CHARACTERIZATION OF VILLAGE CHICKEN PRODUCTION AND MARKETING SYSTEM IN GOMMA WEREDA, JIMMA ZONE, ETHIOPIA

M.Sc. Thesis

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CHARACTERIZATION OF VILLAGE CHICKEN PRODUCTION AND MARKETING SYSTEM IN GOMMA WEREDA, JIMMA ZONE, ETHIOPIA

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As thesis research advisor, we hereby certify that we have read and evaluated this thesis prepared, under our guidance, by Meseret Molla Bogalle entitled: Characterization of Village Poultry Production and Marketing System in Gomma Wereda, Jimma Zone, Ethiopia. We recommend that it be submitted as fulfilling thesis requirement.

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As member of *Board of Examiners* of the *M.Sc*. *Thesis Open Defense Examination*, We certify that we have read, evaluated the thesis prepared by Meseret Molla Bogalle and examined the candidate. We recommended that the thesis could be accepted as fulfilling the thesis requirement for the Degree of Master of Science in Animal Production.

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DEDICATION

I dedicate this manuscript to my father Ato Molla Bogalle, who passed away without seeing any of my achievements.

STATEMENT OF AUTHOR

I declare that the thesis hereby submitted for the M.Sc. degree at the Jimma University, College of Agriculture and Veterinary Medicine is my own work and has not been previously submitted by me or others at another University or institution for any degree. I concede copyright of the thesis in favor of the Jimma University, Collage of Agriculture and Veterinary Medicine.

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BIOGRAPHICAL SKETCH

Meseret Molla, the author, was born in Gonder town, Amhara Regional State in 1982 G.C. She started her elementary school education at Sadiku Yohannes in 1988, and completed her elementary in 1993 and she started her Junior Secondary education at Ato Bekafa Junior Secondary School in 1994. She continued her Secondary school at Faciledes Compressive high School in 1996, and completed in 2000 G.C. Then, she joined Debub University, Awassa college of Agriculture, in 2001, and graduated with B.Sc. degree in Agriculture (Animal Production and Rangeland Management) in 2004. After graduation, she joined Jimma University, College of Agriculture and Veterinary Medicine, as Graduate Assistant -I and served until she joined Jimma University, School of Graduate Studies for the Degree of Master of Science in Animal Production in 2008.

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LIST OF ACRONYMS AND ABBREVIATIONS

ANOVA: -Analysis of Variance

AACMC:- Australian Agricultural Consulting and Management Company

CACC:- Central Agricultural Census Commission

CSA:- Central Statistic Authority

EARO: - Ethiopian Agricultural Research Organization

HU: - Haugh unit

IBD:- Infectious Bursal disease

IPMS: - Improving Productivity and Market Success

JATS:- Jimma Agricultural Technique School

JUCAVM: - Jimma University, Collage of Agriculture and Veterinary Medicine

Md:- Marek disease

ND:- Newcastle disease

RIR: - Rhode Island Red

SAS:-Statistical Analysis System

SPSS: - Statistical Package for Social Sciences

SNNPRS: - Southern Nation Nationalities Peoples Regional State

USAID:- United States Agency for International Development

WLH: - White Leghorn

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CHARACTERIZATION OF VILLAGE POULTRY PRODUCTION AND MARKETING SYSTEM IN GOMMA WEREDA, JIMMA ZONE, ETHIOPIA

By
Meseret Molla Bogalle (B.Sc in Animal Production and Rangeland Management)
Name of Major advisor: Solomon Demeke (Professor)
Name of Co-advisor: Tadelle Dessie (Ph.D)

ABSTRACT

This study was conducted to characterize the production and marketing system of village chickens in Gomma Wereda of Jimma Zone. Six Kebeles were selected using multistage random sampling from each of which 30 Households (HHs) were randomly selected. A survey was conducted on the selected HHs pertaining indigenous chicken management, marketing and productivity. Fresh eggs (purchased from the household) and market eggs (purchased from the local market) were studied for quality and hatchability. Finally close follow up of the farmers who adopted improved poultry using hay-box brooder under IPMS project in the Wereda was made for comparative study over a period of 5 months. The results obtained showed that mean flock size/HH in Gomma Wereda is 6.2 indigenous chickens. About 94.4% of the respondents indicated that there is no separate poultry house, and the feeding system is based on full day scavenging with supplementation. Poultry diseases are widely spread and 85.6% of the respondents reported serious and occasional disease outbreak commonly resulting in complete devastation. Live bird and eggs are sold in an open market. Egg storage conditions and market live bird and egg transportation practices contribute to disease spread and egg quality deterioration as measured by changes in egg weight, albumen height and, HU of eggs collected from market places of Gomma Wereda. The Production Performance of the indigenous chickens of Gomma Wereda, as measured by rates of chick survival, sexual maturity and laying looks fairly good compared to that of central highlands and southern Ethiopia. In contrast, the results of the survey and egg incubation trials conducted clearly indicated that percent hatchability as measured by the number of fertile eggs that hatched into normal chick was found to be very low (27.4 %). According to the majority of the respondents household poultry is source of income that benefits women since about 96.7% of the chicken population of the Wereda are reported to be owned by women who are said to be responsible for making almost all the major decisions concerning poultry. The results of this study also showed that farmers who adopted exotic chickens under IPMS farmers-project in the Wereda, were successful in raising layer type day old chicks with the use of hay-box brooder. Mean egg production of the exotic layers kept in separate poultry house and fed with commercial ration was reported to be about 0.7egg/hen/day.In summary the results of this study tends to indicate that improvement in hatchability seems to be the future direction of research in the Gomma Wereda.

Key words: *Indigenous chickens, quality, hatchability, chicken production, marketing systems and gomma wereda.*

1. INTRODUCTION

Nearly all rural and peri-urban families in the developing world keep household poultry. In Africa, village poultry contributes over 70% of poultry products and 20% of animal protein intake (Kitalyi, 1998). In East Africa over 80% of human population live in rural areas and over 75% of these households keep indigenous chickens and Ethiopia is not exception to this situation (Kitalyi, 1998). Recent estimates put the poultry population in Ethiopia at around 34.2 million with native chicken of none descriptive breeds representing 94.4%, hybrid chicken 3.92% and exotic breeds of chickens mainly kept in urban and peri-urban areas 0.64% (CSA, 2007). The total national annual poultry meat and eggs production is estimated at 72 300 and 78 000 metric tones, respectively and indigenous poultry contribute almost 99% of the national egg and poultry meat production (Tadelle *et al.*, 2003).

Rural household poultry is affordable source of animal protein and sources of family income. Poultry is a source of self-reliance for women since, poultry and egg sales are decided by women (Aklilu *et al*., 2007) both of which provide women with an immediate income to meet household expenses and sources of food. Household poultry require limited space, feed and capital investment compared to other domestic animals kept in rural Ethiopia. The indigenous chickens also represent part of the livestock production system. Thus household poultry of the Ethiopian indigenous chicken has a unique position in the rural household economy and plays a significant role in the religious and cultural life of the society (Tadelle and Ogle, 1996a). However, the contribution of the indigenous chicken resource to human nutrition and export earnings is disproportionately small. All the available literature tends to indicate that the per capita poultry and poultry product consumption in Ethiopia is one of the lowest in the world: 57 eggs and 2.85 kg of chicken meat per annum (Alemu, 1995). The indigenous flocks are considered to be very poor in egg production performance, attributed to the low genetic potential (slow growth rate, late sexual maturity and broodiness for an extended period).

The low productivity of local scavenging chickens is not only because of their low egg production potential, but also due to high chick mortality and longer reproductive cycle. About 40-60% of the chicks hatched die during the first 8 weeks of age (Hoyle, 1992, Tadelle and Ogle, 1996a) mainly due to disease and predators attack. About half of the eggs produced have to be hatched to replace chicken that have died (Tadelle and Ogle, 1996a), and the brooding time of the laying hens is longer, with many brooding cycles required to compensate for its unsuccessful brooding. It is estimated that, under scavenging conditions, the reproductive cycle of indigenous hens consists of 20-days of laying phase, 21-days of incubation phase and 56-days of brooding phase (Alemu and Tadelle, 1997). This implies the fact that, the number of clutches per hen per year is probably 2-3. Assuming 3 clutches per hen per year, the hen would have to stay for about 168 days out of production every year, entirely engaged in brooding activities.

The low productivity of the indigenous stock could also partially be attributed to the low management standard of the traditional household poultry production system. It have been seen that the provision of vaccination, improved feeding , clean water and night time enclosure improve the performance of the indigenous chickens, but not to an economically acceptable level (Burley, 1957; Teketel, 1986; and Abebe, 1992). Unfortunately however, the productivity of indigenous chicken and the production system at which the indigenous chicken are exposed is little know in Gomma Wereda This condition calls for a scientific study in the area of characterization of the production performance of village chicken followed by the identification of technological interventions.

As a means to improve poultry productivity, there are a number of farmers who have adopted improved exotic chicken with hay-box brooder under IPMS (Improving Productivity and Market Success) farmers' project particularly in the Gomma and Dale areas of the Oromiya and SNNPRS Region, respectively. Currently IPMS is interested in the follow up of these farmers and monitoring their perception and performance of the exotic chicken introduced in the IPMS project sites. IPMS is also interested in assisting community driven and proper input supply system (breeding stock, feeds, market access,

health care and pharmaceuticals) for improved poultry production suitable to smallholder farmers management condition. This being the cases, this study is aimed at characterizing the production performance of village chicken in Gomma Wereda of Jimma Zone with the following specific objectives.

1) To carry out a survey on management practices, and production performance of indigenous household chicken kept in Gomma Wereda.
2) To investigate the marketing systems followed and quantify the post-harvest loss of eggs and chicken in Gomma Wereda.
3) To follow up farm households who adopted improved poultry package with the use of hay-box under IPMS farmers- project for five months in Gomma Wereda.

2. LITERATURE REVIEW

2.1 Ethiopian poultry population and distribution

Poultry include all domestic birds kept for the purpose of human food production (meat and eggs) such as chickens, turkeys, ducks, geese, ostrich, guinea fowl and doves and pigeons. In Ethiopia ostrich, ducks, guinea fowls, doves and pigeons are found in their natural habitat (wild) whereas, geese and turkey are exceptionally not common in the country. Thus the word poultry production is synonymous with chicken production under the present Ethiopian conditions (EARO, 1999). Indigenous poultry contribute almost 99% of the national egg and poultry meat production (Tadelle *et al.*, 2003).

There is no recorded evidence indicating the exact time and locations of introduction of the first batch of exotic breeds of chickens into Ethiopia. It is widely believed that the importation of the first batch of exotic poultry was probably done by missionaries. Four breeds of exotic chicken (Rhode Island Red, Australop, New Hampshire and White Leghorns) were imported to Jimma and Alemaya in 1953 and 1956, respectively under USAID project (Solomon, 2007). On top of these, the Ministry of Agriculture established several exotic chicken breeding and multiplication centres at different parts of the country to enhance the national poultry extension activities.

According to the CSA (2005), the majority of the national chicken population (41.7%) comprises of chicks of 0-8 weeks of age and about 30.9 % of the total national standing chicken population is hens, of which about 16% are none layers. The four major Regional States (Oromiya, Amhara, SNNP, and Tigray) collectively account for about 96% of the total national poultry population. The other Regional States collectively own 3.24% of the total national chicken population of which 2.2 % is owned by Banishing-Gumuze Regional State (Solomon, 2007).

Oromiya region habitat about 34.4% of the total national chicken population and contribute 36% of the total annual national egg and poultry meat production. Almost all

the available commercial poultry farms of the country are located in Oromiya region specifically in and in the vicinity of DebreZiet. The Regional State operates seven exotic poultry breeding and multiplication centers. The Amhara, Southern Nation and Nationality People (SNNP) and Tigray Regional State habitat about 31.3, 18.8 and 11.65% of the total national poultry population respectively. The SNNP Regional State Bureaus of Agriculture (RSBA) operates 4 poultry breeding and multiplication centers. The Amhara and Tigray Regional States have two and one exotic poultry breeding and multiplication centers respectively (Solomon Demeke, 2007).

2.2 Breeds and productivity

The Ethiopian indigenous chickens are none descriptive breeds closely related to the Jungle fowl and vary in color, comb type, body conformation and weight. Broodiness (maternal instinct) is pronounced. They are characterized by slow growth rate, late sexual maturity and low production performance. The mean annual egg production of indigenous chickens is estimated at 60 small eggs with thick shell and deep yellow yolk color (Alemu and Tadelle, 1997). According to Teketel (1986), the productivity of indigenous chickens (expressed in terms of egg production, egg size, growth and survivability of chicks) kept under traditional production system is very low. The low productivity of the indigenous chickens could be attributed to lack of genetic improvement, incidence of diseases and predation and management factors (Alemu & Tadelle, 1997; Sonaiya, 2000).

The results of experimental studies conducted on indigenous chickens at Holota Agricultural Development Unit (Kidane, 1980) indicated that the average annual egg production of scavenging village indigenous chicken ranges between 30 and 60 eggs/hen. Study conducted at Assela livestock farm revealed that the average annual production potential of local birds is about 34 eggs /hen, with an average egg weight of 38g (Brannang & Pearson, 1990). The AACMC (1984) reported that local males could reach a live weight of 1.5 kg at 6 months of age and the females of the same age weigh 30 % less than the males. Teketel (1986) reported that the local stocks reached 61 % and 85 %

of the body weight of White Leghorn (WLH) at 6 months of age and maturity, respectively. In a study, conducted in Eastern Ethiopia Abebe (1992) reported that the local birds attained 71.5 % of the body weight of WLH at 6 months of age. The carcass weight of the local and WLH chickens at the age of 6 months was 559 g and 875 g, respectively (Teketel, 1986).

According to Alamargot (1987), about 99% and 1% of the Ethiopian poultry population consisted of indigenous and exotic chickens respectively during the 1970s and 1980s. At present it is estimated that the exotic chickens make up about 2.18% of the national poultry population (CSA, 2005; Solomon, 2007) indicating that the share of exotic chickens in the total annual egg and poultry meat production has increased by 118% over the last 20 years. Unfortunately however, the contribution of exotic poultry to the Ethiopian economy is significantly lower than that of other African countries (Table 1).

Table 1: Percentage contribution of exotic breeds of chicken in selected African Countries to the total poultry population.

Country	**Contribution (%)**
Cameroon	35.0
Ethiopia	2.0
Gambia	10.0
Kenya	20.0
Malawi	10.0
Nigeria	9.0
Zimbabwe	70.0

Source: Alemu and Tadelle, 1997

All the available evidence indicates that all the imported breeds of chickens performed well under the intensive management system (Alemu and Tadelle, 1997). Some productivity measures of the indigenous chickens, the breeding and multiplication centers

and the commercial poultry farms located in and around the vicinity of Debre Zeit are shown in Table 2.

Table 2: Comparative productivity indicators of the traditional, breeding centers and commercial poultry production systems in Ethiopia.

Item	Traditional (indigenous)	Breeding centers	Commercial farms
Average egg weight(g)	38	56	56
Mean laying period/ hen(days)	20	>200	>200
Eggs/hen per year	60	200	230
Natural incubation period (days)	21	NA	NA
Natural brooding period (days)	56	NA	NA
Mean total days out of laying	96	NA	NA
Chick mortality (%)	40	5-10	5-6
Fertility (%)	75	80	90
Hatchability (%)	70	65	80
Age at first egg (days)	180	150	145
Slaughter weight at 12 months (kg)	1.5	NA	NA
Mortality of adult flock (%)	20-30	6-8	5-6
Mortality of broilers (%)	NA	NA	10-15
Slaughter weight at 8 weeks(kg)	1.5	NA	1.8
Adult weight (kg)		NA	NA

Source: CACC 2003 and Alemu 1997 cited by Solomon, 2007

2.3 Poultry production systems

In Ethiopia poultry production systems show a clear distinction between the traditional, low input system on the one hand and modern production systems using relatively advanced technology on the other hand (Alemu, 1995). The traditional poultry production system comprises of the indigenous chickens and characterized by small flock size, low input and output and periodic devastation of the flock by disease. There is no separate poultry house and the chickens live in family dwellings together with human beings.

