Width, Albumen Length, Eggshell Weight, Egg Shape Index, Egg shell Thickness and Egg Surface Area of Japanese Quails, using various egg quality traits as regressors. International Journal of Poultry Science 7 (1): 85-88.

Shawkat, Md. Ali. 2002. Study on the effect of feed supplementation to laying hen under the rural condition of Bangladesh. M.Sc Thesis. The royal veterinary and agricultural university, Dyrlægevej, 1870 Frederiksberg C., Denmark.

Silversides, E.G. 1994. The Haugh unit correction for egg weight is not adequate for comparing eggs from chickens of different lines and ages. Journal of Applied Poultry Research, 3: 120-126.

Singh, R.A. 1990. Poultry Production. 3rd edition. Kalyani publishers, New Delhi, India.

Smith, A. J. 1996. Poultry. Macmillan Education Ltd, London and Oxford. pp:130.

Sonaiya, E.B, O.A. Olukosi, O. Obi and K M. Ajuwon. 2002. Vaccination and scavengeable feed resource assessment for village poultry. In: Proceedings of 3rd Scientific Coordination meeting of the Joint FAO/IAEA Coordinated Research Program on assessment of the effective of vaccination again Newcastle disease and Gumboro disease using immuno−assay−based techniques for increasing farmyard poultry production in Africa. Quatre Bornes, Mauritius.
www.iaea.org/programmes/nafa/d3/mtc/sonaiya−doc.pdf

Sonaiya, E.B. and S.E.J. Swan. 2004. Small-scale poultry production, technical guide manual. FAO Animal Production and Health 1. Food and Agriculture Organization of the United Nations (FAO), Rome, 2004.

Sonaiya, E.B. and S.E.J. Swan. 2005. Small-scale poultry production, technical guide manual. FAO Animal Production and Health 1. Food and Agriculture Organization of the United Nations (FAO), Rome, 2004.

Sonaiya, E.B. and V.E.Olori. 1998. Village chicken production in South-Western Nigeria. In: Proceeding of an International workshop on rural poultry development in Africa, 13-16 November, 1989, IIe-Ife, Nigeria. pp: 243-247.

Sonaiya, E.B. 1990. Toward sustainable poultry production in Africa. In: Paper presented at the FAO expert consultation on strategies for sustainable animal agriculture in developing countries, Rome, Italy.

Sparks, N.H.C. 2006. The hen's egg. Is its role in human nutrition changes? World's poultry science journal. Vol. 62. pp: 308-325.

Spradbrow, P.B. 1993. Newcastle disease in village chickens. Poultry Science Reviews 5 (2), 57–96.

Statistical Packages for Social Sciences (SPSS). 2002. SPSS 12 for Windows. SPSS Inc. Chicago, Illinois.

Steinbach, J. 1997. Alternative to crop residues as feed resources in mixed farming systems. In: crop residues in sustainable mixed crop livestock farming system (ed Renard). CAB International.

Tadele, D. 2003. Phenotypic and genetic characterization of chicken ecotypes in Ethiopia. Ph.D Thesis. Humboldt University, Germany.

Tadelle, D. 2004. Effect of scavenging on diet selection and performance of RIR and Fayomi breeds of chicken offered a choice of Energy and Protein Feeds.

Tadelle Dessie, Alemu Yami and K.J. Peters. 2000. Indigenous chickens in Ethiopia: genetic potential and attempts at improvement.

Tadelle, D., C. Kijora & K.J.Peters. 2003. Indigenous chicken ecotypes in Ethiopia, Growth & feed utilization potential. International Journal of Poultry Science 2(2): pp 144-152.

Tadelle, D., T. Million, Alemu Yami & K.J. Peters. 2003. Village chicken production systems in Ethiopia: Use patterns & performance valuation and chicken products & socio-economic functions of chicken. Livestock Research for Rural Development 15 (1).

Tadelle Dessie. 2001. The Role of Scavenging Poultry in Integrated Farming Systems in Ethiopia. Debre Zeit Agricultural Research Center, Debre Zeit, Ethiopia. Livestock Feed Resources within Integrated Farming Systems 377.

Tadelle, D., B. Ogle. 1996. Studies on poultry production systems in the central highlands of Ethiopia. M.Sc Thesis. Swedish University of Agricultural Sciences. 72 p.

Tadelle, D. and B. Ogle. 2001. Village Poultry Production System in the Central Highlands of Ethiopia. Tropical Animal Health and Production 33, 521- 537.

Taplin, D. E., J. P. F. D'Mello and P. Phillips. 1983. Evaluation of Leucaena leaf meal from Malawi, as a source of xanthophylls for the laying hen. Tropical Science, 23: 217-226.

Tegene Negesse. 1992. Dilatory status of small holder local chicken in Leku, Southern Ethiopia. Sinet, an Ethiopian Journal of Science, 15 (1): 57-67.

Teguia, A. 2000. A note on the effect of feeding local forages to commercial layers on egg production and yolk color. Journal of Animal and Feed Science, 9: 391-396.

Teketel Forsido. 1986. Studies on the meat production potential of some local strains of chicken in Ethiopia. Ph.D Thesis. J.L.University of Giessen, Germany. 210 p.

Thear, K. 1997. Free-range poultry. 2nd Edition. Farming Press, UK. 173 p.

Uluocak, A.N., F. Okan, E. Efe and H. Nacar. 1995. Bildircin yumurtalarinda bazi dis ve ic kalite ozellikleri ve bunlarin yasa gore degisimi. Turk Journal of Veterinary and Animal Science. 19: 181-185.

Veluw Van., K. 1987. Traditional poultry keeping in Northern Ghana. ILEIA Newsletter.3 (4):12-13.

William Stadelman, R. and J. Owen Cotterill.1995. Egg Science and Technology. 4th edition. New York: Food Products Press. pp: 59-60.

Wilson, R.T. 1986. Poultry production in Sub-Saharan Africa. Outlook on Agriculture 15: 121-127.

Wilson, R.T. 1979. Production of poultry in Darfur, Sudan, under simulated traditional conditions. Tropical Animal Health and Production journal 11: 143-150.

Wilson, R.T., A.Traore, H.G. Kuit and M. Slingerland. 1987. Livestock production in central Mali: Reproduction, growth and mortality of domestic fowl under traditional management. Tropical Animal Health and Production journal 19(4): 229-236.

Winrock International. 1992. Assessment of Animal Agriculture in sub-Saharan Africa. Win rock international Institute for Agricultural Development Morrilton. Arkansas. USA, 125 pp.

World Bank. 1999. Development Indicators. The World Bank.

Yakubu, A., D.M. Ogah and R.E. Barde. 2008. Productivity and Egg Quality Characteristics of Free Range Naked Neck and Normal Feathered Nigerian Indigenous Chickens. International Journal of Poultry Science 7 (6): pp 579-585.

Yongolo, M.G.S. 1996. Epidemiology of Newcastle disease in village chickens in Tanzania. Ph.D Thesis.

Zelleke G., R.P. Moudgal and A. Asmare. 2005. Fertility and hatchability in RIR and WLH chicken breeds as functionally modified by crossing them in alternate sex combinations. British Poultry Science 46 (1): 119–123.

Zhang, L.C., Z.H. Ning, G.Y.Xu.Z.C. Hou and N. Yang. 2005. Heritability, Genetic and Phenotypic correlations of egg quality traits in dwarf and brown-egg layers. Poultry Science Journal, 84:1209–1213.