There is no purposeful feeding of chickens and scavenging is almost the only source of diet. There is no designed selection and controlled breeding. It is by natural incubation and brooding that chicks are hatched and raised all over the rural Ethiopia. A broody hen hatching, rearing and protecting few number of chicks (6-8) ceases egg laying during the entire incubation and brooding periods of 77 days. Yet the successes of the hatching and brooding process depends on the maternal instinct of the broody hen and prevalence of predators in the area, such as birds of prey, pets and some wild animals, all of which are listed as the major causes of premature death of chicks in Ethiopia (Solomon 2007). Newcastle disease (ND) is the most important cause of economic loss since vaccination occurs only in response to an outbreak in the traditional poultry production system.

The modern poultry sub-sector comprises of the small scale intensive and large scale commercial production systems. The small scale intensive poultry is newly emerging system in urban and peri-urban areas, where either broilers or egg type exotic breeds of chicken are produced along commercial lines using relatively modern management methods. This activity is being undertaken as a source of income in and around major cities and towns such as Debre Ziet. Most of these farms obtain their feeds and foundation stocks from the large scale commercial poultry farms and involved in the supply of table eggs to various supermarkets, kiosks and hotels through middlemen.

There are several private large scale commercial poultry farms in and in the vicinity of Addis Ababa, the majority of which are located in Debre Ziet. ELFORA, Alema and Genesis are the top 3 largest commercial poultry farms with modern production and processing facilities. ELFORA annually delivers around 420 000 chickens and over 34 million eggs to the market of Addis Ababa. Alema poultry farms is the 2nd largest commercial poultry farms in the country delivering nearly half a million broilers to Addis Ababa market each year. The farm has its own broilers parent stock, feed processing plants, hatchery, slaughter houses, cold storage and transportation facilities. Genesis farm keeps about 10,000 layers at a time and has its own hatchery. There is also a third sector, keeping dual purpose chickens of exotic breeds at the government owned poultry breeding and multiplication centers. The centers distribute fertile eggs, baby chicks and

pullets and cockerels for the farming communities. They have hatchery, brooder and layers houses, and veterinary clinic and feed processing units. The centers directly import fertile eggs and day-old chicks of dual propose chickens (commonly RIR) as a parent stock (Solomon, 2007).

2.4 Socio-economic role of poultry

The Ethiopian chickens' population accounts for about 60 % of the total chicken population of East Africa (Mekonnen *et al.,* 1991). The contribution of these birds to household food security and income source is highly significant (Halima, 2007). It is widely accepted that village chickens are important in breaking the vicious cycle of poverty, malnutrition and disease (Roberts and Gunaratne, 1992). This is true in northern Ethiopia particularly in Tigray, Amhara and northern Oromia Regional States which collectively own about 43% of the total national poultry population. The average number of chickens per household (flock size) is estimated at 7.2 and 4.4 in Tigray and Amhara Regional State respectively, the values of which are above that of the national average of 4.1. Annual poultry meat and egg consumption per household is estimated to be 2.19 and 1.72 kg respectively in the Tigray Regional State as compared to the national average of 0.12 and 0, 14 kg respectively. Similarly annual live bird and egg sale per household is estimated at 6 chicken and 100 eggs respectively in the Tigray Regional State. At a current market price these figures tend to indicate annual income of Birr 322 from household poultry, indicating that village poultry in extremely poor areas of these parts of the country play important economic, nutritional and socio-cultural roles in the livelihoods of the rural households. Rural poultry is also the only capital that households have left when declining into poverty because of varies reasons such as drought (Aklilu, 2007).

Poultry are used for strengthening marriage partnerships and social relationships. In the local culture, particularly in remote areas of Tigray and Amhara regions, women who can provide men with food like a chicken dish (*Doro wot*) are considered to be contributing to a stable marriage. Serving *Doro Wot* is also a demonstration of respect to guests, thus

strengthening a social relationship which is especially important for poor households. For the poor, poultry meat is the only special meal they can afford during religious festivities like New Year, Christmas and Easter. Church leaders and attendants are also served with chicken dishes (Aklilu *et al*., 2007)

Socio-cultural roles are more important in the area with the poorest market access particularly in the Tigray, Amhara and Oromia Regional States (Aklilu, 2007). The market demand and price of live chickens and eggs experienced during the last 5 years are very much rewarding compared to the previous times indicating that for poor families, poultry are often one of their few sources of petty cash (Bush, 2006). Yearly income from rural household poultry ranges from ETB 50 to over ETB 300 and is largely under the control of women. This income is significant for poor families with ETB 300 a year representing 25% of the typical annual income of poor families in SNNPR (Bush, 2006).

Commercial poultry are kept as full time business, highly dependant on market for inputs, and the owners are wealthy by the Ethiopian standard. The small scale modern poultry farms could either be kept as supplementary to family income or as full time business. Reliable economic data concerning the value of commercial poultry products sold in any one year is not available. The general indications are that the intensive poultry industry plays a key role in supplying poultry meat and eggs to urban markets at a competitive price. The industry also provides employment for a range of workers from poultry attendants to truck drivers and professional managers.

2.5 Challenges of poultry production

2.5.1 Disease and predation

Adene (1996) reported that Newcastle disease (ND), Infectious Bursal disease (IBD) or Gumboro, Marek disease (MD), Fowl typhoid, Cholera, Mycoplasmosis and Coccidiosis are widely distributed in most African countries. According to Chaheuf (1990), Ethiopia is not exception to this situation.

The Ethiopian indigenous flocks are said to be disease resistant and adapted to their environment. However, survival rates of chicks kept under natural brooding conditions is considered to be very low. Disease and predators are known to be the major causes of mortality in the country (Negussie, 1999). According to Negussie and Ogle (1999), losses attributed to Newcastle disease is estimated at about 57.3% of the overall annual chicken mortality whereas fowl pox, coccidiocis, and predation accounts for about 31.6%, 9.4% and 1.7% of the total annual flock mortality respectively. A survey conducted in Southern Ethiopia identified Fowl cholera followed by New Castle Disease, Coccidiosis, Fowl influenza [Infectious Bronchitis], Fowl pox ,Fowl typhoid and Salmonella to be the major poultry diseases respectively (Aberra, 2007).

The general indications are that the health status of the backyard poultry production system is very poor and risky, since scavenging birds live together with people and other species of livestock. Poultry movement and droppings are very difficult to control and chickens freely roam in the compounds used by households and children. There is no practices (even means) of isolating sick birds from the household flocks and dead birds could some times be offered or left for either domestic or wild predators (Solomon, 2007).

The health measures at the government owned poultry breeding and multiplication centers were extremely poor. The basic hygienic practices are often disregarded and husbandry know-how are generally lacking. Foot-bath application, if at all it is practiced,

was only when people enter the poultry houses but not when they leave poultry houses. Almost all the breeding and multiplication centers were devastated by the outbreak of Infectious Bursal Disease i.e. Gumboro disease (Yilma, 2007). The health status in many of the small scale intensive poultry farms is extremely poor (Abebe, 2006).

2.5.2 Nutritional constraint

There is no purposeful feeding of chickens under the village conditions in Ethiopia and scavenging is almost the only source of diet. Scavenging feed resource base for local birds are inadequate and variable depending on season (Hoyle 1992 and Alemu and Tadelle, 1997). The amount of feed available for scavenging in relation to the carrying capacity of the land areas and flock dynamics across the different seasons and agro-ecologies is still not adequately quantified. However, studies conducted in three villages of the central highlands with different altitudes and in three different seasons revealed that the materials present in the crop, as visually observed, are, seeds, plant materials, worms, insects and unidentified materials (Tadelle and Ogle, 2000).

During the short rainy season (March to May) the percentage of seeds in the crop contents is higher at all the three study sites, probably because of the increased availability of cereal grains which had just been harvested and are given to the birds in larger amounts than during the big rainy season and dry season of the year. The relative amounts of available plant materials are lower during the short rainy season. The mean percentage of plant materials in the crop contents is highest during the rainy season (June to September) as a result of the increased availability of plant materials and the relative scarcity of seeds during this season might have increased intake of plant materials. The largest proportions of worms in the crop contents were found during October to February in higher altitude which might be attributed to the relatively high and extended rainfall. A larger proportion of insects were also found during the short rainy seasons (Tadelle and Ogle, 2000).

The crop analysis result indicated that the physical proportion of seeds was higher in the short rainy season and the concentration of crude protein; calcium and Phosphorus were

below the recommended requirements for egg production (Tegene, 1992; Tadelle and Ogle, 1996b; Alemu and Tadelle, 1997). Both egg production and egg size vary with season, as the quality and availability of feed varies (Mbugua, 1990). According to the finding of Tadelle and Ogle (1996b), the scavenging feed resource is deficient in protein, energy and probably calcium for layer birds, indicating the role of supplementation in bringing a considerable increase in egg production. There might be deliberate supplementary grain feeding during the ripening and harvesting period (October-March). The quantities of supplementation gradually decrease until June-August, during which scavenging is the only source of their feed (Alemu and Tadelle, 1997).

2.6 Internal and external egg quality

Food products from villages, which are particularly advertised as natural and fresh, are in the focus of consumers' preferences (Tugcu, 2006). Besides, the positive effects of eggs, eggs which are not produced under suitable conditions or are not consumed, when they are fresh can cause severe health problems (Avan and Alisarli, 2002). In this respect, egg quality characteristics are of high importance. In analyzing egg quality, different internal and external egg quality characteristics have to be analyzed (Silversides and Scott, 2001). Of internal egg quality characteristics, thick albumen is quite an important measure for the freshness of an egg. The longer an egg is stored, the more the height of the thick albumen decreases (Toussant and Latshow, 999).

3. MATERIALS AND METHODS

3.1 Description of the study area

The study was conducted in Gomma Wereda of Jimma Zone, Oromia Regional State. Gomma Wereda is located at about 390 km southwest of Addis Ababa, the capital of Ethiopia. It is one of the administrative units (equivalent to district) found in Jimma Zone of Oromia Regional State. The topography of the study area ranges from gentle sloppy to hilly lands with ridges and valleys in between. Agro-ecologically, Gomma district is classified as 96% wet *Weina Dega* (wet midland) and 4% *kolla* (lowland). A survey of the land in this woreda shows that 60.7% is arable or cultivable (52.7% was under annual crops), 8.1% pasture, 4.6% forest, and the remaining 20.1% is considered swampy, mountainous or otherwise unusable. Land in cultivation included the two state coffee farms. Fruits, avocadoes and spices are important cash crops (IPMS, 2007).

The altitude of Gomma Wereda ranges from 1380 to 1680 meters above sea level; however, some points along the southern and western boundaries have altitudes ranging from 2229 to 2870 meters (IPMS, 2007). Gomma has well distributed annual rainfall with very low seasonal and area- wise variability (IPMS, 2007). The mean annual rainfall is about 1524 mm with bi-modal distribution. March to April characterizes the small rainy season (planting time for major crops) and the big rainy season extends from June to October. Mean monthly temperature varies between 12.67^0C and 29.10^0C (IPMS, 2007). There are 36 rural and 3 urban *Kebeles* (*Kebele* is the smallest administrative unit in Ethiopia) in the Wereda. The total agricultural households of the Wereda are 45,567 of which 78% and 22% is male and female headed, respectively (IPMS, 2007). The total area of the Wereda is 96.4 km^2 and the total population of the Wereda is reported to be 216,662 of which 51% are males (IPMS, 2007).

3.2 Survey of the study area

3.2.1 Selection of study households

Multi stage probability random sampling method was followed to select six *Kebeles* namely; Belfo Konche, Limu Sapa, Bulbulo, Koye Seja, Kilole Kirkir and Beshasha, where two from each of the high (1855 - 17051), medium (1025 -1765) and low (407 - 1011) chicken population were randomly selected. A total of 30 households were randomly selected from each of the six *Kebeles* (Table 3 and Figure 1). Thus a total of 180 (6x30) households were used to carry out the survey on management practices, marketing system and production performance of indigenous chickens. The farmers recalled information was considered for this study.

Table 3: Sampling frame of households in each *Kebele.*

Poultry Population	***Kebeles***	**Number of Households**
High (1855 – 17051)	Belefo Konche	30
	Limu Sapa	30
Medium (1025-1765)	Bulbulo	30
	Koye Seja	30
Low (407 – 1011)	Kilole Kirkir	30
	Beshasha	30
Total	**6**	**180**

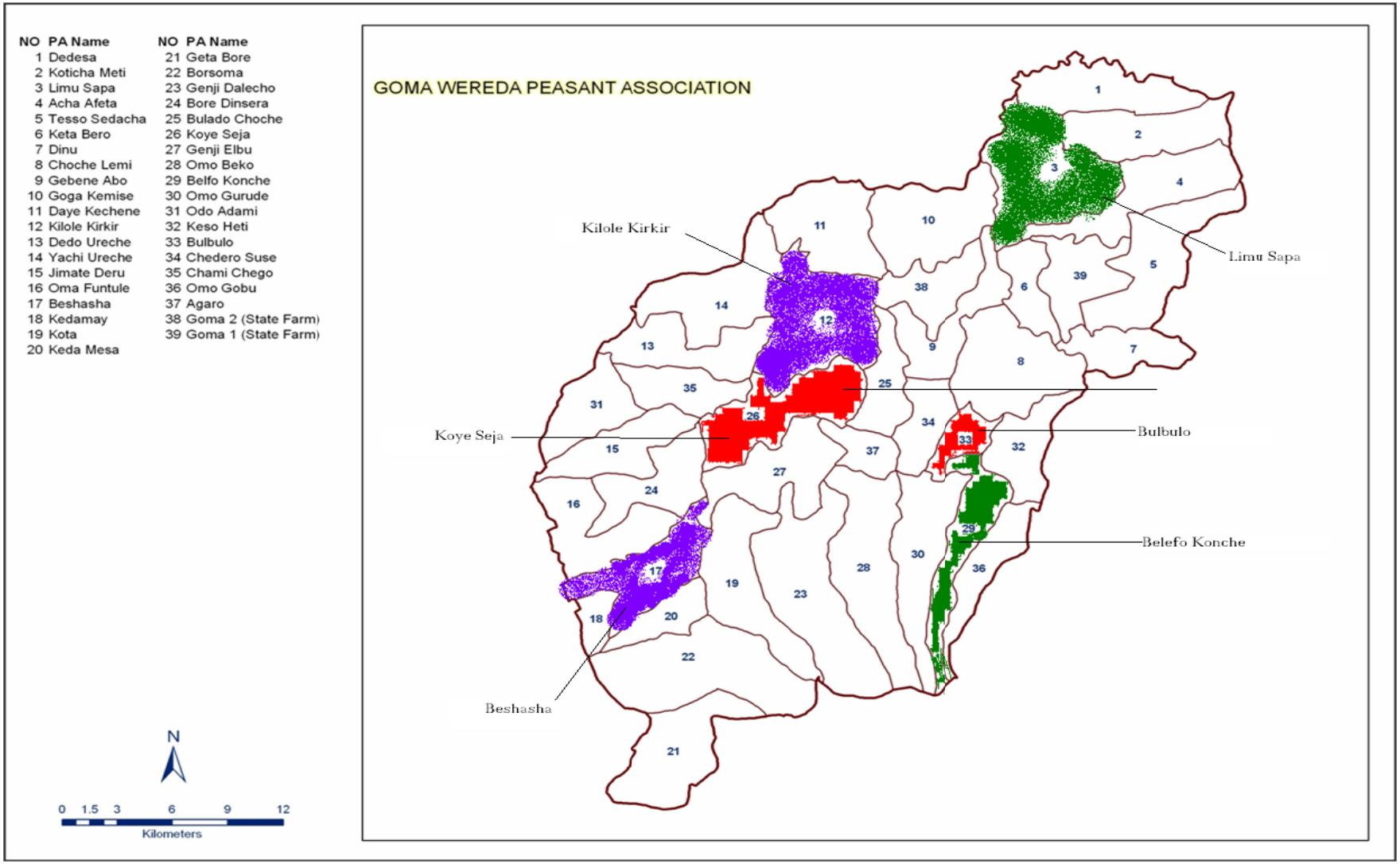

Figure: 1. Map of Gomma Wereda with the selected *Kebeles*.

3.2.2 Data collection

Structured questionnaire was used to collect data from primary source which mainly comprised of households, development agents and key informants followed by review of the available secondary data source. A visit to physical facility of live bird and egg markets and open discussion with poultry farmers and live bird and egg sellers, buyers and intermediaries were also made. Finally data on poultry population and flock structure, management practices followed, marketing system followed and production performance (number of clutches, age at first egg …) were collected using the questionnaires prepared to collect the data (Annex 4).