Zinash Sileshi. 1995. Chemical composition, in-vitro digestibility and energy value of Ethiopian feedstuffs. In: Proceeding of the 3rd annual conference of the Ethiopian Society of Animal Production (ESAP), held in Addis Ababa, Ethiopia, 27-29 April 1995. pp: 307-311.

7. Appendices

7.1. ANOVA Tables

Tables 7.1.1. Average age of local breed cockerels at first mating (in weeks).

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
B/n Agro-ecologies	0.992	2	.496	.146	.864
Error	940.4	277	3.395		
Total	941.4	279		CV= 7.5	

Tables 7.1.2. Average age of local breed pullets at first egg (in weeks)

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
B/n Agro-ecologies	38.301	2	19.151	3.259	.040
Error	1627.667	277	5.876		
Total	1665.968	279		CV= 8.9	

Tables 7.1.3. Average number of eggs laid/clutch of local chicken breed

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
B/n Agro-ecologies	219.341	2	109.671	11.426	.000
Error	2658.828	277	9.599		
Total	2878.169	279		CV= 19.8	

Tables 7.1.4. Average number of eggs incubated using local broody hen

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
B/n Agro-ecologies	40.619	2	20.310	4.464	.012
Error	1260.283	277	4.550		
Total	1300.902	279		CV= 16.4	

Tables 7.1.5. Average percent of chicken weaned (% of chicken weaned) ,

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
B/n Agro-ecologies	21.464	2	10.732	.040	.961
Error	74419.552	276	269.636		
Total	74441.016	278		CV= 27.1	

Tables 7.1.6. Average hatchability percentage from the whole eggs set

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
B/n Agro-ecologies	422.321	2	211.160	1.599	.204
Error	36575.127	277	132.040		
Total	36997.448	279		CV= 14.1	

Tables 7.1.7. Number of total clutch periods/year for local breed hen with out hatching,

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
B/n Agro-ecologies	9.509	2	4.754	8.689	.000
Error	151.563	277	.547		
Total	161.071	279		CV= 19.9	

Tables 7.1.8. Total egg production/hen/year under existing farmer's management condition.

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
B/n Agro-ecologies	146.458	2	73.229	.606	.546
Error	33482.367	277	120.875		
Total	33628.825	279		CV= 18.3	

Tables 7.1.9. Average distance travel in km to reach the nearby local markets

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
B/n Agro-ecologies	367.877	2	183.9	32.342	.000
Error	1575.372	277	5.687		
Total	1943.2	279		CV= 47.3	

Tables 7.1.0. Average distance travel in km to reach to urban markets

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
B/n Agro-ecologies	21626.952	2	10813.5	1102.5	.000
Error	2716.776	277	9.808		
Total	24343.728	279		CV= 18.5	

Tables 7.1.11. Market price in birr of Matured male birds in different market days at Burie market, Ethiopia in 2007/2008.

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
B/n Agro-ecologies	5644.555	5	1128.911	139.545	0.000
Error	13542.529	1674	8.090		
Total	19187.083	1679			

Tables 7.1.12. Market price in birr of Matured female birds in different market days at Burie market, Ethiopia in 2007/2008.

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
B/n Agro-ecologies	14484.821	5	2896.964	353.139	.000
Error	13732.607	1674	8.203		
Total	28217.429	1679			

Tables 7.1.13. Market price in birr of pullets and cockerels in different market days at Burie market, Ethiopia in 2007/2008.

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
B/n Agro-ecologies	3185.020	5	637.004	103.569	.000
Error	10295.975	1674	6.151		
Total	13480.995	1679			

Tables 7.1.14. Average weight of eggs collected from the study area (N=600)

Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.489	1	.489	.026	.872
Within Groups	11186.368	597	18.738		
Total	11186.857	598	CV= 18.5		

Tables 7.1.15. Average shape index of eggs collected from the study area (N=600)

Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5.400	1	5.400	.311	.58
Within Groups	10376.782	597	17.382		
Total	10382.182	598	CV= 5.7		

Tables 7.1.16. Average shell thickness (mm) of eggs collected from the study area (N=600)

Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.005	1	.005	5.062	.025
Within Groups	.534	597	.001		
Total	.538	598	CV= 11.5		

Tables 7.1.17. Haugh unit of eggs collected from different sources of the study area (N=600)

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	79.544	1	79.544	1.55	.214
Within Groups	30635.4	597	51.316		
Total	30714.9	598	CV= 10.8		

Table 7.1.18. Effect of agro-ecology and season on the price of matured male birds in Burie wereda in2007/08, (N=600).

Source of Variation	df	Sum of Squares	F-Value	Sig.
Agro-ecology (AE)	2	102.8	4.68	0.0097
Season (SE)	1	3728.6	339.5	0.0001
AE*SE	2	27.3	1.24	0.23
Error	554	6084.2		
Total	559	9942.8	R^2=0.39,	CV=14.5%

Table 7.1.19. Effect of agro-ecology and season on the price of matured female birds in Burie wereda in2007/08, (N=600).

Source of Variation	df	Sum of Squares	F-Value	Sig.
Agro-ecology (AE)	2	57.2	5.13	0.0062
Season (SE)	1	2349.3	421.13	0.0001
AE*SE	2	4.8	0.43	0.6526
Error	554	3090.5		
Total	559	5501.8	R^2=0.44,	CV=19.4%

Table 7.1.20. Effect of agro-ecology and season on the price of pullets and cockerels birds in Burie wereda in2007/08, (N=600).

Source of Variation	df	Sum of Squares	F-Value	Sig.
Agro-ecology (AE)	2	57.2	5.13	0.0062
Season (SE)	1	2349.3	421.13	0.0001
AE*SE	2	4.76	0.43	0.6526
Error	554	3090.5		
Total	559	5501.8	R^2=0.44,	CV=19.4%

Table 7.1.21. Effect of agro-ecology and season on the price of eggs in Burie wereda in2007/08, (N=600).

Source of Variation	df	Sum of Squares	F-Value	Sig.
Agro-ecology (AE)	2	1.177	6.43	0.0017
Season (SE)	1	8.06	88.12	0.0001
AE*SE	2	0.78	4.27	0.0144
Error	554	50.69		
Total	559	60.71	R^2=0.16,	CV=13.5%

7.2. Human population and Livestock distribution tables

Table 7.2.1. Zonal distribution of chicken population in Amhara region

Adm. Zone	Area		Chicken Population		Chicken/Km^2
	Km^2	Share from region (%)	Number	Share from region (%)	
North Gondar	45561	28.2	3,165,069	23.6	69
South Gondar	20062	12.4	1,575,937	11.7	79
North Wollo	10177	6.3	1,200,512	8.9	118
South Wollo	17462	10.8	1,933,730	14.4	111
North Shewa	17698	11.0	1,333,835	9.9	75
East Gojam	14705	9.1	809,702	6.0	65
West Gojam	13910	8.6	2,016.039	15.0	145
Wag Himra	8421	5.2	252,657	1.9	30
Awi	8579	5.3	810,144	6.0	94.4
Oromia	4665	2.9	308,890	2.3	66
Bahir Dar Sp. Zone	160	0.1	28,367	0.2	177.3
Amhara Region	161,399	100.0 %	13,434,878	100 %	83.2

❖ Source- CACC. 2003

Table 7.2.2. Livestock population of the study wereda (formerly called Burie-Womberma), before its separation from Womberma district.