3.3 Evaluation of post-harvest losses

3.3.1 Internal and external egg quality

A total of 360 eggs (60 from each *Kebele*) were purchased from the local markets (old eggs) and at household level (fresh eggs) of the six *Kebeles*, and transported to JUCAVM nutrition laboratory. Soon after arrival at JUCAVM nutrition laboratory, each egg was individually weighed using a two digit sensitive balance and carefully opened (broken) onto a flat plate. The yolk and albumen were carefully separated and weighed using the balance. The shell weight was also weighed by the same balance. Egg shell thickness was measured at the middle, big size and small size of the shell by using calibrated micrometer screw gauge and the average value was taken. Yolk color was measured using roach color fun. Haugh unit measures the quality of the egg and it was calculated using the following formula adopted from **(**Haugh, 1937**).**

$$HU = 100 \log (H + 7.57 - 1.7 W^{0.37})$$

Where, HU= Haugh unit

H= Albumen height (mm).

W = Egg weight (g).

3.3.2 Hatchability measurement

Six hundred fresh eggs (stored for 10 days) were purchased on contractual basis from the study site for comparative evaluation with that of 600 eggs randomly purchased from the local markets of the six *Kebeles*. A total of 1200 eggs (600 the sources and age is known and 600 market eggs) selected against abnormal shape, size (small and big) and undesirable shell structure were incubated using JUCAVM hatchery. Empty incubators and all the fixtures were fumigated in advance using 70ml of formalin plus 35g potassium permanganate (Altman *et al.*, 1997). The incubation temperature, humidity and turning device were adjusted according to the recommendations of the manufacturer. Candling was done on the 7^{th} and 14^{th} day of incubation. Finally hatchability was calculated as follow.

Total Hatchability = 100[Number of chicks hatched]/ Number of total eggs set

Fertile Hatchability = 100[Number of chicks hatched]/ Number of fertile eggs set

3.3.3 Chick quality evaluation

Upon hatching the chicks were collected, counted, and weighed. The chicks were grouped according to their body condition and level of dryness and transferred to electric brooder house which was well cleaned, disinfected and prepared in advance. All the chicks were placed on commercial starters ration purchased from Addis Ababa (Kality) and clean water was made available all the times. Feed consumption was measured daily whereas body weight was taken weekly for eight weeks. Growth rate was calculated as follows.

Percent growth rate = (V present-V past)/V past*100

In this formula,

V present = present value (weight)

V past = past value (weight)

3.4 Follow up of the IPMS groups

At the time of conducting this research project, there were a number of farmers who have taken up or adopted improved exotic chicken (*Isa Brown*) with the use of hay-box brooder under IPMS (Improving Productivity and Market Success) farmers' project in the Gomma Wereda. Attempt was made to follow up these farmers aimed at monitoring their perception and performance of the breeds adopted followed by comparative evaluation of the production performance of the indigenous and exotic chickens. IPMS farmers' project was also interested in the set up of proper input supply system for improved poultry production to work for smallholder farmers. Data on management practices followed, source of feed, mortality rates, sexual maturity (age at first egg), rate of egg production and other related parameters were collected using both the primary and secondary sources.

3.5 Statistical analysis

Descriptive statistics such as mean, range, frequency and percentage were calculated and all the surveyed data were analyzed using Statistical Package for Social Sciences (SPSS) version 16 (SPSS Inc., Chicago, Illinois, USA, 2007). The descriptive statistics (mean, SD) for numerical survey data were subjected to analysis of variance (ANOVA) using the general linear model procedure of SPSS. Data collected from experimental work were subjected to ANOVA using the linear model equation of Statistical Analysis System (SAS) version 9.2 (SAS, 1999).

Model 1. Model for survey

$$Y_{ijk} = \mu + I_{th} + J_{th} + \epsilon_{ijk}$$

Where:

Y_{ijk} = The value of the respective variable mentioned above

μ = overall mean of the respective variable

I^{th} = the effect of ith *Kebele* (i= 1--6, Bulbulo, Limu Sapa, Beshasha, Kilole Kirkir, Belfo Konche and Koye Seja)

J^{th} = the jth production and reproduction performance

ϵ_{ijk} = random error term

Model 2. Model for designed experiment

I. $Y_{ijk} = \mu + \tau_i + \beta_j + \tau\beta_{ij} + \varepsilon_{ijk}$

Where

Y_{ijk} = the value of the respective variable mentioned above

μ = overall mean of the respective variable

τ_i = the effect of ith *Kebele* (i= 1---6, Bulbulo, Limu Sapa, Beshasha, Kilole Kirkir, Belfo Konche and Koye Seja) on the respective variable

β_j = the effect of jth age (j= 1---2, Fresh, Aged)

$\tau\beta_{ij}$ = The interaction effect of ith *Kebele* and jth age

ε_{ijk} = random error term

II. $Y_{ijk} = \mu + \tau_i + \beta_j + \tau\beta_{ij} + \varepsilon_{ijk}$

Where

Y_{ijk} = the value of the respective variable mentioned above

μ = overall mean of the respective variable

τ_i = the effect of ith Time (i= 1---8, 1st week, 2nd week, 3rd week, 4th week, 5th week 6th week, 7th week and 8th week) on the respective variable

β_j = the effect of jth age (j= 1---2, Fresh, Aged)

$\tau\beta_{ij}$ = The interaction effect of ith Time and jth age

ε_{ijk} = random error term

List Significant Difference (LSD) test was made for mean separation, when there was significant deference between treatments. The relationship between any two quantitative variables was determined using Spearman correlation coefficient **(**Gomez, 1984**).**

4. RESULTS AND DISCUSSION

4.1. Respondent's profile

About 70% of the interviewed farmers were females and 95.6% of the respondents were fully involved in farming activities as means of livelihood. The remaining 4.4% of the respondents were merchant. The majority of the respondents (97.2%) were married and (Figure 2) and the largest proportion (82.8%) of the respondents was within the age group of 31 -60 years. About 86.1% of the respondents were Muslim whereas the remaining 12.8% and 1.1% are Orthodox Christian and Protestants respectively (Figure 2). About 82.2% and 17.8% of the respondents reported to have experience of 2 to 14 and 15 to 40 years in poultry rearing, respectively. About 23.3% of the interviewed farmers were illiterate while 15% read and write. About 25, 25.6 and 11.1% of the literate respondents had gone through primary first cycle (1-4), primary second cycle (5-8) and high school (9-12) education respectively (Figure 3).

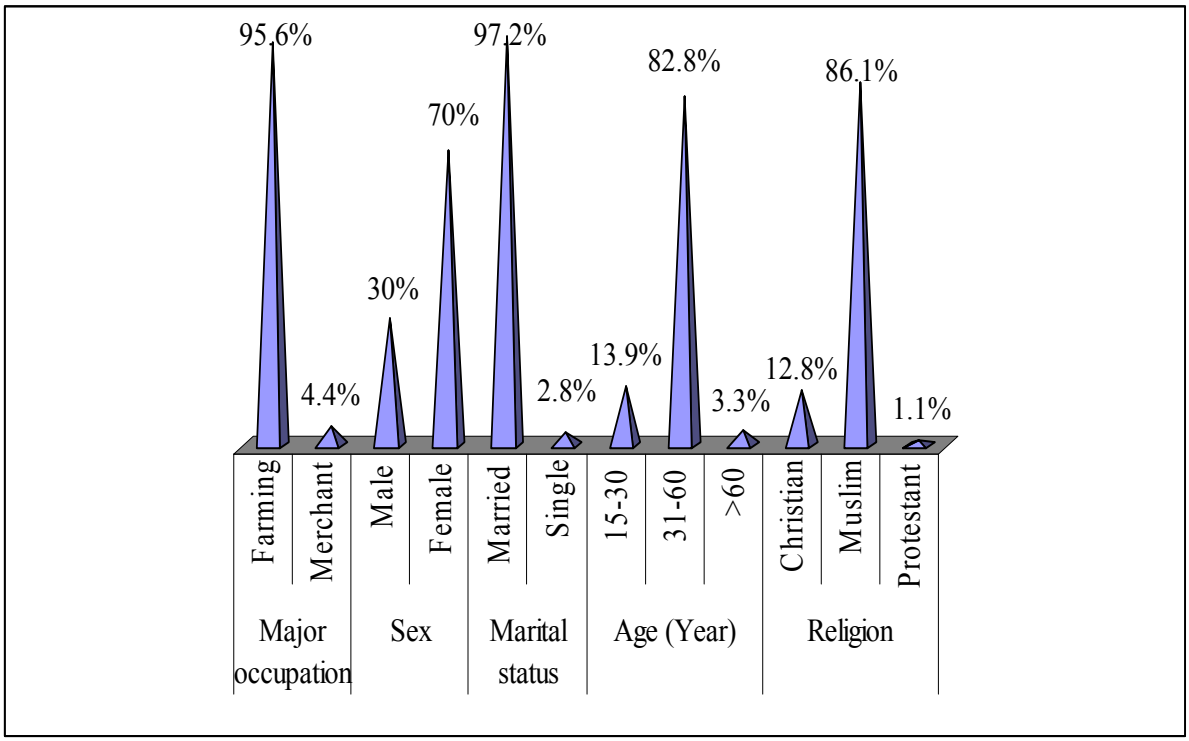

Figure: 2. Major occupation, sex, marital status age and religion of the respondents

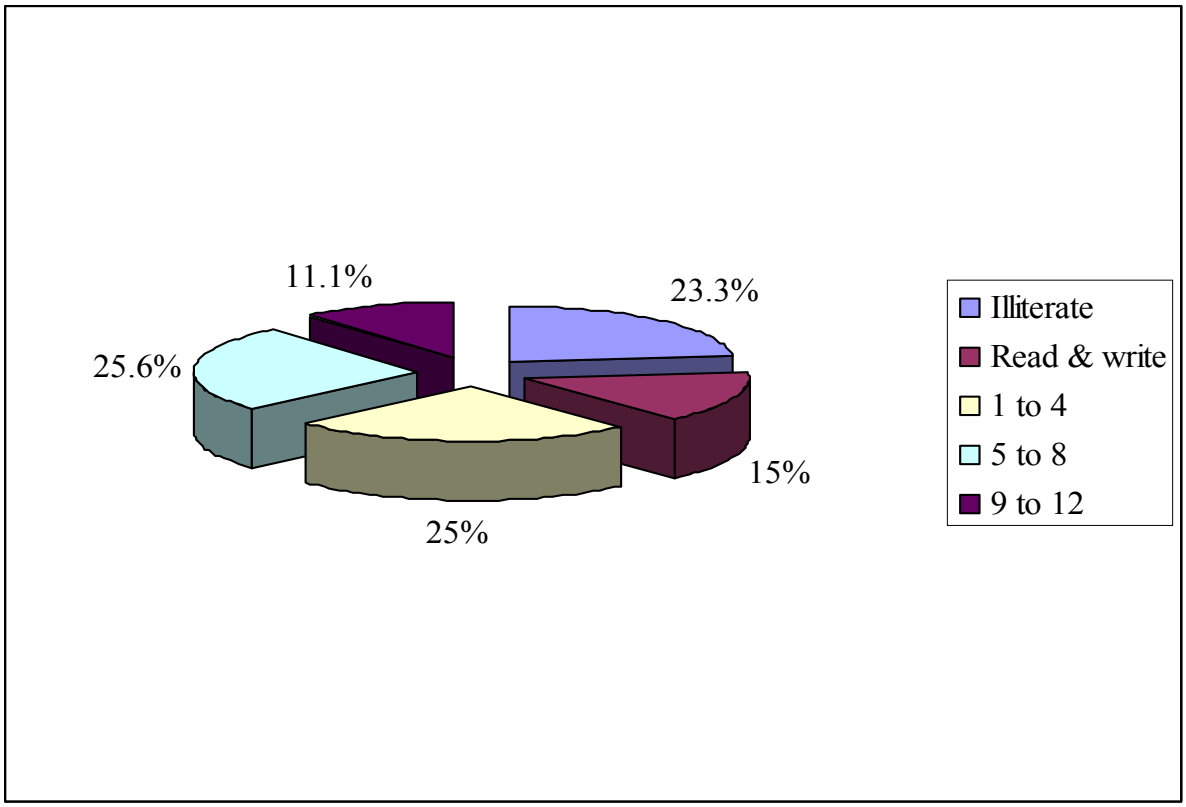

Figure: 3. Educational level of the respondents of Gomma Wereda, Ethiopia.

4.2 Flock structure and characteristics

The plumage colors of the local chicken found in the study area were mixed (black, white, red, grey, Libe-tikur etc). The total number of chicken in the study area was 1121 ranging from 152 to 233. The mean number of chicken in each *Kebele* was 186.8. The flock size and structure of indigenous chickens in Gomma Wereda of Jimma Zone are shown in Table 4. Flock structure is described in terms of proportion of the different sex and age groups in the flock. The results of this study showed that the mean flock size per household was 6.23 chickens, the mean number obtained in this study was comparable to the reported mean flock size of 7-10 and 5-10 chickens/household from the central highlands of Ethiopia and Africa Tadelle and Ogle (1996a) and Sonaiya (1990b), respectively. In contrast, the mean flock size recorded in this study was lower than the mean flock size of 8.8 and 9.2 chickens/ household reported by Asefa (2007) for Awassa Zuria and by Mekonnen G/Egziabher (2007) for Dale Wereda in Ethiopia, respectively. On the contrary, the results reported in this study (6.23

chicken/household) was higher than the national (4.1) and Oromia Regional state (3.6) averages reported by CACC (2003); but lower from Tigray (7.2), Gambella (7.5) and Benshangul-Gumuz (7.6) regions (CACC, 2003). The general indication is that the national average flock size reported from Ethiopia (4.1) is significantly lower than that reported from other developing countries such as Philippines (19), Uganda (18) and Sudan (22) (Eugene, 2004; Sewannyana *et al*., 2004 and Khalafalla *et al.*, 2000), respectively. The flock size variation and lower flock size in rural areas has been attributing to the farming systems practiced and prevalence of local factors such as diseases and predators (Kuit *et al.,* 1986).

As shown in Table 4, the indigenous chicken population of Gomma Wereda is dominated by hens (> 5 months of age) and chicks (0-8 weeks of age), followed by pullets, cocks and cockerels; hens and chicks accounts for 43% and 27% of the total indigenous chicken population of the study area, respectively. The present study concured the earlier findings in the Dale Wereda, Ethiopia and revealing the flock composition of 33%, 27%, 17%, 10% and 13% for hens, chicks, pullets, cockerels and cocks from the indigenous chicken population, respectively (Mekonnen G/Egziabher, 2007). The present study did not concured with the findings of Tadelle and Ogle (1996a) that reported the chicks' account for the largest segments (53%) of the indigenous chicken population of the central highlands of Ethiopia followed by mature hens consisting 43% of the flock. The trends in indigenous chickens flock structure reported by Tadelle and Ogle (1996a) seems to be representative of the national indigenous chickens flock structure reported by CACC (2003).

There was a consistent higher proportion of hens in the flock in the studies conducted in villages. The higher proportion of hens in the flocks is an indication of strong desire for egg and chick production (Wilson *et al.,* 1987; Abdou *et al.,* 1992). The relatively large proportion of hens per HH in the study area might purposively done by the farmers' to increase egg production and securing the sources of replacement flocks. It might as well be attributed to lack of strong selection and culling against the hens and build up of old and unproductive hens in the flocks. The comparatively larger number of pullets per household compared to the proportions of cockerels and cocks within the Gomma indigenous chicken population could

be a copping mechanism to replace the number of chicken reduced by selling, consumption and loss due to different reasons.

Table 4: Flock size and structure of indigenous chickens in Gomma Wereda, Ethiopia.

Chicken category	Chicken per HH		% of chicken per HH	Percent of respondents owning Chickens (%)		
	Mean ± SD	Range		0	1-4	5-10
Chicks	1.68±2.80	0-10	27	68.9	11.1	20
Pullets	0.93±1.55	0-5	15	68.3	27.8	3.9
Cockerels	0.1±0.47	0-3	1.6	95.6	4.4	__
Hens	2.65±1.82	0-8	42.6	2.2	87.1	10.6
Cocks	0.86±1.09	0-4	13.8	47.8	52.2	__
Over all	6.23±4.4	1-16	-	-	-	-

Hens (> 5 months), chicks (0-8 weeks),

The lower proportion of the cockerels and cock within the indigenous chicken population might be attributed to the selling of cockerels and cocks. Few cockerels and cocks are maintained in a flock for breeding and sharing of cocks among neighbors is a breeding strategy in a community. These have been demonstrated that, about 47.8% of the respondents reported to have no breeding cock. The transect walk conducted in the study area and a discussion made with key informants demonstrated that, there is free movement of all birds around the compounds of the households, irrespective of age and sex. Such a tradition resulted in indiscriminate mating system in which aggressive and dominant cocks in the neighborhood tends to be a sire in the large segment of the village and also resulted in lack of controlled breeding. The respondents also indicated that farmers in the study area have the experience of removing the males from the flocks at an early age to minimize cock fighting

and to cope up with feed scarcity. The practice of sharing of breeding cock in the villages may warrant community based chicken improvement program in the villages.

4.3. Chicken production system

4.3.1. Management practices

4.3.1.1 Feed resources and feeding practice

The major feeds and feeding practices of chickens in the study area as indicated by the respondents are summarized in Table 5.There is no purposeful feeding of rural household chickens in Ethiopia and the scavenging feed resource is almost the only source of feed. According to the results of this study, almost all of the respondents (97.8 %) reported to practice scavenging system with supplementary feeding. The result of this study was in agreement to that of Asefa (2007) and Mekonnen (2007) who reported 95 -98% of the small scale household poultry producers in Awassa Zuria and Dale offer supplementary feeding to their chickens. The respondents of the current study also confirmed that the scavenging feed resource in Gomma Wereda consists of insect, grass, enset (*Ensete ventricosum*), kitchen wastes, and harvest leftovers indicating that the village chicken production system is friendly with the environment. Unfortunately, all the available evidences tend to indicate that scavenging feed resource base for local birds are inadequate and variable depending on season (Hoyle, 1992 and Alemu and Tadelle 1997). Moreover, some farmers in the study area complained that chickens damage crops, especially cabbage (*Brassica oleraceava*) and other vegetables in the garden.

Cereal grains (maize and sorghum) and household scraps are the major supplementary feeds offered, the amount of each being dependant on seasons of the year and the quantity and availability of the resources at the household level. About 48.3% of respondents offer supplement twice a day (morning and afternoon). According to 97.2 % of the respondents, home grown or purchased supplementary feed materials are offered indiscriminately to all classes of chicken on bare ground. About 98.3% of the respondents reported to provide either river or stream water to their chickens once a day. None of the respondents reported to have regular feeding and watering troughs and exercise the corresponding routine hygiene. Flat

plastic, stone dish, locally made wood and any broken material are used as watering trough depending on availability. About 13.6% of the respondents reported to wash the materials used as watering trough daily.

Table 5: Feed resources and feeding practices for indigenous chicken.

	Parameters		Frequency	Percent
Frequency of feeding	Morning only		26	14.4
	Evening only		3	1.7
	Afternoon only		4	2.2
	Any time during the day		18	10.0
	Morning and evening		2	1.1
	Morning and afternoon		87	48.3
	Morning, evening and afternoon		40	22.2
Type of grain supplements	Maize		91	50.6
	Maize and sorghum		89	49.4
Type of non Conventional supplements	Kitchen west *(injera ferfer)*		27	87.21
	Duket ferfer		4	12.79
Form of supplementation	Grains for chicks	Grounded	180	100
	By-products for chicks	Whole (as it is)	31	100
	Grains for growers & finishers	Whole	180	100
	By-products for growers & finishers	Whole (as it is)	10	100
Feeding practice	Throw on the ground		180	100
Source of the feed	From the house		113	62.8
	Purchased		8	4.4
	Purchased and from the house		59	32.8
Way of supplementation	Separate to different classes		5	2.8
	Together for the whole group		175	97.2
Type of water trough	Flat plastic container		126	71.2
	Locally made wood		19	10.7
	Stone dish		26	14.7
	Any broken material		6	3.4

4.3.1.2. Housing

About 94.4% of the respondents reported to have no separate poultry house. Such a situation might be attributed to the fact that women own and manage rural household poultry whereas construction of poultry house is the job of husbands in the Gomma Wereda. According to 59% of the respondents the birds scavenge around the household during day times and closed into family living areas at night along with other domestic animals. Among the house holds who have no separate poultry houses, about 28, 11 and 2% of the respondents indicated that their birds perch in the kitchen, cattle yard and on trees during night time, respectively (Table 6). Housing facilities in the surveyed area include the use of baskets and cartoons placed on the bare floor of the family house. Bamboos and sticks are occasionally used for construction of perches with in the family houses. The majority of the respondents in the study area reported that their chickens are confined within the family house during night time and released for scavenging early in the morning resulting in high mortality caused by disease condition and predators. In contrast to the Gomma Wereda situation, Halima (2007) evidenced that significant size of the rural households (51%) of Northern Ethiopia had separate sheds for their chickens whereas, Mekonnen (2007) reported that there is no specific separate poultry houses in Dale Wereda.

In a group discussion made with the key informant's high prevalence of predators, fear of theft and lack of experience were frequently mentioned as the major reasons for not constructing separate poultry houses in the Gomma Wereda. All the respondents also mentioned the risk of diseases, predators and thefts associated with day time scavenging poultry. About 5.6% of the respondents reported to have constructed separate poultry house in Gomma Wereda of which about 80% and 20% reported to have used corrugated iron roof and thatch (grass) roof as poultry house construction materials, respectively.

Table 6: Status of night time sheltering for those who have no separate poultry house

Parameters		Frequency	Percent
Birds stay at night	In the kitchen	48	28
	Family dwelling	94	59
	Perch on trees	4	2
	Cattle yard	18	11

4.3.1.3. Disease and predation

The results of this study tend to indicate that poultry diseases are widely spread in the Gamma Wereda. About 85.6% of the respondents confirmed that occasional and serious disease outbreak results in complete devastation of the flock when accrued. About 34.4, 27.9, 26 and 11.7% of the respondents reported Newcastle disease, infectious bronchitis, infectious bronchitis and external parasites, and coccidiocis to be disease of economic importance in the Wereda, respectively compared to the others (Figure 4). The commonest disease out break in the study area is reported to be Newcastle. This is further by the Wereda veterinary experts, all of whom indicated that Newcastle disease is one of the major limitations to poultry production in the study area. Poultry disease is widely distributed in Ethiopia and Newcastle disease (ND) is the most important cause of economic loss in poultry production in the country (Nasser *et al*., 2000). Diseases are the major limiting factor to rural household poultry production system (Aini, 1990) in which the results of this study agreed.

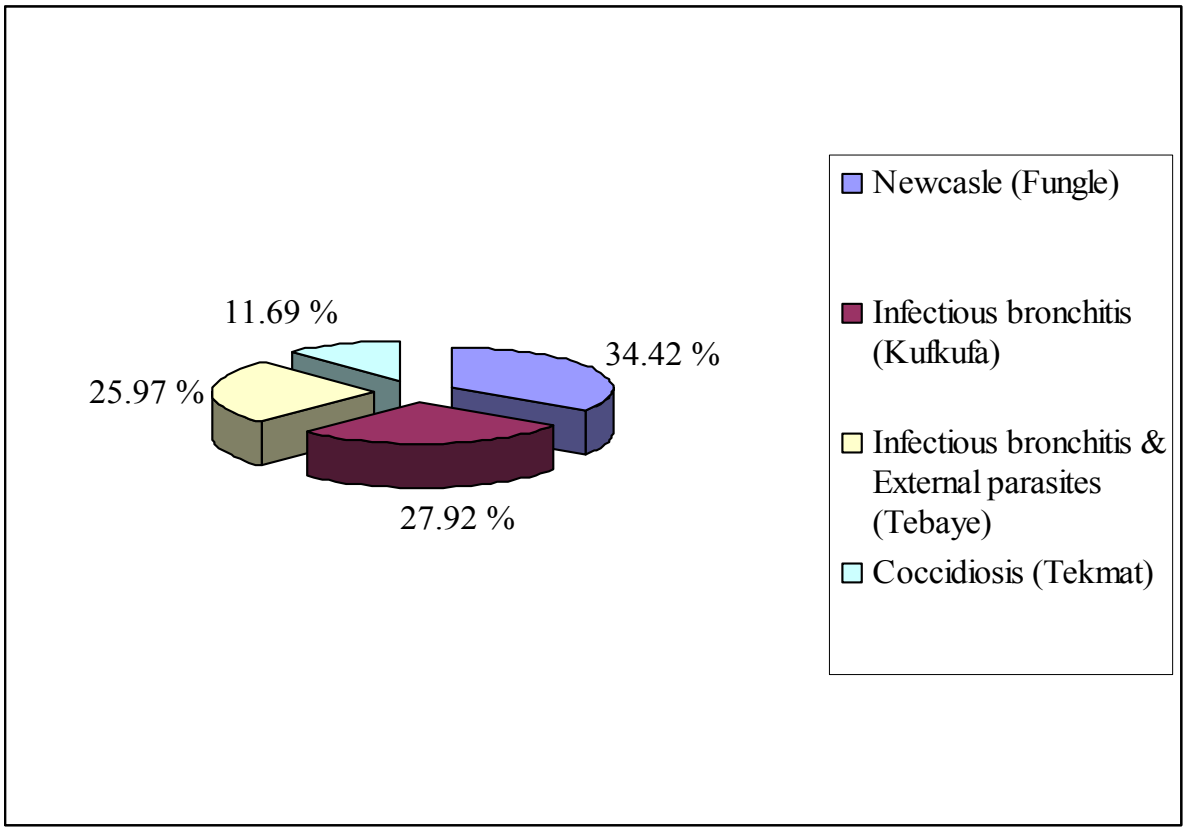

Figure: 4. Common diseases of chicken reported by respondents

None of the farmers in the study area followed regular vaccination and de-worming for their chicken and had formal training on poultry husbandry. According to 91.7 % of the respondents, there is no control of the free movement of birds during disease outbreaks. Sick birds are sold immediately or slaughtered for home consumption. Figure 5 shows the possibilities of disease transmission through the exiting marketing channels. About 91.1% of the respondents reported to throw away dead birds. The results of this study is in agreement with that of Solomon (2007) who reported that the bio-security of the backyard poultry production system is very poor and risky, since scavenging birds live together with people and other species of livestock. Poultry movement and droppings are very difficult to control and chickens freely roam in the compounds used by households and children. There is no practices (even means) of isolating sick birds from the household flocks and dead birds could some times be offered or left for either domestic or wild predators. Chickens and eggs are sold on open markets along with other food items.

According to the result of this study, mean mortality of chicks attributed to predation was reported to be 13.9%. It is apparent that predation by birds, pet animals and wildcat is responsible for high mortality of chicks in the study area contribute to substantial losses of the flock. The majority of the respondents in the study area reported that their chickens are confined within the family dwellings during night time and released for scavenging early in the morning resulting in high mortality caused by disease condition and predators.

According to Solomon (2007), full day scavenging chickens are vulnerable to predation and disease. The need to leave the family dwelling to scavenge for feed makes them more vulnerable to predation. The further they go, the greater the danger. Scavenging for food away from the family dwelling also results in birds coming into contact with larger number of birds from other flocks than would otherwise be so, facilitating the spread of infection. About 36 % of sick birds are treated by the farmers (Figure 5).

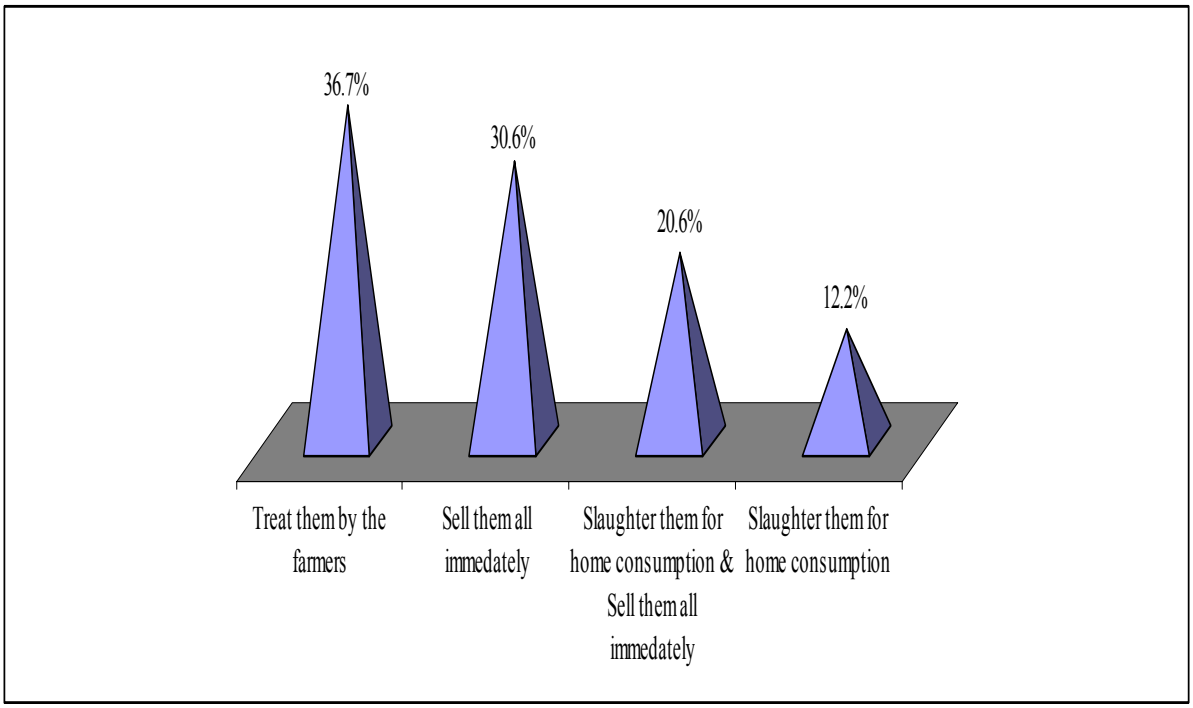

Figure: 5. Fate of sick chickens

4.3.1.4. Breeding

The traditional poultry production system is characterized by lack of systematic breeding program. The determinant factors of culling chicken in the Wereda are shown in Table 7. Sickness and frequent broodiness are the two major factors of culling chickens from the flock in Gomma Wereda as indicated in (Table 7).

Table 7: The determinant factors for culling of chickens

Factors for culling of birds	Frequency	Percent
Sickness	65	36.1
Lack of broodiness	15	8.3
Old age	13	7.2
Frequent broodiness	41	22.8
Lack of broodiness, frequent broodiness & old age	2	1.1
Lack of broodiness, frequent broodiness, sickness, poor Production & old age	4	2.2
Frequent broodiness, sickness, poor productivity & old age	4	2.2
Poor productivity & frequent broodiness	2	1.1
Poor productivity, sickness, lack of broodiness & frequent broodiness	2	1.1
Lack of broodiness & frequent broodiness	10	5.6
Sickness & old age	22	12.2

About 97.8 % of the respondents reported to incubate eggs using mature broody hen on its 2nd and 3rd clutch during the dry seasons (October-January). All the respondents said to have selected thoroughly broody hen for incubation based on different parameters. About 50% of the respondents reported to use the selection criteria of body size, ample plumage cover and previous hatching history (Table 8). The farmers in the Wereda seem to be very conscious and concerned in the preparation of appropriate incubation nest boxes and appropriate place to set the boxes. About 92.2% of the respondents reported to place the incubation boxes in a much protected, quite and dark corner of the family dwellings with the use of cereal straws bedding either on clay pot or on bare ground. About 87% of the respondents do not mind for egg incubation position (Table 8). The majority of the respondents (80.6%) incubates home laid eggs and 78.3% of the respondents reported not to practice any special management during incubation such as putting feed and water near to the brooding nest and avoiding disturbance.

The traditional broody hen management system practiced in the Gomma Wereda is shown in Table 8. Traditionally, all the households communicated reported to attempt increasing egg production by stimulating broody birds to resume laying. Disturbing the broody hen in the nest (48.9%), hanging the birds up side down (18.9 %) and moving to neighbors (1.7%) are some of the methods practiced (Figure 6). About 88.3% of the respondents live eggs to be incubated in the nest through out the laying period, the practice of which expected to negatively affect hatchability.