Livestock Holdings	Livestock population							
	Cattle	Sheep	Goats	Horse	Asses	Mule	Chicken	Beehives
All in district	129265	39066	6895	-	16335	479	188310	13329
Rural Holdings	126225	37873	6765	-	16137	467	185955	11570
Urban Holdings	3041	1193	129	-	199	12	2355	1759
Chicken Holdings								
Chicken Holdings	Cocks	Cockerels	Pullets	Non laying hen	Chicks	Laying hen	Av. Number of clutches	Av. Number of eggs/hen/ clutch
All in district	8566	16982	27716	6276	96924	31846	18	14
Rural Holdings	8449	16715	27365	6216	95999	31210	18	14
Urban Holdings	117	267	351	59	925	636	20	16

❖ Source- CACC. 2003

7.3. Frequency Distribution and Descriptive Statistics tables

7.3.1. Details of the age structure in the study area (N=280)

Age group	High land		Mid altitude		Low land		Total	
	Mean± SD	Range	Mean± SD	Range	Mean± SD	Range	Mean± SD	Range
Male<15	1.7±1.3	0-6	1.5±1.0	0-4	1.8±1.3	0-6	1.6±1.2	0-6
female <15	1.6±1.2	0-4	1.3±.97	0-4	1.4±1.1	0-4	1.4±1.1	0-4
Male b/n 16-30	0.87±.82	0-3	1.06±.8	0-4	0.6±.8	0-3	0.89±.85	0-4
Female b/n 16-30	0.65±.75	0-3	0.8±.91	0-6	0.5±.8	0-4	0.68±.85	0-6
Male b/n 31-45	0.54±.57	0-2	0.48±.5	0-1	0.5±.5	0-1	0.5±.52	0-2
Female b/n 31-45	0.53±.53	0-2	0.45±.5	0-1	0.6±.5	0-1	0.5±.51	0-2
Male>46	0.28±.45	0-1	0.2±.42	0-1	0.3±.5	0-1	0.26±.44	0-1
Female>46	0.30±.46	0-1	0.2±.41	0-1	0.3±.5	0-1	0.26±.44	0-1

SD=standard deviation

Table 7.3.2. Purpose keeping livestock in the study area

Type of livestock species	Importance of livestock keeping in the study area					
	Draft power	Milk and milk products,	Income	Meat, hides and skin	Dung for soil fertilization	Transport ation
Cattle	88.9 %	6.4 %	3.1%	1.1%	0.5%	-
Small ruminant	-	-	90.4 %	9.6 %	-	-
Equines	2.1%	-	-	-	-	97.9%

Table 7.3.3. Livestock holding/household in TLU of the study wereda (N=280)

LS Species	Mean/house hold	TLU value of 1 animal	TLU/ house hold	Livestock population	Total TLU
Cattle	4.16	0.8	3.328	*	-
Sheep	2.24	0.1	0.224	*	-
Goats	0.25	0.1	0.025	*	-
Donkeys	0.54	0.5	0.27	*	-
Mules	0.02	0.7	0.014	*	-
Horse	0.03	0.7	0.021	*	-
Chicken	13.06	0.02	0.2612	*	-

*Latest information about livestock population of the study area (Burie wereda) is not available in CSA report since the district is separated from Womberma wereda in 2007.

Table 7.3.4. Comparison of different livestock according to their uses/functions

Comparison of LS species	cattle		Sheep		goat		equines	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
chicken vs. cattle	222	79.3						
chicken vs. sheep			274	97.9				
chicken vs. goat					191	68.2		
chicken vs. equine							165	58.9
cattle vs. sheep	216	77.1						
cattle vs. goat	241	86.1						
cattle vs. equines	261	93.2						
sheep vs. goats			230	82.1				
sheep vs. equines							218	77.9
goats vs. equines							145	51.8

Table 7.3.5. Presence of any cultural/religious belief to rear a special type of chicken, not to eat chicken products and not to sell chicken and eggs in the area (N=280)

Variables		Frequency	(%)
Presence of any cultural or religious belief to rear a special type of chicken	Yes	9	3.2
	No	271	96.8
	Total	280	100
Presence of any cultural or religious belief not to eat chicken meat and eggs	Yes	0	0
	No	280	100
	Total	280	100
Presence of any cultural or religious belief not to sell chicken and eggs	Yes	0	0
	No	280	100
	Total	280	100

Table 7.3.6. Correlation coefficients between agro ecology, flock characteristics and household characteristics in the study area

Parameters	Agro Ecology	Total Family Size/hh	Total Farm size of Household	Back yard size of Household	Total Cattle size/hh	Total Chicken flock Size/hh
Agro Ecology	1					
Total Family Size of Household	-0.06^{NS}	1				
Total Farm size of Household	0.35(**)	.282(**)	1			
Back yard size of Household	-0.04 ^{NS}	.282(**)	.09 ^{NS}	1		
Total Cattle size/hh	0.1 ^{NS}	.282(**)	.09 ^{NS}	.121(*)	1	.
Total Chicken flock Size/hh	0.1^{NS}	.282(**)	.09 ^{NS}	.121(*)	.21(**)	1

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

* Correlation is significant at the 0.05 level (2-tailed); NS = non significant,

Table 7.3.7. List of some village chicken ecotypes of in Africa

Ecotype	Characteristics	Base of classification	Localization	Consulted references
Kei	Red	Plumage	Ethiopia	Guèye (1998); Teketel (1986) and Abebe (1992). (As sited by Salam, 2005)
Tikur	Black	Plumage	Ethiopia	
Kokima	Reddish brown	Plumage	Ethiopia	
Gebsima	Greyish mixture	Plumage	Ethiopia	
Netch	White	Plumage	Ethiopia	
Naked neck	Naked neck	Plumage	Ethiopia	
Fayoumi	Big size	Selected chicken	Egypt	
Konde chicken	Big size	Size	Burkina Faso	

Source- Salam, 2005

Table 7.3.8. Months of the year when chicken feed is sufficient, surplus and shortage (N=280)

Parameters (%)	High land		Mid altitude		Low land		Total (Study area)	
	Freq	%	Freq	%	Freq	%	Freq	%
First month of the year where chicken face shortage of feed								
July	62	77.5	92	76.7	63	78.8	217	77.5
August	18	22.5	28	23.3	17	21.3	63	22.5
Total	80	100	120	100	80	100	280	100
First month of the year where chicken feed is sufficient								
Oct.	20	25.0	32	26.7	19	23.8	71	25.4
Nov.	56	70.0	82	68.3	60	75.0	198	70.7
April	4	5.0	6	5.0	1	1.3	11	3.9
Total	80	100	120	100	80	100	280	100
First month of the year where chicken feed is surplus								
Dec.	17	21.3	26	21.7	14	17.5	57	20.4
Jan	63	78.8	94	78.3	66	82.5	223	79.6
Total	80	100	120	100	80	100	280	100

Table 7.3.9. Watering local chicken in the study area

Parameters (%)	High land		Mid altitude		Low land		Total (Study area)	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Provision of water to chicken								
Yes	80	100	120	100	80	100	280	100
Total	80	100	120	100	80	100	280	100
Season of the year where chicken provided water								
Dry season (‘Bega’)	69	86.3	105	87.5	65	81.3	239	85.4
Wet season (‘Kiremit’)	-				1	1.3	1	.4
All season	11	13.8	15	12.5	14	17.5	40	14.3
Total	80	100	120	100	80	100	280	100
Frequency of watering								
Once per day	5	6.3	6	5.0	6	7.5	17	6.1
Twice a day	17	21.3	13	10.8	5	6.3	35	12.5
Adlibtum (Offered freely)	52	65.0	101	84.2	68	85.0	221	78.9
Three times a day	6	7.5			1	1.3	7	2.5
Total	80	100	120	100	80	100	280	100
Source of water for chicken								
Spring water	20	25.0	37	30.8	22	27.5	79	28.2
River	40	50.0	27	22.5	18	22.5	85	30.4
Wale (Underground water)	5	6.3	23	19.2	32	40.0	60	21.4
Pipe water (Hand operated)	15	18.8	31	25.8	8	10.0	54	19.3
Spring and under ground water			2	1.7			2	.7
Total	80	100	120	100	80	100	280	100