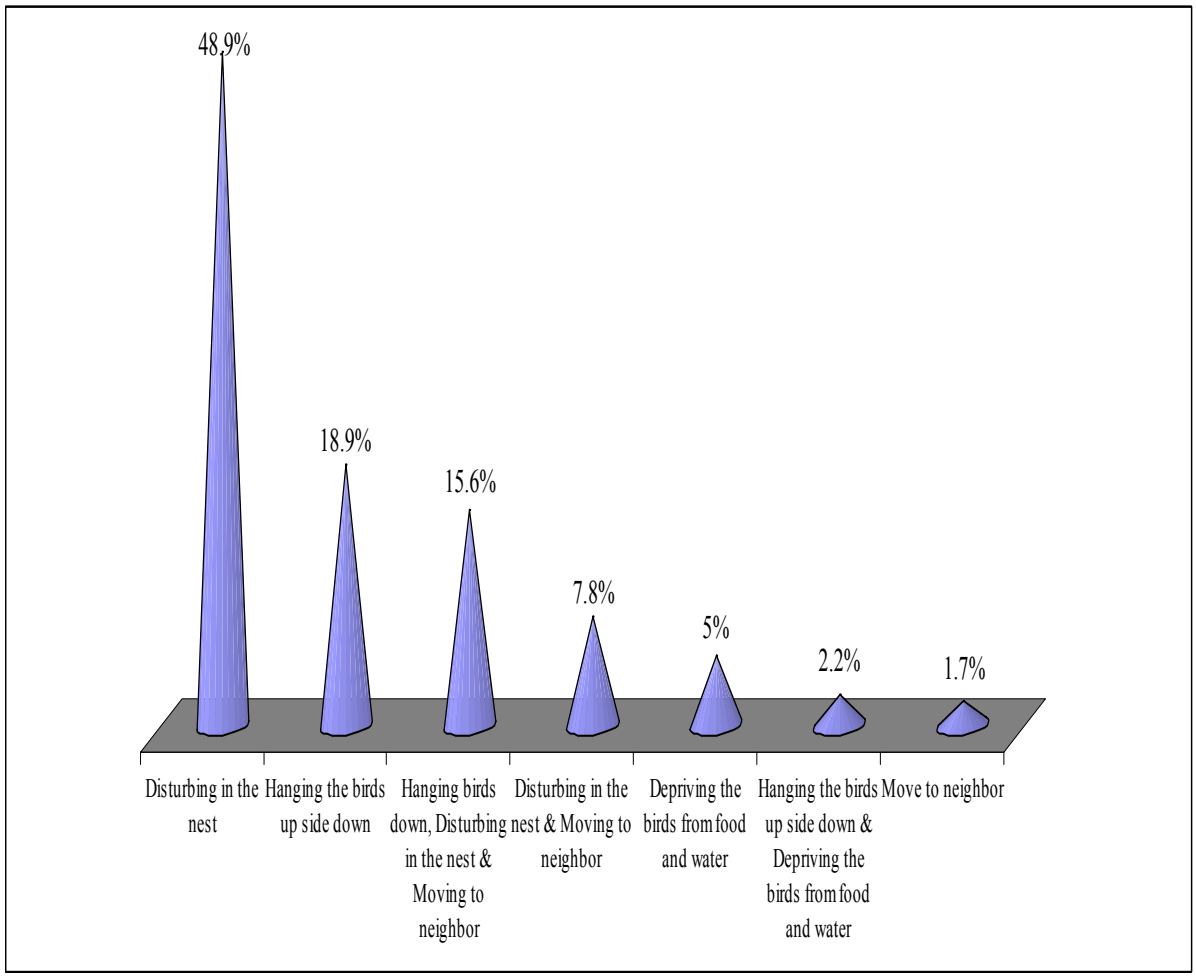

Figure: 6. Practices to avoid broody behavior.

Table 8: Management of the broody hen and incubation practices.

Characters		Frequency	Percent
Position the eggs while incubating	Position on side	23	12.8
	Don't mind position	157	87.2
Considerations during selection of hens for brooding	Hens with large body size	38	21.1
	Ample plumage/feather cover	6	3.3
	Previous hatching history	12	6.7
	Broodiness	35	19.4
	Large body size, ample plumage & previous hatching history	89	49.5
Managing broody hen at a time of incubation	Feed & water near to brooding nest	29	16.1
	No special management other than the usual	141	78.3
	Avoid disturbance & good feeding	10	5.6
Sources of eggs for incubation	Home laid eggs	145	80.6
	Purchased from the market & home laid eggs	25	13.9
	Purchased from the market, purchased from neighbors & home laid eggs	10	5.6

4.3.1.5. Marketing

There is no formal poultry and poultry product marketing channel in the Gomma Wereda and informal marketing of live birds and eggs involving open markets are common through out the Wereda. The farmers directly sell their chicken to consumers and/or to small retail traders who take them to large urban centers. Live chickens and eggs are sold either at the farm gate, small village market (primary market) or at larger Wereda market (Secondary market in the town). There is exchange of commodities through out the week with one regular market day at the center of each *Kebele*. On the other six days the market starts at about 9:00 AM. Eggs are most frequently sold at the market. The results of this study clearly showed that both eggs and chickens pass through different individuals before reaching consumer .The regular customers of live birds and eggs of the Gomma Wereda is shown in (Figure 11). About 52.2% of chickens are collected by market collectors and consumers. At all the market areas of

Gomma Wereda and in most of the cases, the sale and purchase of live chickens and eggs is the responsibility of female indicating that household poultry is a source of self-reliance for women, since live bird and egg sales are decided by women, both of which provide women with an immediate income to meet household expenses. Unstable price and demand seasonality are the problems of egg and live chickens marketing in the study area (Figure 7).

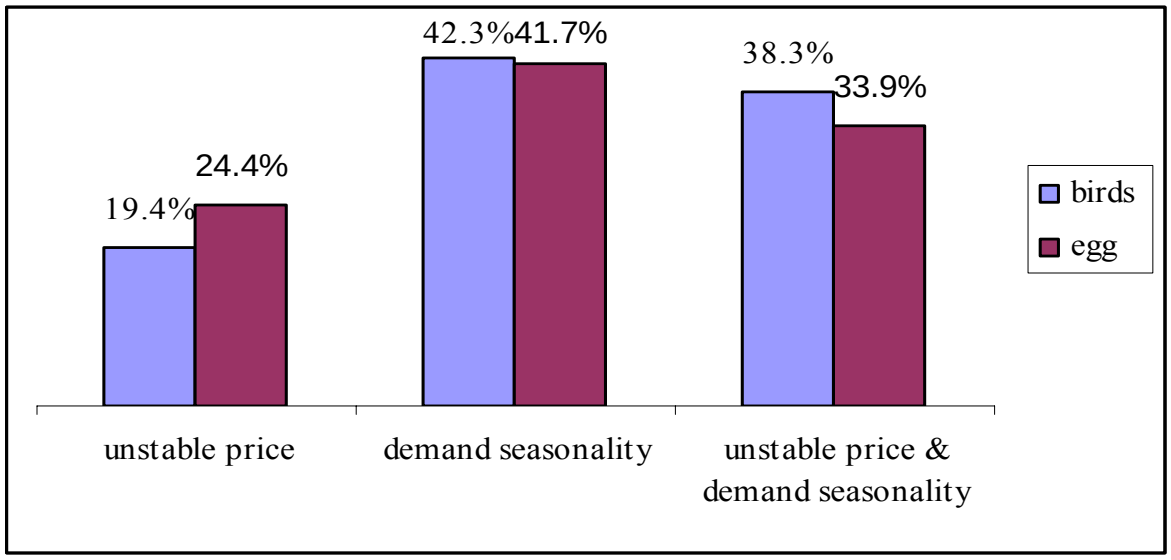

Figure: 7. Problems of egg and chicken marketing.

According to the results of this study, there is variation in price of eggs and live birds attributed to disease outbreak, time of incubation, and holidays and festivals (Figure 8). The price of live birds further varies based on body weight, feather color, comb type, age and sex (Figure 9). Producers get better price both for live birds and eggs during holidays and festivals (Figure 10). The results of this study tends to indicate that live birds are carried by foot and pieces of cloth, plastic shopping bags and basket are used to transport eggs to the market in Gomma Wereda, all of which could result in breakage and deterioration in egg quality. This result agree with that of Solomon (2007), who reported that in Ethiopia, indigenous birds and eggs could be transported over longer distances to supply urban markets which results in quality deterioration. Both eggs and live birds are transported either on foot or using public transportation along with other bags, sacks of grains, bundles of fire wood etc. Moreover the live bird market of Gomma Wereda is characterized by small unhygienic selling space and lack of shelter, feed and water.

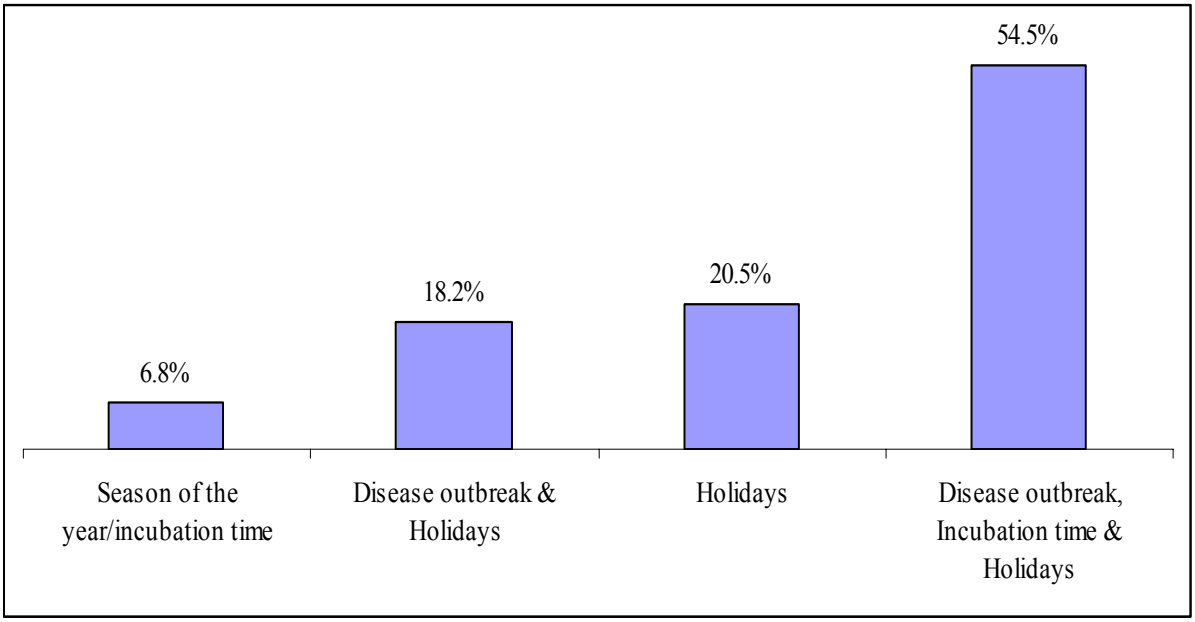

Figure: 8. Causes of price variation for eggs and chickens.

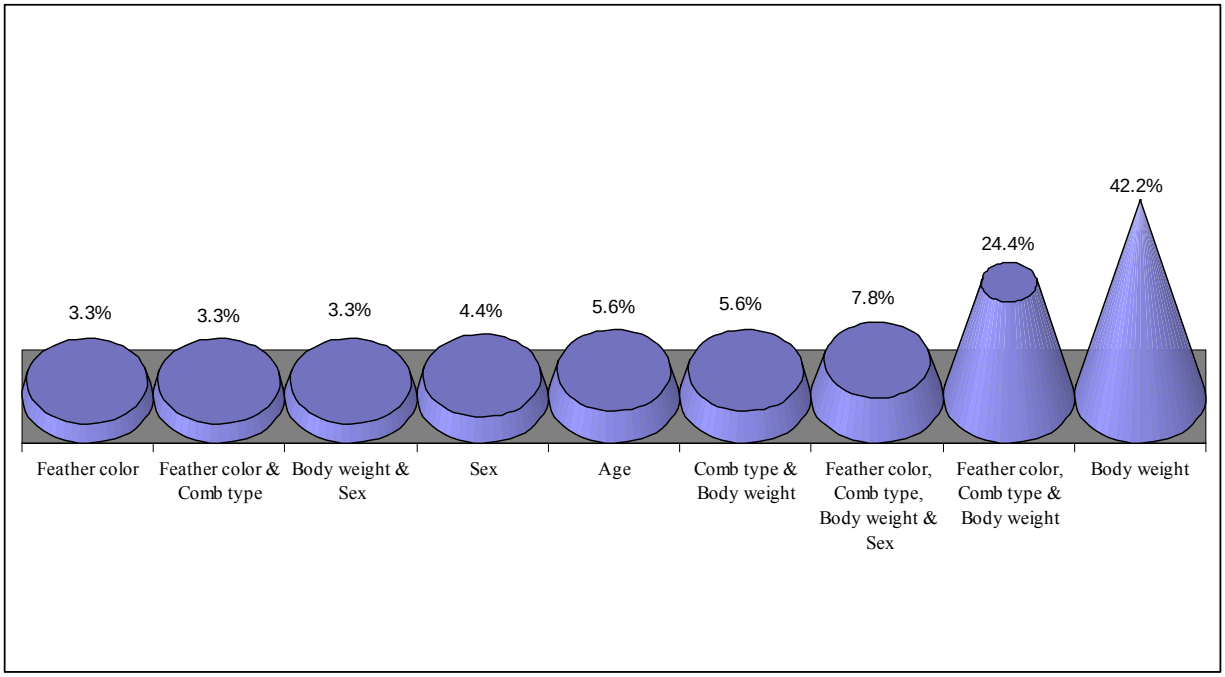

Figure: 9. Causes of price variation for chickens.

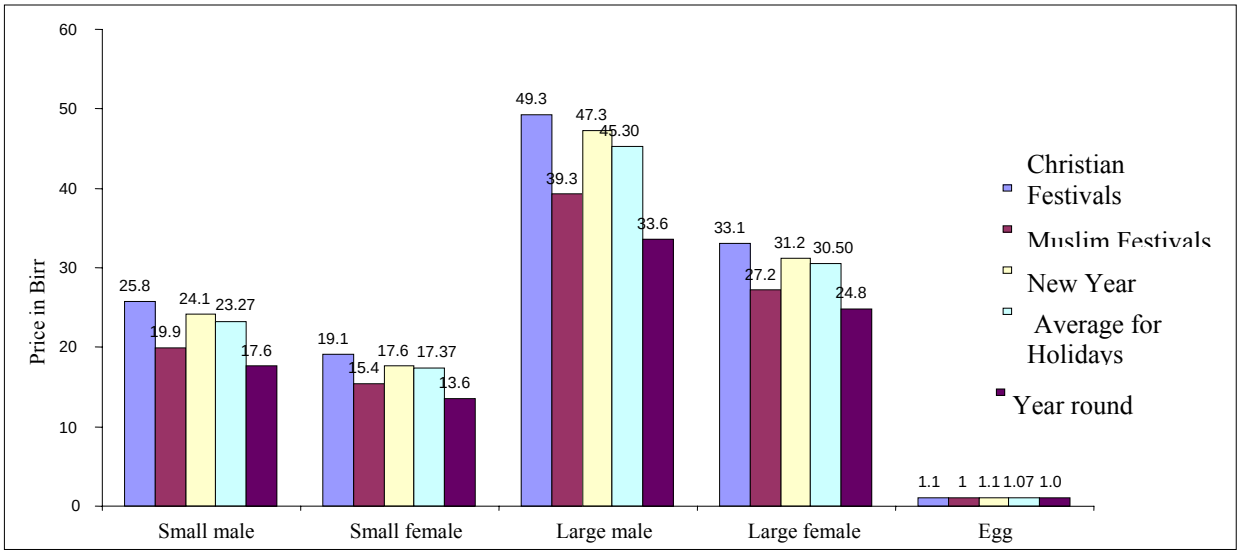

Figure: 10. Price of egg and chickens with different size and sex groups at different seasons of the year

About 57.1% of the respondents stored the market eggs on the nest. The remaining 18.5% and 5.6% of the respondents stored in the basket and in the iron dish respectively. On average the market eggs were stored for 12.15 days before sold.