Table 7.3.10. List of non-preferred months for incubation and brooding, practices used to reduce broody nature hens and Method of chick brooding (N=280)

Variables	Frequency	%
First most non preferred months of the year where farmers refuse incubation of eggs using broody hen		
April	221	78.9
July	59	21.1
Presence of any farmers indigenous practice to avoid/reduce broody nature local breed hens		
Yes	276	98.6
Most preferred types of farmer's indigenous practice used to avoid/reduce broody nature of local hens		
Changing the house of the hen (Sending somewhere else)	191	68.2
Hanging hen upside down for a day or two	68	24.3
Spraying water on hens body and sitting place	17	6.1
None	4	1.4

Table 7.3.11. The average culling age of local cocks in the study area

Agro Ecology	Mean ± SD	Minimum	Maximum	Range
High land	2.7 ±1.1[a]	1	6	5
Mid altitude	2.8 ±0.9 [a]	1	6	5
Low land	2.6±0.9 [a]	1	5	4
Total	2.7 ±0.9	1	6	5

[abc] Least square means with different superscript within a column are significantly different ($P < 0.05$)

Table 7.3.12. Breed type, source and selection of cocks for reproduction purpose (N=280)

Variables	Frequency	%
Presence of own cocks for reproduction purpose		
Yes	198	70.7
Breed of cocks owned by chicken owner farmers		
Local cocks	140	50.0
Cross breeds	53	18.9
Pure exotic breed cocks	3	1.1
Local and Exotic breed	1	.4
Both local and exotic cocks	1	.4
No cocks	82	29.3
Source of local cocks in the study area		
Market purchase	37	13.1
Hatched and grown at house	101	36.1
Purchase from neighbors	1	0.4
Both Purchase at market and hatched and grown at house	1	0.4
No local cocks	140	50
Selection of cocks for replacement/parent stock		
Yes	258	92.1
Criteria's observed for selection of cocks as replacement stock		
Color of chicken	127	45.4
Looking parents performance/pedigree	3	1.1
its physical status/stand (Shank length)	104	37.1
Type of comb	24	8.6
No response/No selection	22	7.9

Table 7.3.13. Egg storage, selection of broody hens and criteria for selection (N=280)

Variables	%
Egg storage place for incubation/sale	
▪ On the floor preparing a hole	1.4
▪ Inside earthen pot with grains	71.4
▪ Container made from mud and grass	15.5
▪ Earthen pot and container made of mud	5.2
▪ Grass made container	4.1
▪ Bamboo made container	2.4
Selection of broody hens (Do farmers' select broody hens?)	
▪ Yes	86.4
Major Criteria observed by farmers for selection of broody hens	
▪ Looking past performance	73.9
▪ Presence of big body size	7.9
▪ Presence of thick feather	2.1
▪ A hen laying big sized eggs	2.5
▪ No Selection	13.6
Duration of egg storage before incubation	
▪ One week	2.1
▪ 2 Weeks	2.9
▪ Keep until the hen finishes laying and start broodiness	95.0

Table 7.3.14. Grading of eggs for incubation in the study area (N=280)

Variables	Frequency	%
Grading of eggs before setting for incubation (Do farmers grade eggs?)		
Yes	123	43.9
If there is grading of eggs, what do farmers see during grading?		
Size of eggs	64	22.9
Shape of eggs	3	1.1
Shell condition, crackness	6	2.1
Duration of lay (age of egg, when the hen lay many eggs)	51	18.2
No grading	157	56.1
If there is no egg grading, what is the reason?		
Lack of awareness	83	29.6
Lack of attention	33	11.8
Shortage of eggs (low number laid)	41	14.6
There is grading	123	43.9
Mixing of different or same breed hen's eggs during incubation		
Yes	152	54.3

Table 7.3.15. Container type and bedding material used for egg incubation (N=280)

Variables	Frequency	%
Most preferred container used for setting the hen during incubation		
Grass made material ('kuna' or 'kimba')	112	40.0
Earthen made material (Made of mud and ash)	6	2.1
Broken pot ('sebara gel')	162	57.9
Presence of bedding material for incubation		
Yes	280	100.0
Most preferred type of bedding materials used for egg incubation		
Grass	125	44.6
Straw (Teff, Wheat)	155	55.4

Table 7.3.16. Cause of chicken loss, type of predators and control mechanisms (N=280)

Variables	%
Major cause of chicken loss (death) in the study area	
Chicken Disease	84.3
Predators (Predation)	11.1
presence of toxic materials inside the house	4.6
Major and dangerous type of predators found in the study area	
Wild birds (‘Chilfit’)	59.3
Tiger (‘Aner’)	36.8
Wild cat (“’Yedur dimet’”)	3.9
Season of the year when the attack of wild birds (‘Chilfit’) was higher	
Dry season (‘Bega’)	31.4
Wet season (‘kiremit’)	16.1
All season	52.5
Total	100
Season of the year when attack of predators, other than wild birds, was more	
Dry season (‘Bega’)	22.5
Wet season (‘kiremit’)	75.4
All season of the year	2.1
Most preferred control mechanisms of predators in the study area	
Killing predators using toxins, dog and other materials	33.9
Housing the chicken and keep inside providing feed and water	47.9
Try to kill the predators and housing chicken	18.2

Table 7.3.17. Type of chicken production activity where farmers pay cost (N=280)

Parameters (%)	High land		Mid-altitude		Low land		Total (Study area)	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Major type of chicken production activity where farmers pay cost								
No cost at all			4	3.3			4	1.4
To purchase chicken	41	51.3	64	53.3	34	42.5	139	49.6
To purchase feed			1	.8			1	.4
For treatment of sick chicken	5	6.3	29	24.2	13	16.3	47	16.8
To purchase chicken and drugs	34	42.5	21	17.5	33	41.3	88	31.4
To purchase feed and Medicine			1	.8			1	.4

Table 7.3.18. Status of agricultural extension services for village chicken production (N=280)

Variables	%
Presence of agricultural extension service with related to village chicken production	
Yes	37.5
If there is extension service, where do farmers get the service?	
From Development agent's office	23.9
In demonstration sites	0.7
In meetings (seminars)	2.1
In farmer's houses	6.8
In churches	3.9
No Extension service	62.5
Major reasons for absence of proper extension service	
Lack of awareness (knowledge)	13.6
Lack of extension agents (Unable to come)	31.8
No need of extension service	15.0
Shortage of time	2.1
I get extension service	37.5

7.4. Structured Questionnaire

1. General information

1.1. PA (Kebele) _____ 1.2. Village (Got) _____
1.2. Agro ecology 1. Dega 2. W/dega 3. Kolla
1.4. Altitude _____ masl
1.5. Questionnaire Number _____ Name of Respondant _____
1.6. Name of Innumerator _____ Signiture _____ Date _____

2.House-hold Characterstics

2.1. Type of Respondant 1. HH Head 2. Non HH Head
2.2. Sex of Respondant 1. Male 2. Female
2.3. Age of Respondant _____
2.4. Sex of Household Head 1. Male 2. Female
2.5.Marital Status 1. Married 2. Single 3. Divorced 4. Widowed
2.6. Education Status of Household Head
1. Illiterate 2. Reading and Writting 3. Grade 1-6 4. Grade 7-12 5. Other (Specify) __
2.6. Family size of Household

Household Head		Children under 15 years old		Age b/n 16-30		Age b/n 31-45		Above 46 years old		Family size
Husband	Wife	Male	Female	Male	Female	Male	Female	Male	Female	

3.Farm Characterstics

3.1. Total Farm Size _____ha
3.2. Back yard (home stead) _____ha
3.3. Major crops grown in the area 1st.---------- 2nd.---------- 3rd.---------- 4th.---

4.Livestock holding in the area (House hold)

No	Livestock type	Amount (Number)	Breed Type		
			Local	Cross	Exotic
1	Cattle				
	• Cows				
	• Oxen				
	• Heifers				
	• Calves				
Total					

No	Livestock type	Amount (Number)	Breed Type		
			Local	Cross	Exotic
2	Sheep				
3	Goats				
4	Equines				
	• Donkeys				
	• Horses				
	• Mules				

No	Livestock type	Amount (Number)	Breed Type				
			Local	Cross		Exotic	
				No	Breed	No	Breed
5	Chicken						
	- Hens						
	- Cocks						
	- Pullets						
	- Cockerels						
	- Young chicken						
Total							

- Comparison of livestock based on their economic function to farmers in the areas

	Chicken	Cattle	Sheep	Goats	Equines
Chicken					
Cattle					
Sheep					
Goats					
Equines					

5.Poultry Production system

5.1. Where do you get your chicken first?

1. Market 2. Family 3. Gift 4. Other (specify) _____

5.2. When did you start rearing chicken? Since _____years

5.3. What is the major chicken feather color types found in your area?

1st. _____ 4th. _____

2nd. _____ 5th. _____

3rd. _____ 6th. _____

5.4. Which color do you prefer more?

1st. _____

2nd. _____

3rd. _____

Why? 1. _____

2. _____

5.5. What is the comb type of your birds?
1. Netela 2. Dimdim 3. Netela and Dimdim 4. Others (Specify) _____
5.6. Which comb type do you prefer most? Why?
1. Netela (Single comb) 2. Dimdim 3. Both Netela and Dimdim 4. Others (Specify)
Why Netela (Single comb)? 1. _____
2. _____
Why Dimdim (Dimdim)? 1. _____
2. _____
5.7. Presence of any cultural or religious belief to rear a special type of chicken
1. Yes 2. No
5.8. If yes; specify the type of cultural/religious belief to rear a special type of chicken
---
5.9. Presence of any cultural or religious belief not to eat chicken meat and eggs
1. Yes 2. No
5.10. If yes; specify the type of cultural/religious belief not to eat chicken meat & eggs
---
5.11. Presence of any cultural or religious belief not to sell chicken and eggs
1. Yes 2. No
5.12. If yes; specify the type of cultural or religious belief not sell chicken and eggs
---
5.13. How do you start chicken rearing (Source of knowledge for chicken rearing)?
1. Learning from my parents 2. From my own interest
3. From colleagues and neighbors 4. Training 5. Others (Specify) _____

5.14. What type of poultry production system do you practice?
1. Traditional (Scavenging only)
2. Scavenging + Seasonal/conditional supplementation
3. Semi scavenging (Scavenging + Regular supplementation) 4. Intensive system

5.15. Why do you keep (rear) birds?

No	Purpose of keeping chicken	Rank
		1st
		2nd
		3rd
		4th

5.16. For what purpose do you use Eggs?

No	Purpose of Eggs	Rank
		1st
		2nd
		3rd
		4th

5.17. When do you consume (eat) eggs mostly?
1. Every time (when available) 2. During religious/cultural holidays
3. When being sick 4. Others (Specify) _____

5.18. When do you consume Chicken mostly?
1. Every time (when available) 2. During religious/cultural holidays
3. When being sick 4. Others (Specify) _____

5.19. What do you think the advantages and disadvantages of poultry rearing?
5.19.1. Advantages
1. _____
2. _____
3. _____
5.19.2. Dis advantages
1. _____
2. _____
3. _____

5.20. When (which season) do you rear more birds? Why?
1. Bega (Why) 1. _____
2. _____
2. Kiremit (Why) 1. _____
2. _____
3. Both Bega & Kiremit (Why) 1. _____
2. _____

6. Chicken Management

6.1. Chicken Feed and Feeding

6.1.1. Do you provide supplementary feed for your chicken?
1. Yes 2. No

6.1.2. If yes, which season do you provide additional feed most frequently?
1. July – Sep 2. Oct. - Dec 3. Jan. – March 4. April – June

6.1.3. What type of supplementary feed you provide mostly? Rank accordingly;

No	Type of Feed	Rank
1	Grains	
	• Maize	
	• Wheat	
	• Barley	
	• Millet	
	• Oats	
2	House hold left over	
3	Left scavenging only	
4	Other feed (specify)	

6.1.4. How do you provide the feed?

1. By feeder 2. Spreading on the floor 3. Other feed (specify) _____

6.1.5. Indicate availability of feed resources (Tick accordingly)

Status	Jan	Feb	Mar	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
	Yes/ no	Yes/ no	Yes/ no	Yes/ no	Yes/ no	Yes/ no	Yes/ no	Yes/ no	Yes/ no	Yes/ no	Yes/ no	Yes/ no
Shortage												
Sufficient												
Surplus												

6.1.6. What amount of supplemental feed you provide per bird?

1. Hand full 2. Unknown 3. Other (specify) _____

6.1.7. How do you provide the feed to the birds (Status of the feed)?

6.1.7.1. For adult chickens (Pullets, Cockerels, Hen and Cocks)

1. The grain itself 2. Crushed (ground feed)
3. Socked in water 4. Other (specify) ____

6.1.7.2. For young chickens

1. The grain itself 2. Crushed (ground feed)
3. Socked in water 4. Other (specify) _ _____

6.1.9. Which breed of chicken gets supplementary feeding most frequently?

1. Local breed 2. Cross breed 3. Exotic breed 4. All breeds

6.1.9. What is the frequency of providing supplemental feed during the above season listed?

i/ For local breeds

1. Every day 2. Every other day 3. Every 3 days 4. Unknown

ii/ For exotic breeds

1. Every day 2. Every other day 3. Every 3 days 4. Unknown

6.1.10. Which age group of chicken given priority for feeding? Rank

No	Age Group	Priority Rank	Reasons
1	Young Chicken		
2.	Pullets and Cockerels		
3	Laying Hen		
4	Cocks		

6.1.11. Where do you get the supplementary feed?

1. Crop harvest (Self produced) 2. Purchased from market
3. Harvest and Purchase 4. Other (specify)_____

6.1.12. How do you reduce the risk of chicken rearing during the time feed shortage and other Problems, like risk of predators, diseases and cropping seasons?