In this study, all of the respondents stored eggs for more than 15 days before incubation. About 29.4%, 50.6% and 20% of the respondents stored the eggs from 15 to 20, 21 to 26 and 27 to 35 days before incubation respectively.

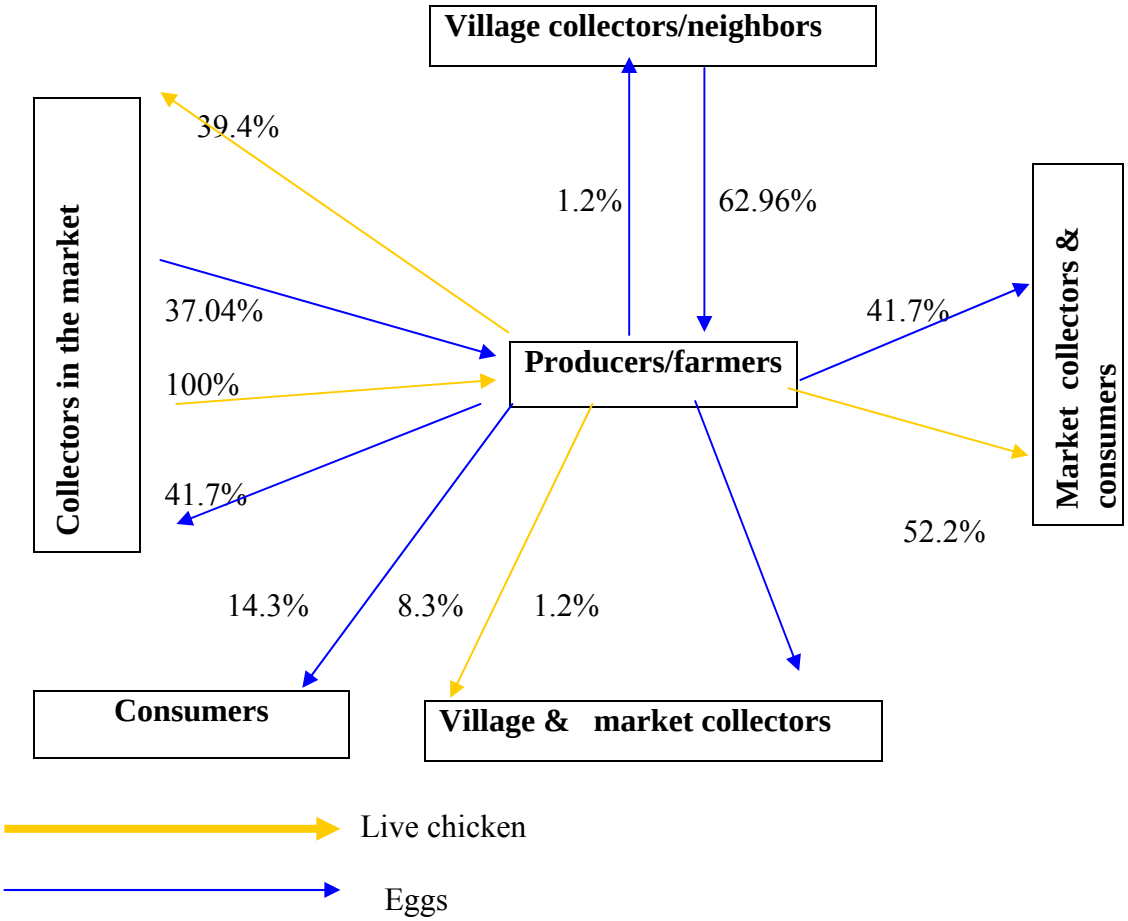

Figure: 11. The regular clients for live birds and egg marketing.

4.4. Socio economic and intra household dynamics

4.4.1. Socio economic aspects of chicken production

The results of this study indicate that there are no cultural or religious taboos connected to production and consumption of poultry (chickens) and poultry products in the Gomma Wereda. About 94% of the respondents reported to consume eggs 1-6 times a year whereas as 4% of the respondents do not consume eggs at all. About 80% of the respondents consume poultry meat 1-2 times a year indicating egg consumption is comparatively affordable than poultry meat from the point of view of purchasing power since there seems to be no taboos

connected to the consumption of poultry and poultry product in the study area. It is reported that 78% of the total egg produced in the Wereda are meant for sale. The purpose of chicken rearing in the study areas was reported to be for sale (50%), replacement (35%) and consumption (15%) showing that household poultry of indigenous chickens is source of family income and poultry and poultry products are not among staple food items in the Gomma Wereda. The results of this study is not in agreement with that of Tadelle and Peters (2003) who reported that 52% of the eggs produced under the Ethiopian village chicken production system are incubated in order to replace the new stock.

The major input required to initiate and run rural household poultry in Gomma Wereda are financial resource to purchase foundation and replacement stocks (49.4% of respondents) and feed (37.2% of respondents). About 7.8% and 5.6% of the respondents reported to have spent money for the purchase of pharmaceuticals and construction of poultry houses respectively. The Majority of the respondents (84.4%) are interested in improving their poultry production through better feeding, health care and housing. However, the results of this study clearly showed that, there is no credit access designed for chicken production in the Gomma Wereda before launching IPMS project. Lack of access to credit and relevant technical extension package seems to be a limiting gap in the area of rural household poultry production in Gomma Wereda. The remaining 15.6% of the respondents are reluctant to invest on poultry mainly due to wide spread disease conditions and high prevalence of predators, among other reasons (Table 9) indicating that Poultry diseases are widely spread in the Wereda and household poultry became untenable due to disease and predations.

Table 9: Barriers for future expansion of poultry.

Constraints	Frequency	Percent
Disease	2	1
Predator & disease	47	26
Predator, disease & financial problems	19	11
Predator, disease & land scarcity	60	33
Predator, disease, lack of labor & financial problems	14	8
Feed shortage & predator	38	21

The contribution of poultry and their products to the household cash income are generally difficult to assess. Nevertheless, the sub-sector is considered as a viable and promising alternative source of income for rural households in developing countries (Oh, 1990).The mean annual income from sale of eggs in Gomma Wereda is estimated to be about Birr 174.26. About 70% of the respondents reported to spend earnings from chicken and egg sale for purchase of items for home consumption (food, salt, oil, fuel etc) and to cover educational materials (books, pen, pencils, uniforms and an immediate cash inquires from the school).

4.4.2. Intra-household dynamics and labor profile

The intra-household dynamics refers to the way in which household members behave and react to each other in the production process.

According to this finding, about 96.7% of ownership of chicken was held by women. This value was higher than the value reported by Hoyle (1992) who reported elder men and women accounted for 30% and 47% ownership, respectively in Welaita area. This result was similar to the findings of Tadelle et *al.* (2003) in the central highlands of Ethiopia which reported as women owned and manage birds and controlled the cash generated from the sale of birds. The ownership of village chickens in most African societies is a product of social and cultural aspects of societies (Sonaiya, 1990a). The ownership pattern was usually related to decision making in selling and consumption of chicken and eggs.

About 90% of house construction in the study area was covered by the men. According to Fisseha (2009), this value was 97.5% for men. However, women were highly responsible for many activities like provision of water and supplementary feed to chicken (100%), selling of chicken (94%) & cleaning chicken's waste in their night time resting areas (91%). Concerning on these values Fisseha (2009) was reported women were responsible for cleaning bird's house (38.6%), provision of supplementary feed to birds (80.7%) and selling of chicken (46.8%). The result of the study 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. Abubakar *et al.,* (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%). Treating sick birds in this study was dominated by the men with the value of 67%. But according to Fisseha (2009), 89.3% of the men were treating sick birds in North-west Amhara. Decision making practices (selling and consumption of eggs and chickens) were also dominated by women with the value of 96.7%. However the study of Fisseha (2009) showed that the decision making power for women was 30%. There was a positive significant correlation (0.39**) between number of chickens and the time spent to take care of the birds at $P< 0.01$.

4.5. Productivity of local chicken

4.5.1. Age at sexual maturity

Age at sexual maturity of the indigenous chickens in the study area is given in Table 10. There was no significant difference ($P>0.05$) between the six *Kebeles* studied, in sexual maturity of the indigenous chickens as measured by age at first egg. Mean sexual maturity expressed in terms of age at first egg was reported to be 6.33 months. Mekonnen (2007) reported age at first egg of 7.07 months from indigenous pullets of Dale wereda the value of which is longer than that of the Gomma Wereda by 0.73 months. Mean age at slaughter weight of 1.5kg of the male chickens of the Gomma Wereda was found to be about 8.62 months. There was variations between the different *Kebeles* in age at slaughter weight of the indigenous male chickens ($P<0.01$). Chickens encountered in Belfo Konche and Kilole Kirkir and Koye Seja *Kebeles* were found to be significantly higher ($P<0.01$) than all the others in age at slaughter weight. Chick survival to an age of 2 months was reported to be higher for *Kebeles* in the vicinity of Agaro town.

Table 10: Reproductive and productive performances of the local hen based on hen history data obtained from the study *kebeles*.

Kebele		**ASMm (Month)**	**ASMf (Month)**	**AS (Months)**	**NEC**	**NCY**	**NEY**
		Mean ± SD	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**
Bulbulo		6.27 ± 0.78	6.13 ± 0.77	7.87^{c} ± 1.91	12.77^{b} ± 1.55	3.53^{ab} ± 0.77	44.50^{ab} ± 10.10
Limu Sapa		6.57 ± 0.90	6.43 ± 0.90	8.20^{bc} ± 1.52	12.43^{b} ± 1.52	3.80^{a} ± 0.48	46.70^{a} ± 6.61
Beshasha		6.30 ± 0.79	6.30 ± 0.79	8.20^{bc} ± 1.45	12.53^{b} ± 1.68	3.63^{ab} ± 0.61	45.17^{a} ± 8.54
Belfo Konche		6.70 ± 0.53	6.60 ± 0.56	9.20^{a} ± 1.45	13.87^{a} ± 1.28	3.43^{b} ± 0.50	47.43^{a} ± 7.09
Kilole Kirkir		6.53 ± 1.14	6.37 ± 0.85	9.20^{a} ± 2.40	12.80^{b} ± 2.55	3.10^{c} ± 0.76	38.90^{c} ± 9.87
Koye Seja		6.47 ± 1.14	6.13 ± 0.82	9.07^{ab} ± 2.26	13.13^{b} ± 2.45	3.10^{c} ± 0.55	40.33^{bc} ± 8.77
Overall	**Mean ± SD**	**6.47 ± 0.91**	**6.33 ± 0.80**	**8.62 ± 1.92**	**12.92 ± 1.93**	**3.43 ± 0.67**	**43.84 ± 9.05**
	Range	**5-9**	**5-8**	**5-12**	**6-18**	**2-5**	**18-64**
P – value		0.42	0.17	0.01	0.05	0.001	0.001
Kebele		**NDC**	**NES**	**NCHS**	**NCS5m**	**NTHHY**	**WA (Months)**
		Mean ± SD	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**
Bulbulo		25.00 ± 2.79	10.43^{a} ± 1.76	8.67^{a} ± 1.88	3.00 ± 1.02	1.93 ± 0.52	2.68^{a} ± 0.44
Limu Sapa		24.60 ± 5.34	10.13^{a} ± 1.36	8.13^{a} ± 1.74	2.83 ± 1.12	1.97 ± 0.49	2.87^{a} ± 0.32
Beshasha		24.13 ± 3.12	10.13^{a} ± 1.17	$7.93^{a\,b}$ ± 1.23	2.57 ± 0.63	1.87 ± 0.51	2.70^{a} ± 0.45
Belfo Konche		27.37 ± 4.99	9.30^{b} ± 1.05	7.37^{b} ± 0.93	2.53 ± 0.97	1.63 ± 0.49	2.67^{a} ± 0.38
Kilole Kirkir		25.40 ± 4.30	10.33^{a} ± 1.67	$7.93^{a\,b}$ ± 1.48	2.83 ± 0.70	1.87 ± 0.43	2.43^{b} ± 0.50
Koye Seja		25.23 ± 4.81	10.47^{a} ± 1.46	8.27^{a} ± 1.26	3.13 ± 0.90	1.83 ± 0.59	2.33^{b} ± 0.42
Overall	**Mean ± SD**	**25.29 ± 4.39**	**10.13 ± 1.47**	**8.05 ± 1.49**	**2.82 ± 0.92**	**1.85 ± 0.51**	**2.61± 0.45**
	Range	**24-32**	**7-15**	**5-12**	**1-5**	**1-3**	**2-3**
P – value		0.08	0.02	0.03	0.07	0.17	0.001

Means within a column with different superscript differ significantly (P<0.05).

ASMm= Age of sexual maturity of male, ASMf= Age of sexual maturity of female, AS= Age for slaughter, NEC= Number of eggs per clutch , NCY= Number of clutch per year, NEY= Number of eggs per year NDC= Number of days per clutch, NES= Number of eggs per set, NCHS= Number of chicks hatched per set, NCS5mA= Number of chicks surviving to an age of 5 month, NTHHY= Number of times the hen hatches per year, WA= Weaning age.

4.5.2. Egg production performance

The average number of eggs per clutch reported from overall study area (12.92) is similar to the national average (12) as reported by CSA (2003). There was significant difference ($P<0.002$) between the different *Kebeles* in productivity of the indigenous chickens as measured by the average number of eggs per clutch. Chickens from Belfo Konche had significantly higher ($P<0.002$) average number of eggs/clutch (13.87 eggs) than chickens of all the other *Kebeles*. The average number of clutches per year recorded from the Gomma Wereda was 3.43. The average number of clutches per year reported from Limu Sapa *Kebele* (3.8) was significantly higher than Belfo Konche, Kilole Kirkir and Koye Seja ($P<0.001$). Mean annual egg production of the indigenous chickens of Gomma Wereda was estimated at 43.8 eggs (Table 10) , the value of which is lower than those reported (55.2 eggs/year/head) from Dale wereda (Mekonnen 2007) but higher than those reported (36-42 eggs/year/head) from Ambo (Fikere 2000). Mean annual egg production of the indigenous chickens of Gomma Wereda was also higher than those reported (32eggs/year/hed) from Assela (Brännänng and Pearson 1990), indicating the availability of better potential in egg production potential of the indigenous chickens of Gomma Wereda. There was significant difference ($P<0.001$) between the indigenous chickens of different *Kebeles* in annual egg production. The existence of variability in egg production performance of the indigenous chicken of the Gomma Wereda could be an indication of the potential for genetic improvement through selection followed by cross breeding with selected improved breeds.

4.5.3 Hatchability and mortality

Hatchability and rate of chick survival are one of the major determinant factors of productivity in poultry. There was no significant difference in hatchability between the *Kebeles* studied. The mean percent total hatchability calculated for the indigenous chickens of the Gomma Wereda was 22% (Table 11), the value of which is lower than those reported from different parts of Ethiopia, with the exception of that of Jimma (Brännänng and Pearson (1990); Mekonnen (2007) and Tadelle and Ogle (1996a)).

The results of this study clearly showed that hatchability seems to be one of the detrimental factors limiting poultry production in Gomma Wereda. About 91.7% of the respondents believe that percent hatchability varies with variation in seasons, the lowest percentage hatchability occurring from eggs incubated both during small (April to May) and big (June – September) rainy seasons. Almost all the respondents believe that the highest percentage hatchability could be obtained from eggs incubated from October to January.

Mean chick mortality (to an age of 8 weeks) of the indigenous chickens of Gomma Wereda was calculated to be 41% without showing no significant difference between the six *Kebeles* studied (P>0.05), which was lower than that reported from the central highland of Ethiopia (61%) Tadelle and Ogle (1996a), Dale wereda (55%) Mekonnen (2007) and from Assela (93%) Brännänng and Pearson (1990). According to Sastry et *al*. (1996) incubation temperature affected both quantity and quality of hatch. About 40.6% of the respondents believe that the highest chick mortality occur at the 5^{th} and 6^{th} weeks of brooding which might be attributed to the free movement of chicks accompanying the mother hen (Table 12).

Table 11: Hatchability and rate of chick survival.