1. _____3. _____
2. _____4. _____

6.1.13. Do you have feeding trough (feeder)? 1. Yes 2. No
6.1.14. If yes, what type of feed trough you have?
1. Plastic made 2. Earthen pot 3. Wooden trough
4. Stone made 5. Other (Specify) _____
6.1.15. Do you provide water to your chicken? 1. Yes 2. No
6.1.16. If yes, which season of the year you provide water?
1. Bega 2. Kiremit 3. All season (Bega and Kiremit)
6.1.17. How frequent you provide water to your chicken during the above season?
1. Once a day 2. Twice a day 3. Adlibitum (freely)
6.1.18. What is the source of your water?
1. Spring water 2. River 3. Wale (under ground water)
4. Rain water 5. Pond water
6.1.19. Do you have watering trough (Waterer)? 1. Yes 2. No
6.1.20. If yes, what type of Watering trough you have?
1. Plastic made 2. Earthen pot 3. Wooden trough
4. Stone made 5. Other (Specify) _____

6.2. Poultry Housing

6.2.1. Do you have a separate house for your chicken? 1. Yes 2. No
6.2.2. If yes, what type of poultry house do you have?
1. Stone wall + grass roof
2. Stone made with corrugated iron sheet
3. Wooden made with grass roof
4. Wooden made with corrugated iron sheet 5. Other (specify)_____
6.2.3. If no, why not you construct a house for your chicken?
1. Lack of knowledge (Awareness)
2. Lack of attention to poultry
3. Lack of construction materials (Availability and Cost)
4. Risk of predators
5. Risk of Thief 6. Other (specify) _____
6.2.4. If no, where do you keep your chicken at night?
1. Night perch inside the house
2. On ceilings of the house
3. On the ground (Floor) covered by bamboo or grass made material
4. On the eave of the house (Barandah) 5. Other (specify) _____

6.3. Chicken Health Care
6.3.1. Is there any poultry disease in your area? 1. Yes 2. No
6.3.2. If yes, what is the most prevalent disease affecting chicken in the area?
1. Newcastle disease (*fengil*) 2. Other disease, specify _____

6.3.3. Discuss about the major economically important diseases?

No	Local name of the disease	Major symptoms (Circle)	Season (month)	Affected breed (Rank)			Affected age group (Rank)			*Control measures
				Local	Cross	Exotic	Young	Grower	Adult	
1	Newcastle *(Fengle)*									

* *Control measures* *1. Traditional methods* *2. Vaccination* *3. Spraying* *4. De-worming* *5. Proper hygiene* *6. Treatment* *7. No control measure used*

6.3.4. What type of traditional control measures (Indigenous knowledge) you used to prevent the risk of Newcastle disease (*Fengil*)?

1._____2. _____ 3. _____

6.3.5. Do you ever vaccinate your chicken? 1. Yes 2. No

6.3.6. If Yes, What type of vaccine (Type of disease)? _____

6.3.7. If yes, to which breed you get vaccine?

1. Local 2. Cross 3. Exotic 4. All breed

6.3.8. If not, what is the reason? _____

6.3.9. Have you ever treated your sick birds? 1. Yes 2. No

6.3.10. If yes, to which breed you get treatment?

1. Local 2. Cross 3. Exotic 4. All breed

6.3.11. If not, what is the reason? _____

6.3.12. What is the fate of sick chicken? _____

6.4. Chicken Productivity and Reproductivity

6.4.1. Do you have your own Cock? 1. Yes 2. No

6.4.2. If yes which breed? 1. Local Cock 2. Cross Breed 3. Pure Exotic Cock

6.4.3. If yes, where is the source of your cock?

No	Source of cocks	Breed of Cock		
		Local Cock	Cross Breed	Pure Exotic Cock
1	Market purchase			
2	Hatched and grown in the house			
3	Purchased from neighbors			
4	Agricultural Office			
5	Other (specify) _____			

6.4.4. If no, where do you get a cock for your hen?

1. From neighbors 2. I do not need a cock for my hen 3. Other (specify) _____

6.4.5. What is the average age of a cockerel at first mating in your management?

1. Local breed ___ months 2. Cross breed ___ months 3. Exotic breed ____ months

6.4.6. What is the average age of a pullet at first egg laying in your management?
1. Local breed ___ months 2. Cross breed ___ months 3. Exotic breed ____ months

6.4.7. How frequent hens lay eggs until the end of the clutch period?

I. Local Hen
- A. During feed surplus season
  1. Daily 2. Every other day 3. Every 3 days 4. No egg (Stop laying)
- B. During feed Shortage season
  1. Daily 2. Every other day 3. Every 3 days 4. No egg (Stop laying)

II. Cross Hen
- A. During feed surplus season
  1. Daily 2. Every other day 3. Every 3 days 4. No egg (Stop laying)
- B. During feed Shortage season
  1. Daily 2. Every other day 3. Every 3 days 4. No egg (Stop laying)

III. Exotic Hen
- A. During feed surplus season
  1. Daily 2. Every other day 3. Every 3 days 4. No egg (Stop laying)
- B. During feed Shortage season
  1. Daily 2. Every other day 3. Every 3 days 4. No egg (Stop laying)

6.4.7. Repeated survey of a local hen production data, on the bases of hen history,

Mature Hen	Breed	Color	Comb type	No of eggs layed per clutch	No of eggs incubated	No of chicken hatched	No of eggs wasted	No of chicken weaned	
								No	%
1	Local								
2	Local								
3	Local								
Average				@					

- Hatchability % = (*No of chicken hatched / No of eggs incubated)*100 = __ %*

6.4.8. How many clutch periods are there in a year, if a hen does not hatch eggs?
1. Local breed _____ clutch periods
2. Cross breed _____ clutch periods
3. Exotic breed _____ clutch periods

6.4.9. What is the average number of eggs layed per clutch?
1. Local breed @____ eggs
2. Cross breed _____eggs
3. Exotic breed _____eggs

6.4.10. What is the total average egg production per year per bird under the existing chicken management condition? *(No of clutch periods * Av.No of eggs/clutch)*
1. Local breed _____ eggs
2. Cross breed _____ eggs
3. Exotic breed _____ eggs

6.4.11. Do you have any local practices used to avoid broodiness?
1. Yes 2. No
6.4.12. If yes, what type of practices you used? (Put in order of preference and applicability)
1st. _____
2nd. _____
3rd. _____

6.4.13. What method do you use for brooding and rearing chicken?
1. Broody hen (natural methods) 2. Hay box brooder 3. All methods
6.4.14. Do you have a culture of culling chicken?
1. Yes 2. No
6.4.15. Do you purposely cull cocks?
1. Yes 2. No
6.4.16. If yes, for what purpose do you cull cocks? What is the fate of culled cocks?

consumption	sold	cultural ceremony	other; specify

_____

6.4.17. Which birds are culled primarily?
1. _____ 2. _____ 3. _____
6.4.8. If it is due to age factors, at what average age do you cull cocks? _____Years.
6.4.8. If it is due to health problems, when do you cull your birds? _____.

7.Egg Quality and management

7.1. How frequent do you collect your eggs?
1. Every day 2. Every 2 days 3. Every 3 days
4. Weekly 5. Not collected until incubation/sale
7.2. Where do you store eggs used for incubation and hatching purpose? -
_____
7.3. Where do you store eggs used for sale or house consumption?
_____
7.4. Do you select broody hens for incubation?
1. Yes 2. No
7.5. If yes what is the major criteria for selection of broody hens? _____
7.6. How long do you store your eggs before incubation? _____
7.5. Do you grade (select) eggs before incubation? 1. Yes 2. No
7.5.1. If yes, what do you observe during selection of eggs?
1. Size of the eggs 2. Shape of the eggs
3. Cleanness of the eggs (dirtiness) 4. Shell condition (crack ness)
5. Other (specify) _____
7.5.2. If no, why don't you select eggs for incubation?
1. Lack of awareness (knowledge) 2. Lack of attention
3. Shortage of eggs (low number layed) 4. Other (specify) _____
7.6. Do you mix eggs obtained from different hens? 1. Yes 2. No
7.6.1. If yes, why _____

7.6.2. If no, why _____
7.7. How do you set the eggs for incubation?

1. Vertically broad end up 2. Vertically pointed end up
3. Horizontally 4. Do not mind (Any position randomly)

7.8. What type of material or container you use to put the hen for incubating the eggs
1st. _____
2nd. _____
3rd. _____

7.9. Do you use bedding material for incubation of eggs?
1. Yes 2. No
7.10. If yes, what type of bedding material you use for incubation (Litter type)

1st. _____
2nd. _____
3rd. _____
7.11. Which months of the year you don't prefer to incubate and hatch eggs? Why?

No	Months of the year	Reasons for Incubation Refusal	Remark
1			1st
2			2nd
3			3rd

8.Labor Allocation and management for poultry production

8.1. Describe the allocation house hold labor for poultry

No	Activity type	Responsible family members (Rank)			
		Women	Men	Children	All family
I	Chicken management and marketing				
1	Shelter construction				
2	Cleaning chicken house				
3	Supplementary feeding				
4	Providing water				
5	Selling chicken				
6	Selling eggs				
7	Treatment of sick birds, if any				

No	Activity type	Responsible family members (Rank)			
		Women	Men	Children	All family
II	Decision making				
1	Selling eggs				
2	Selling Chicken				
3	Home consumption of eggs				
4	Home consumption of chicken				
5	Purchase of drugs, vaccines				
6	Purchase of foundation/replacement stock				

9. Chicken production Constraints

9.1. State and rank major poultry production constraints in your area

No	Constraint type	Rank	Preventive mechanisms
		1st	
		2nd	
		3rd	
		4th	
		5th	

9.2.What are the major causes of chicken losses? Rank them?

No	Cause of chicken loss (Death)	Rank
1		1st
2		2nd
3		3rd

9.3. Is there any predator problem in your locality? 1. Yes 2. No

9.3.1. If yes what is the major predator (wild and domestic animal attacking chicken)?

1st. _____ 2nd. _____3rd. _____

4th. _____ 5th. _____

9.3.2. If yes, in which season is the problem worst?

A. Eagle ("Chilfit") attack 1. _____2. _____ 3. _____

B. Other Predators attack 1. _____2. _____ 3. _____

9.3.3. Which age groups of chicken are attacked more?

A. Eagle ("Chilfit") attack 1. _____2. _____ 3. _____ 4. _____

B. Other Predators attack 1. _____2. _____ 3. _____ 4. _____

9.3.4. Which breed groups of chicken are attacked (affected) more?

1. Local chicken 2. Cross breeds

3. Pure exotic chicken breed 4.All breeds are affected

9.3.5. How do you control the problem?

1. _____2. _____ 3. _____ 4. _____

10. Poultry Recording

10.1. Do you have any poultry recording system? 1. Yes 2. No

10.1.1. If yes, what do you record?

1. _____ 2. _____ 3. _____ 4. _____

10.1.2. If not, what is the reason?

1. _____ 2. _____ 3. _____ 4. _____

11. Chicken and Egg Marketing

11.1. For farmers (Producers)

11.1.1. Do you sale chicken?

1. Yes 2. No

11.1.2. If yes, Where do you sale your chicken (Circle accordingly)?

1st. _____ 2nd. _____

3rd. _____ 4th. _____

11.1.3. To whom do you sale your chicken (circle accordingly)

1st. _____ 2nd. _____

3rd. _____ 4th. _____

11.1.4. How do you transport chicken to local and urban markets (circle accordingly)

1st. _____ 2nd. _____

3rd. _____ 4th. _____

11.1.5. Have you ever faced death of birds during transportation to markets?

1. Yes 2. No

11.1.6. Do you sale eggs?

1. Yes 2. No

11.1.7. If yes, Where do you sale your Eggs (Circle accordingly)

1st. _____ 2nd. _____

3rd. _____ 4th. _____

11.1.8. To whom do you sale your Eggs (circle accordingly)

1st. _____ 2nd. _____

3rd. _____ 4th. _____

11.1.9. How do you transport eggs to local and urban markets (circle accordingly)

1st. _____ 2nd. _____

3rd. _____ 4th. _____

11.1.10. What is your major Source of information about the price of chicken and eggs?

1. Other farmers 2. Market visit 1. Extension workers 2. Medias (Radio, etc)

11.1.11. In what type of chicken production activity do you expend money?

1st. _____ 2nd. _____

3rd. _____ 4th. _____

11.1.12. What is the average selling price of chicken and eggs (unit price)?

	Sale price (Birr)							
	Matured male		Matured Female		Growers (Pullets & Cockerels)		Eggs (No of eggs/1Birr)	
	Bega	Kiremit	Bega	Kiremit	Bega	Kiremit	Bega	Kiremit
Price in Birr/bird								

11.1.13. Market prices of live chicken and eggs in ordinary market days and market days on eves of four different festivals in Burie woreda, Ethiopia (2007/2008 production year)

No	Market time	Price of chicken (by age and sex) and eggs (Birr/unit)			
		Matured male (Birr)	Matured Female (Birr)	Growers (Pullets & Cockerels) (Birr)	Eggs (Eggs/1Birr)
1	Ordinary weekly market days				
2	Market days of eves of festivals				
2.1	Eth. New year (Sep. 11)				
2.2	"Meskel" (Sept 30)				
2.3	X-mas ("Gena")				
2.4	Easter ("Fasika")				
2.5	Muslim festival				

11.1.14. Market selling prices of matured male chicken with different feather colors and comb type at ordinary market days and market days on eves of four different festivals in Burie woreda, Ethiopia (2007/2008 production year)

No	Market time	Price of mature male chicken (Birr/unit)									
		Kei (red)		Netch (white)		Gebsima (grayish mixture)		Wossera (black and white)		Tikur (black)	
		dimdim	Netela	Dimdim	Netela	dimdim	Netela	dimdim	Netela	dimdim	Netela
1	Ordinary weekly market day										
2	Market days of eves of festivals										
2.1	Eth. New year (Sep. 11)										
2.2	"Meskel" (Sept 30)										
2.3	X-mas ("Gena")										
2.4	Easter ("Fasika")										
2.5	Muslim festival										

11.1.15. How many kms do you travel on average to markets to sell your chicken/eggs?

1. To nearby local markets (Primary markets) _____ Kms

2. To urban markets (Secondary markets) _____ Kms

11.1.16. What are the major determinant factors that affect (control) the price of chicken and eggs during the dry season (Bega)?

1._____
2._____
3._____
4._____
5. _____

11.1.17. What are the major determinant factors that affect (control) the price of chicken and eggs during the rainy season (Kiremit)?