The study area		Total Hatchability %	Chick mortality %
		Mean ± SD	Mean ± SD
Bulbulo		20±0.07	39±0.11
Limu Sapa		22±0.09	42±0.12
Beshasha		22±0.09	44±0.12
Belfo Konche		20±0.08	42±0.10
Kilole Kirkir		25±0.09	40±0.11
Koye Seja		21±0.09	40±0.13
Overall	Mean±SD	22±0.09	41±0.12
	Range	0-42	13-70
P - value		0.396	0.500

Table 12: Season of incubation and chick mortality.

Parameters	Character	Frequency	Percentage
Season of incubation	Oct - Jan.	176	97.80
	Sept – May	4	2.20
Worst hatchability	April – may	2	1.00
	June –Sep.	163	99.00
Best hatchability	Oct –Jan.	165	100.00
Highest chick mortality (Weeks)	1^{st}	7	3.90
	2^{nd}	25	13.90
	3^{rd}	15	8.30
	2^{nd} & 3^{rd}	4	2.20
	4^{th} & 5^{th}	2	1.10
	5^{th} & 6^{th}	73	40.60
	3^{rd} & 4^{th}	54	30.00
Cause of highest chick mortality	Predator	25	13.90
	Disease	15	8.30
	Predator & disease	140	77.80

4.6. Evaluation of post harvest losses

4.6.1 Internal and external egg qualities

The result of the comparative analysis is shown in Table 14. The eggs purchased from the market had lower values in all the quality parameters investigated compared to the freshly collected eggs, indicating the occurrence of egg quality deteriorations as a result of storage conditions and storage period. Decrease in egg quality parameters of market eggs was highest for Haugh Unit (HU), followed by egg and albumen weight respectively. This result is similar to that of Samli et al (2005), who suggested that HU and egg weight is the parameter greatly influenced by egg storage period and temperature. According to Samli et al (2005), egg storage period of more than 10days at 29°C brought egg weight losses of 1.94g. Similarly

Aini (1990), reported egg weight loss of 0.57 g from storage period of 14 days at 21°C. According to the results of this study mean weight loss of eggs purchased from Gomma Wereda market places was 3.30g indicating longer period storage at relatively higher temperature(about 29°C).

Of all the internal and external egg quality characteristics, thick albumen is quite an important measure for the freshness of an egg. The longer an egg is stored, the lower the height of the thick albumen could be (Toussant and Latshaw, 1999). The results of this study showed that HU, albumen weight and yolk height of eggs purchased from the Gomma Wereda market places decreased by 7.76%, 2.46g and 1.97mm, respectively (Table 14). Most of these changes in egg quality in terms of albumen height, HU, and yolk index, could be attributed to water loss by evaporation through the pores in the shell and the escape of carbon dioxide from albumen, the net effect of which results in progressive loss in egg weight and a continual decline in egg quality (Samli et al, 2005). Based on the result of this study, the average values of all variables of fresh egg was higher than that of aged egg (Table 14) indicating quality deterioration as a result of longer period of storage at relatively higher temperature.

There was significant difference in egg weight among *Kebeles* and ages of eggs at $P<0.01$ and at $P< 0.001$, respectively (Table 13 & 14). The egg weight of Limu Sapa (43.38g) was significantly higher than that of all the other *Kebeles*' except that of Belfo Konche (42.96g). The fresh egg weight (43.38g) was also significantly higher than the aged egg weight (40.08g) at $P < 0.001$. There was significant differences between fresh eggs and eggs collected from the market in shell weight, albumen weight & yolk height. In all the traits, fresh eggs had higher mean values than that of the aged eggs.

Table 13: Egg weight in different *Kebele*s.

Kebele	Bulbulo	Limu Sapa	Beshasha	Belfo Konche	Kilole Kirkir	Koye Seja	P-Value	CV
Egg weight (g) (Mean)	41.36^{bc}	43.38^{a}	40.86^{c}	42.96^{ab}	41.17^{bc}	40.65^{c}	0.01	12.73

Means within a column with different superscript differ significantly ($P<0.05$).

Table 14: Comparative evaluation of egg qualities of fresh and aged eggs.

Variables	Treatment			Significance (Two - tailed)
	Fresh (Mean)	Aged (Mean)	Difference (Mean)	
Egg weight (g)	43.38	40.08	3.30	0.001***
Shell weight (g)	4.61	4.35	0.26	0.001***
Albumen weight (g)	22.60	20.14	2.46	0.001***
Yolk height (mm)	11.06	9.09	1.97	0.001***
Shell thickness (mm)	0.38	0.33	0.05	0.001***
Albumen height (mm)	2.87	2.10	0.77	0.001***
Yolk weight (g)	15.02	14.56	0.46	Ns
Haugh unit (%)	54.50	46.74	7.76	0.001***
Yolk color	10.16	10.15	0.01	Ns

Ns = not significant at $P < 0.05$, *** = significant at $P < 0.001$

Table 15: Egg quality parameters having interaction between *Kebele* and Age of eggs

Kebele	Age	Shell Thickness	Albumen height	Yolk weight	Haugh unit	Yolk color
Bulbulo	Fresh	0.46^{a}	2.66^{bc}	14.76^{bcd}	51.96^{abe}	9.73^{bcdg}
	Aged	0.42^{b}	2.38^{bd}	15.18^{abc}	51.39^{bce}	9.71^{bcdg}
Limu Sapa	Fresh	0.36^{cd}	3.12^{a}	15.36^{abc}	56.20^{ab}	11.33^{a}
	Aged	0.21^{f}	1.84^{e}	15.28^{abc}	41.56^{d}	9.38^{dg}
Beshasha	Fresh	0.37^{c}	2.88^{ac}	13.85^{d}	56.41^{a}	10.40^{be}
	Aged	0.35^{cd}	1.90^{e}	14.49^{bcd}	43.66^{df}	10.00^{bcdf}
Belfo Konche	Fresh	0.37^{c}	2.88^{ac}	15.96^{a}	52.91^{ab}	9.03^{g}
	Aged	0.34^{d}	2.16^{de}	13.92^{d}	47.60^{cf}	10.87^{aef}
Kilole Kirkir	Fresh	0.34^{de}	2.95^{ac}	15.39^{ab}	55.79^{ab}	10.40^{be}
	Aged	0.31^{e}	1.82^{e}	14.48^{bcd}	43.38^{df}	9.96^{bcdf}
Koye Seja	Fresh	0.37^{c}	2.73^{bc}	14.78^{abd}	53.74^{ab}	9.97^{bcd}
	Aged	0.34^{d}	2.42^{bd}	14.20cd	51.90abce	11.00ae
P- value		<0.0001	0.0001	0.02	<0.0001	<0.0001
CV		12.86	27.46	15.54	18.70	17.30

Means within a column with different superscript differ significantly (P<0.05).

As shown in Table 15, significantly thicker (P<0.0001) egg shell was recorded from fresh eggs collected from Bulbulo *Kebele* (0.46mm) while significantly lower (P<0.0001) shell thickness was recorded from eggs collected from Limu Sapa *Kebele* (0.21mm) compared to all the others. Fresh eggs collected from Limu Sapa *Kebele* had significantly higher albumen height (3.12mm) than all the other combinations except that of fresh eggs collected from Beshasha, Belfo Konche and Kilole Kirkir *Kebele* (Table 15). The significantly lower albumen heights (P<0.0001) were recorded from aged eggs collected from Limu Sapa (1.84mm), Beshasha (1.9mm) & Kilole Kirkir (1.82mm) *Kebele*s. The Fresh eggs collected from the majority of the *Kebeles* had significantly higher (P<0.0001) haugh unit than the eggs collected from the market areas of the corresponding *Kebeles*. The yolk color of fresh eggs (11.33) collected from Limu Sapa was significantly higher (P<0.0001) than that of all the others with few exceptions. This result indicates that as the age of the egg increases the quality is deteriorated due to storage condition and storage period.

4.6.2 Hatchability and chick survival

In this study, eggs randomly purchased from Gamma Wereda market places were also incubated at JUCAVM along with freshly collected eggs aimed at comparative evaluation of the eggs in terms of hatchability and survival rate of the resulting chicks and the results are shown in (Table 16 & 17). There was no significant deference between the fresh (27.39) and market (17.63) eggs in Percent hatchability as measured by number of fertile eggs that hatched to normal chick(P>0.05) (Table 17). Percent hatchability (number of fertile eggs that hatched in to normal chick) recorded from both market and freshly collected eggs in Gomma Wereda were very low the results of which confounded the attempts made to measure the freshness of the eggs in terms of hatchability. Moreover, there was no significant difference between fresh and market eggs incubated in death rate (P>0.05).

Table 16: Percent growth rate and death rate at different weeks of chicks' age

	% Growth rate	% Death rate
Time (Week)	Mean	Mean
1st	37.54[b]	5.88[b]
2nd	45.82[ab]	0.69[c]
3rd	37.31[b]	0.76[c]
4th	23.54[c]	13.43[a]
5th	38.34[ab]	0.00[c]
6th	24.70[c]	0.00[c]
7th	47.54[a]	0.00[c]
8th	5.59[d]	0.00[c]
P- Value	<0.0001	< 0.0001
CV	36.72	30.07

Means within a column with different superscript differ significantly (P< 0.05)

According to Table 16, there was statistically significant difference both in % growth rate and % death rate at different weeks of age. The lowest percent growth rate of chicks was measured at 8th week of age and this may be due to the nutrient requirement at the transition period from chicks to growers. In this study the highest death rate of chicks was observed at 4th week of age.

Table 17: Total and fertile hatchability of fresh and aged eggs.

Variables	Treatment		Significance (Two- tailed)
	Fresh (Mean)	Aged (Mean)	
Total hatchability (%)	21.82	14.16	Ns
Fertile hatchability (%)	27.39	17.63	Ns

Ns = not significant at $P < 0.05$

Table 18: Percent total hatchability and weak chicks at different *kebeles*

Kebele	% Total hatchability	% Weak chicks
Bulbulo	12.05^{bc}	0.00^{c}
Limu Sapa	7.21^{c}	33.33^{a}
Beshasha	18.81^{abc}	$9.09b^{c}$
Belfo Konche	29.17^{a}	13.85^{abc}
Kilole Kirkir	18.57^{abc}	29.72^{ab}
Koye Seja	22.15^{ab}	6.25^{c}
P-Value	0.04	0.04
CV	26.16	22.35

Means within a column with different superscript differ significantly ($P < 0.05$).

There was statistically significant difference among the *Kebele*s both in percent total hatchability and percent weak chicks at $P < 0.05$ (Table 18). Moreover, there was no significant difference between fresh and market eggs incubated in chick quality ($P>0.05$).

The percent fertile hatchability obtained from incubation of fresh and aged eggs collected from market places of the Wereda is similar to percent hatchability calculated from data collected through the survey. According to the results of the survey and the results of incubation made at JUCAVM percent hatchability (number of fertile eggs that hatched in to normal chick) of the indigenous chickens of Gomma Wereda were much more lower than those reported from different parts of Ethiopia, with the exception of that of Jimma (Brännänng and Pearson (1990); (Mekonnen G/Egziabher, 2007 and Tadelle Dessie and Ogle, 1996a). All the available evidences tend to indicate that Jimma is also characterized by

exceptionally very low percentage hatchability. According to Burley (1957), eight hatches of artificial incubation averaged only 27% hatchability at JUCAVM (formerly JATS) as early as 1950s. Solomon (2000) also reported low hatchability from both White Leghorn and Rhode Island Red eggs incubated at JUCAVM. At the time of conducting this study 5 hatches involving eggs of Rhode Island Red and the Egyptian Fayoumi incubated at JUCAVM averaged 31% hatchability (Solomon Demeke 2010, unpublished data). The reason(s) for low hatchability recorded from Gamma Wereda and Jimma are not clearly known and need further investigation.

4.7. Monitoring of exotic chickens

According to the results of the attempts made to identify the profile of the recipients, the farmers who adopted the exotic chickens were evenly distributed within an age group of 26-42 years, of which 75% are female (Table 19). Their educational background ranges between 5^{th} and 12^{th} grade. They all belong to either low or medium income families, the majority being members of low income families. At the time of the study, the farmers were keeping both the indigenous and exotic chickens side by side and the mean flock size of exotic chickens was reported to be 29.5 /household. The mean values of chickens in different breed and sex categories are shown in (Table 20).

Table 19: Profile of the respondents of IPMS group.

Age	Percent	Major occupations	Percent	Sex	Percent	Educational level	Percent
26	25	Merchant	50	Male	25	5th - 8th	50
30	25	House wife	25	Female	75	9th - 12th	50
35	25	Merchant and security	25				
42	25						

Table 20: The mean values of chickens in different breed and sex categories of IPMS group

	Indigenous Chicken	Male Indigenous chicken	Female Indigenous chicken	Exotic Chicken	Male Exotic chicken	Female Exotic Chicken
Mean	1.75	0	1.75	29.5	0.5	29
Minimum	0	0	0	27	0	26
Maximum	5	0	5	31	1	31

4.7.1 Management practices

4.7.1.1. Feeding and housing

All the exotic chickens adopted were placed on commercial poultry rations purchased from Debre Ziet through the assistance of IPMS project since all the attempts made in the area of home made ration formulation resulted in depressed production performance. About 50% of the respondents reported to use supplementary green materials (Figure 12). The majority of the respondents (75%) reported to provide feed adlib whereas all the respondents reported to make drinking water available all the times (Table 21). Locally made feeding and watering troughs are used by all farmers that adopted the exotic chickens in Gomma Wereda under IPMS project.

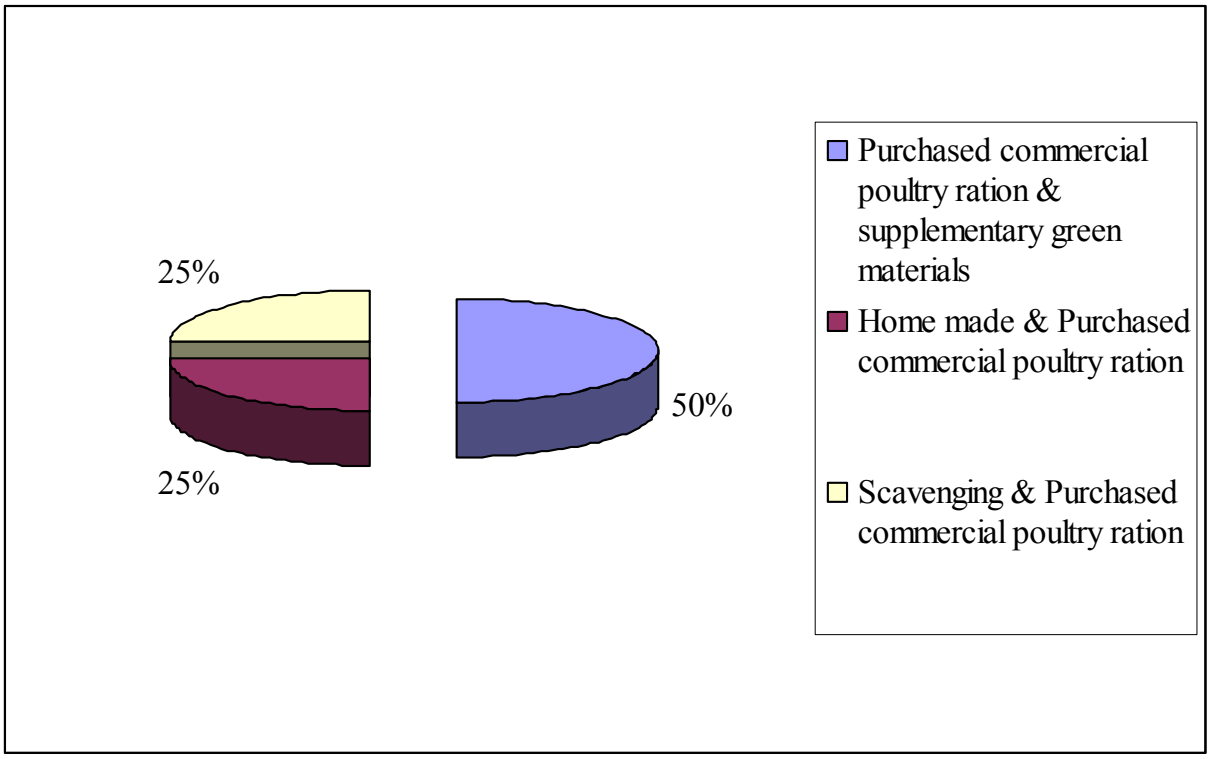

Figure: 12. Major feed sources for exotic chickens of Gomma Wereda, Ethiopia

Table 21: Frequency of feeding and watering of exotic chickens of Gomma Wereda, Ethiopia

Parameters		**Frequency**	**Percent**
Provision of water	Yes	4	100
Frequency of watering	Adlib	4	100
Frequency of feeding	Morning	1	25
	Adlib	3	75

All the 4 farmers (100%) reported to have started with day old chicks of *Isa Brown* purchased from Debre Ziet through the assistance of IPMS project and used hay-box under close supervision and guidance of the project during chick brooding (0-8 weeks of age) and are

happy with the brooding performance of the box brooder of 50 chicks capacity. In addition to the box brooder, three (75%) of the respondents reported to have newly constructed separate poultry houses whereas the other farmer reported to have modified the available family dwellings. Seventy-five percents of the respondents kept the pullets and layers (more than 2 months age) in total confinement and the remaining 25% allowed to scavenging in the afternoon for the purpose of compensating the feed shortage. The average construction of poultry house of 300 chick capacities and hay-box of 50 chick capacities was reported to be Birr 6966.67 and 220 respectively.