1._____
2._____
3._____
4._____
5. _____

11.1.18. What are the major Chicken and Egg Marketing Constraints in your area?

No	Marketing Constraint type	Tick accordingly		Suggested Solutions against the problem
		Yes	No	
1	Low prices			
2	Seasonality of market prices			
3	Low marketable output (egg & chicken)			
4	Reliable markets found very far			
5	Limited market outlets			
6	Lack of buyers			
7	Lack of marketing information			
8	Disease outbreaks			
9	No problem			
10	Lack of capital			
11	Others (specify)			

12. Farmers Comments, Suggestions and Recommendations

11.2. What do you think or recommend to improve poultry production in your area?
1. _____
2. _____
3. _____

11.3. What do you think or recommend to improve chicken and egg marketing in your area?
1. _____
2. _____
3._____

13. Extension Service in local chicken production

13.1. Presence of extension service in local chicken production
(Are farmers getting extension Service regarding chicken production and marketing)?
1. Yes 2. No

13.2. If yes where do you get the service?
1. Development agent's office 2. In demonstration sites
3. In meetings (seminars) 4. In farmer's houses 5. In churches

13.3. How frequent do you get extension workers?
1. Every day 2. Every week 3. Every 15 days 4. Every month 5. Every month

13.4. If no, what is the reason for absence or poor extension service?
1. Lack of awareness (knowledge)
2. Lack of extension agents (unable to come)
3. No need of extension service

13.5. What are your sources of information about improved chicken production?
1st. _____ 2nd. _____
3rd. _____ 4th. _____

14. Income and Source of income

14.1. Describe your income in the year 1999/2000 E.C

14.1.1. From crops, fruits and vegetables
1. Maize _____ Birr 5. Millet _____ Birr
2. Teff _____ Birr. 6. Oil crops (Noug, etc) _____ Birr
3. Wheat _____ Birr 7. Fruits and vegt. _____ Birr
4. Barley _____ Birr. 8. Others (specify) _____ Birr
9. Total income _____ Birr

14.1.2. From Livestock and livestock products
1. Cattle sale (cow, oxen, etc) _____ Birr 5. Egg sale _____Birr
2. Sheep and goat sale _____ Birr. 6. Honey sale _____ Birr
3. Cattle products sale (Butter, milk, etc) _____ Birr 7. Equine sale. _____ Birr
4. Chicken sale _____ Birr. 8. Others (specify) __Birr
9. Total income _____ Birr

11. Chicken and Egg Marketing

11.2. For Egg and Chicken Traders

11.2.1. General information

1. P.A _____ 2. Market name _____

3. Market type 1. Local (rural) market 2. Urban market

4. Agro ecology 1. Dega 2. W/dega 3. Kolla

5. Name of Enumerator _____ Signiture _____ Data collection date _____

6. Name of respondant (Trader) _____

7. Sex of trader 1. Male 2. Female

8. Age of trader _____ years

1. < 18 years 2. 18-30 years 3. 31-40 years 4. 41-50 years 5. >51 years

9. Marital Status 1. Married 2. Single 3. Divorced 4. Widowed

10. Education status

1. Illiterate 2. Reading and Writting 3. Grade 1-6 4. Grade 7-12 5. Other (Specify)

11. What poultry products do you buy and sale?

1. Chicken 2. Eggs 3. Both

12. When do you start the activity? Since _____ Years

13. How frequent do you work this activity?

1. Regularily (main activity) 2. Some times (occasionally)

11.2.2. Marketing Channel

11.2.2.1. What is your major group of activity? (To whom do you sale the products)

1. Assembler (Buy from farmers and sale to retailers (hotels))
2. Retailer (Buy from assembler's and sale to consumers),
3. Assembler and retailer (Buy from farmers and sale to consumers and retailers
4. Others (specify) _____

11.2.3. Demand and Supply for Chicken and Eggs

11.2.3.1. Demand and supply for live chicken

Poultry Product	*Demand (Need)		*Supply (Production)	
	Chicken (Tick accordingly)		Chicken (Tick accordingly)	
	High	Low	High	Low
Bega				
Kiremit				
Christian/Muslim Festivals				

11.2.3.2. Demand and supply for eggs

Poultry Product	*Demand (Need)		*Supply (Production)	
	Eggs (Tick accordingly)		Eggs (Tick accordingly)	
	High	Low	High	Low
Bega				
Kiremit				
Christian and Muslim Festivals				

11.2.4. Chicken products prices and major marketing constraints

11.2.4.1. What is the average purchasing price of chicken and eggs (unit price)?

	Sale price							
	Matured male		Matured Female		Growers (Pullets &Cockerels)		Eggs (No of eggs/1Birr)	
	Bega	Kiremit	Bega	Kiremit	Bega	Kiremit	Bega	Kiremit
Price in Birr								
*Period of highest sale								

* X = Christ-mas T= Traditional festival M= Muslims festival A= Year round

11.2.4.2. What is the average selling price of chicken and eggs (unit price)?

	Sale price							
	Matured male		Matured Female		Growers (Pullets &Cockerels)		Eggs (No of eggs/1Birr)	
	Bega	Kiremit	Bega	Kiremit	Bega	Kiremit	Bega	Kiremit
Price in Birr								
*Period of highest sale								

* X = Christ-mas T= Traditional festival M= Muslims festival A= Year round

11.2.4.3. What are the major determinant factors that affect (control) the price of chicken and eggs during the dry season (Bega)?

1. High Demand due to Traditional and Religious festivals
2. High supply of chicken and eggs due to high production during dry season
3. Transport of eggs and chicken
4. Others (Specify) _____

11.2.4.4. What are the major determinant factors that affect (control) the price of chicken and eggs during the rainy season (Kiremit)?

1. High Demand due to Traditional and Religious festivals
2. Low supply of chicken and eggs due to low productivity during rainy season
3. Low supply of eggs and chicken 4. Others (Specify) _____

11.2.4.9. What are the major Chicken/Egg Marketing Constraints in your area?

No	Marketing Constraint type	Tick accordingly		Suggested Solutions against the problem
		Yes	No	
1	Low prices			
2	Seasonality of market prices			
3	Low marketable output			
4	Reliable markets found very far			
5	Limited market outlets			
6	Lack of buyers			
7	Lack of marketing information			
8	Disease outbreaks			
9	No problem			
10	Lack of capital			
11	Others (specify)			

12. Comments, Suggestions and Recommendations

12.1. What do you recommend to improve poultry production in your area?

1. _____
2. _____
3. _____
4. _____
5. _____

12.2. What do you recommend to improve chicken and egg marketing in your area?

1. _____
2. _____
3. _____
4. _____
5. _____

Annex

Annex 1. Pictures of Chicken and Egg marketing in local and urban markets

Chicken marketing

Egg marketing

Local markets (Alefa Market)

Annex 2. Pictures of some equipment used for internal and external egg quality study

Electrical Balance,
used for measuring egg weight

Yolk color measuring fan
graded from 1 to 15

Tripod micrometer used for measuring yolk height and albumen height

Caliper, used for calculating egg shape index
and shell thickness

Eggs quality study

Biographic sketch

The author of the present thesis, Fisseha Moges, was born on 18th November, 1972 at Addis-Zemen, Amhara National Regional State. When he was 7, he joined Addis-Zemen Elementary School. After completion of his elementary school, he pursued his Secondary & High school education at Addis-Zemen Junior & Secondary School.

After successfully passing his Ethiopian School Leaving Certificate Examination (ESLCE), he then joined the former Jimma College of Agriculture in December 1991 and awarded Diploma in Animal Science in July 1993.

A year after graduation, he was employed by Amhara National Regional State Bureau of Agriculture and Rural Development (ANRS-BoARD) and assigned at West Gojam administrative zone. He worked in Bahir-Dar zuria, Womberma and Burie district agriculture offices as an agricultural extension/development agent since February 1999.

He then joined Debub University (now Hawassa University), Awassa College of Agriculture in February 1999 as an advanced standing student and graduated with B.Sc. degree in Animal Production and Rangeland Management (APRM) in July 2001.

Between 2001/2 and 2006 he was employed by Andassa Livestock Research Center, ARARI and worked for Poultry Research Division of the center. He was admitted to the School of Graduate Studies of Hawassa University in 2006/7 for his graduate studies in the specialization of Animal Production.