4.7.2 Productivity of *Isa* Brown chicken

4.7.2.1 Chick growth and survival rates

According to all the respondents (100%) and IPMS development agents (personal communication), mean percent mortality of all the *Isa Brown* chicks during brooding (0-8 weeks of age) was less than 5%, the value of which is very high by the Ethiopian standard. It was rather comparable (even better) to those reported from commercial poultry farms (5-10%) located in and in the vicinity of Addis Ababa as reported by Alemu and Tadelle (1997). Similarly mean percent mortality of 5%, reported from exotic chicks adopted by Gomma Wereda farmers under IPMS project is superior to the mean percent mortality (41%) reported from scavenging indigenous chicks of the Wereda. Thus the results of this study clearly indicates that smallholder farmers are successful in raising layer type day old chicks with the use of hay-box brooder in Gomma Wereda of the Jimma Zone.

The results of the follow up study also indicated that mean sexual maturity, as measured by age at the first egg of the exotic breed of chicks adopted by the farmers under IPMS project was reported to be 156 days (5.2months), the value of which is similar to that reported from the government owned breeding and multiplication centers (150 days) but slightly longer than that reported from the commercial poultry farms (145 days) located in and in the vicinity of Addis Ababa as reported by Alemu and Tadelle (1997).

4.7.2.2. Egg production

The mean egg production performance of the exotic chickens adopted by the farmers under the IPMS project is shown in (Table 22). According to the current state of production the average daily egg production/ head of the *Isa Brown* breed of chickens is reported to be 0.70 eggs /hen/day, which seems to be high compared to the egg production performance of the commercial poultry farms (0.630 egg/hen/day) and government owned breeding and multiplication centers (0.55egg/hen/day) Alemu and Tadelle (1997). This value is also higher than the egg production performance (0.046 eggs/hen/day) of the indigenous chickens in the study area.

At the time of conducting this study the market egg price was Birr 1.50/egg indicating that the mean daily family income from the sale of eggs of exotic chicken could best be estimated at Birr 30.45. The mean cost/kg of commercial poultry ration at the production site is calculated to be Birr 5.6 and Birr 0.4 is required to move a kg of feed from Addis to Gomma Wereda indicating feed cost at the poultry production site is Birr 6.0/kg. Assuming daily feed intake of 90 g/d/hen, the average feed consumption of the exotic flock (29.5/household) could be estimated at Birr 15.93, compared to the daily income from egg sale of Birr 30.45.

Table 22: The mean egg production and uses of eggs from exotic chickens

	Age at First Egg (months)	Daily Egg Production	Eggs used for home consumption (%)	Eggs sold (%)	Eggs for incubation %
Mean	5.2	20.3	14	86	0
Minimum	5	10	0	56	0
Maximum	5.4	25	44	100	0

5. SUMMARY AND CONCLUSIONS

This research undertaking was aimed at characterizing village poultry production and marketing system in Gamma Wereda of Jimma Zone. The results of the study showed that the mean flock size per household of the Gomma Woreda was 6.23 chickens the value of which is higher than the national average but lower than reported for Tigray, Gambella and Benshangul-Gumuz Regional States. The indigenous chickens of the Wereda are kept under scavenging condition with supplementation. The chickens are confined within the family dwellings during night time and released for scavenging early in the morning resulting in high mortality caused by disease condition and predators. Scavenging as it is practiced in the Gomma Wereda makes the implementation of bio-security and hygienic practices very difficult and contributes to indiscriminate mating and lack of controlled breeding. More over the current live bird and egg transportation and market system of the Wereda results in quality deterioration as measured by changes in albumen height, HU, and egg weight, of eggs collected from market places of the Wereda.

The production performance of the indigenous chickens of Gomma Wereda as measured by rates of chick survival, sexual maturity and egg production performance looks fairly good as compared to that of the indigenous chickens of central highlands and southern Ethiopia. In contrast percent hatchability recorded from the study area (as measured by the number of fertile eggs that hatched in to normal chick) was found to be very low and need further investigations. It is reported that 78% of the total egg produced in the Wereda are meant for sale and only 15% of the respondents rear poultry for the purpose of consumption indicating that poultry and poultry products are not among the staple food items in the Gomma Wereda, since there are no cultural or religious taboos connected to production and consumption of poultry and poultry products in the wereda.

Despite the existence of a huge interest to invest on household poultry among the farming population of Gomma Wereda, there was no credit access designed for poultry production before launching IPMS project. Several farmers adopted day old exotic chicks of *Isa Brown*

under close observation and credit scheme of IPMS project and proved that smallholder farmers are successful in raising layer type day old chicks with the use of hay-box brooder. Mean daily egg production of 0.7 egg/head was reported from exotic layer of *Isa Brown* layer with the use of commercial ration purchased from Addis Ababa, the value of which seems to be high compared to the egg production performance of the commercial poultry farms located in and in the vicinity of Addis Ababa. However lack of regional commercial poultry ration is the major limitation of exotic poultry adopted by small holders of Gomma Wereda under IPMS project. In summary the results of this study tends to suggest the following recommendations.

- Experimental study aimed at improving hatchability in the Gomma Wereda seems to be urgently needed.

- Smallholder farmers in Gomma Wereda are successful in raising layer type day old chicks with the use of hay-box brooder. However, the feasibility of using hay-box brooding technology in raising indigenous chickens need to be assessed.

- Researching in the area of setting up of proper input supply system for improved poultry production to work for smallholder farmers in the Gomma Wereda seems to appealing. Special emphases need to be placed on the provision of exotic chicken breeding stock and commercial poultry ration at the zonal level.

- There was no credit access designed for poultry production before launching IPMS project in the Gomma Wereda. There is a strong need to build up on the initiatives of IPMS farmers project in the area of provision of sustainable credit scheme and farmers training program.

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7. APPENDICES

Appendix A: Comparative productivity indicators of the traditional, breeding centers and commercial poultry production systems in Ethiopia.

Item	Traditional (indigenous)	Breeding centers	Commercial farms
Average egg weight(g)	38	56	56
Mean laying period/ hen(days)	20	>200	>200
Eggs/hen per year	60	200	230
Natural incubation period (days)	21	NA	NA
Natural brooding period (days)	56	NA	NA
Mean total days out of laying	96	NA	NA
Chick mortality (%)	40	5-10	5-6
Fertility (%)	75	80	90
Hatchability (%)	70	65	80
Age at first egg (days)	180	150	145
Slaughter weight at 12 months (kg)	1.5	NA	NA
Mortality of adult flock (%)	20-30	6-8	5-6
Mortality of broilers (%)	NA	NA	10-15
Slaughter weight at 8 weeks(kg)	1.5	NA	1.8
Adult weight (kg)		NA	NA

Source: CACC 2003 and Alemu Yami 1997 cited by Solomon, 2007

Appendix B: Literature on reproductive performance of chicken in free range rural village chicken production system in selected African countries **(**Production parameter)

Source and country	Age at first egg in weeks	Number of clutches per year	Egg per clutch per hen	Egg per hen per year	Egg set per clutch	Hatchability (%)	Chick Mortality (%)	Matured male body weight (kg)	Female Body wt (kg)
(Gueye, 2003). Africa.	24-36	-	-	37-95		60-95		1.2-3.2	.7-2.2kg
(Barua and Yoshimura , 2005) Bangladsh	23	-	-	44	-	-	-	-	1.30±0.60
(Eugene et al.,l 2004) Philippines			8.4		6.3	67.9			
(Awuni,2005) Ghana	-	3.7	10	-	9.3	76	-	-	-
(Ssewannyana et al.,2004)Uganda		2-3	14	40-50		80-90	25	2.1	1.4
(Khalafalla, etal .,2000) Sudan		3.1	12			78			
(Fiker, 2000) Ethiopia				36-42		68-85			
(Tadelle and Ogle,1996a.) Ethiopia				40-60		80.9±11	61		

Appendix C: Reproductive & productive performances of the local hen based on hen history data obtained from the study *kebeles.*

Kebele		**ASMm (Month)**	**ASMf (Month)**	**AS (Months)**	**NEC**	**NCY**	**NEY**
		Mean ± SD	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**
Bulbulo		6.27 ± 0.78	6.13 ± 0.77	7.87^{c} ± 1.91	12.77^{b} ± 1.55	3.53^{ab} ± 0.77	44.50^{ab} ± 10.10
Limu Sapa		6.57 ± 0.90	6.43 ± 0.90	8.20^{bc} ± 1.52	12.43^{b} ± 1.52	3.80^{a} ± 0.48	46.70^{a} ± 6.61
Beshasha		6.30 ± 0.79	6.30 ± 0.79	8.20^{bc} ± 1.45	12.53^{b} ± 1.68	3.63^{ab} ± 0.61	45.17^{a} ± 8.54
Belfo Konche		6.70 ± 0.53	6.60 ± 0.56	9.20^{a} ± 1.45	13.87^{a} ± 1.28	3.43^{b} ± 0.50	47.43^{a} ± 7.09
Kilole Kirkir		6.53 ± 1.14	6.37 ± 0.85	9.20^{a} ± 2.40	12.80^{b} ± 2.55	3.10^{c} ± 0.76	38.90^{c} ± 9.87
Koye Seja		6.47 ± 1.14	6.13 ± 0.82	9.07^{ab} ± 2.26	13.13^{b} ± 2.45	3.10^{c} ± 0.55	40.33^{bc} ± 8.77
Overall	**Mean ± SD**	**6.47 ± 0.91**	**6.33 ± 0.80**	**8.62 ± 1.92**	**12.92 ± 1.93**	**3.43 ± 0.67**	**43.84 ± 9.05**
	Range	**5-9**	**5-8**	**5-12**	**6-18**	**2-5**	**18-64**
P – value		0.42	0.17	0.01	0.05	0.001	0.001

Kebele		**NDC**	**NES**	**NCHS**	**NCS5m**	**NTHHY**	**WA (Months)**
		Mean ± SD	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**
Bulbulo		25.00 ± 2.79	10.43^{a} ± 1.76	8.67^{a} ± 1.88	3.00 ± 1.02	1.93 ± 0.52	2.68^{a} ± 0.44
Limu Sapa		24.60 ± 5.34	10.13^{a} ± 1.36	8.13^{a} ± 1.74	2.83 ± 1.12	1.97 ± 0.49	2.87^{a} ± 0.32
Beshasha		24.13 ± 3.12	10.13^{a} ± 1.17	$7.93^{a\,b}$ ± 1.23	2.57 ± 0.63	1.87 ± 0.51	2.70^{a} ± 0.45
Belfo Konche		27.37 ± 4.99	9.30^{b} ± 1.05	7.37^{b} ± 0.93	2.53 ± 0.97	1.63 ± 0.49	2.67^{a} ± 0.38
Kilole Kirkir		25.40 ± 4.30	10.33^{a} ± 1.67	$7.93^{a\,b}$ ± 1.48	2.83 ± 0.70	1.87 ± 0.43	2.43^{b} ± 0.50
Koye Seja		25.23 ± 4.81	10.47^{a} ± 1.46	8.27^{a} ± 1.26	3.13 ± 0.90	1.83 ± 0.59	2.33^{b} ± 0.42
Overall	**Mean ± SD**	**25.29 ± 4.39**	**10.13 ± 1.47**	**8.05 ± 1.49**	**2.82 ± 0.92**	**1.85 ± 0.51**	**2.61± 0.45**
	Range	**24-32**	**7-15**	**5-12**	**1-5**	**1-3**	**2-3**
P – value		0.08	0.02	0.03	0.07	0.17	0.001

Means within a column with different superscript differ significantly ($P<0.05$).

ASMm= Age of sexual maturity of male, ASMf= Age of sexual maturity of female, AS= Age for slaughter, NEC= Number of eggs per clutch , NCY= Number of clutch per year, NEY= Number of eggs per year NDC= Number of days per clutch, NES= Number of eggs per set, NCHS= Number of chicks hatched per set, NCS5mA= Number of chicks surviving to an age of 5 month, NTHHY= Number of times the hen hatches per year, WA= Weaning age.

Appendix D: ANOVA of a quality, death rate, birth rate and hatchability parameters

Variables	Sources of variation	DF	Mean square	F	Pr>F	CV (%)
% Death rate	Time	7	9.44	8.44	<.0001	30.07
% Growth rate	Time	7	2317.26	16.22	<.0001	36.72
Albumen height	*Kebele**Age	5	2.49	5.29	0.0001	27.46
Yolk weight	*Kebele**Age	5	14.06	2.66	0.0225	15.54
Haugh unit	*Kebele**Age	5	529.33	5.87	<.0001	18.70
Egg weight	*Kebele*	5	79.20	2.81	0.0168	12.73
Shell thickness	*Kebele**Age	5	0.03	16.07	<.0001	12.86
Yolk color	*Kebele**Age	5	24.37	7.89	<.0001	17.30
% Total hatchability	*Kebele*	5	117.90	5.32	0.0452	26.16
% Weak chicks	*Kebele*	5	355.86	5.49	0.0425	22.35

Appendix E: ANOVA of productive and reproductive performances of indigenous chicken at six *kebeles* of Gomma Wereda, Ethiopia .

Variables	DF	Mean Square	F-value	Sig.
Average number of eggs per set	5	5.613	2.738	0.021
Number of chicks hatched per set	5	5.570	2.629	0.026
Age of sexual maturity of Males of Local breed (Month)	5	0.819	0.998	0.421
Age of sexual maturity of Females of Local breed (Month)	5	0.979	1.566	0.172
Age of Local breed for Slaughter (Months)	5	10.756	3.075	0.011
Number of eggs in one clutch per bird of Local	5	8.196	2.271	0.050
Number of clutch per year of Local breeds	5	2.440	6.244	0.000
Number of eggs per year of Local breeds	5	359.926	4.873	0.000
Weaning age of Local breeds (Months)	5	1.141	6.364	0.000
Number of times the hen hatches per year	5	0.410	1.589	0.166
Average number of days per clutch	5	52.022	3.972	0.081
How many chicks survive to an age of sexual maturity (5 Months)	5	1.663	2.029	0.077

Appendix F: Questionnaires

1. General information of the study area

• Region--------- • Zone: ------ • District/wereda: ------- • *Kebeles* :--------

• Agricultural institutes involving on research-------

• Extension services---------- • Human population density----------

•Estimated average family size---------- •Occupation----------

Land use patterns

•Total farm size ----------ha----------(In local unit of measurement)

• Arable land _____ha ---------- (in local unit of measurement)

• Forest land_____ha---------- (in local unit of measurement)

• Grazing land_____ha---------- (in local unit of measurement)

• Un-utilized land_____ha---------- (in local unit of measurement)

• Other types of land_____ha---------- (in local unit of measurement)

Availability of infrastructure ----------

Mobility • Transhumance • Nomadic • Sedentary •Others, specify

Ethnic groups ---------- Major religions----------

Population distribution of male and female ----------

a. Farm resources---------- b. Source of cash income---------

2. Flock characteristics ----------

3. Housing ----------

4. Production & productivity potentials----------

5. Management and feeding----------

6. Disease occurrence & health management----------

7. Role of poultry farming----------

8. Role of extension system----------9. Major constraints: ----------

10. Potential of poultry farming for development----------

11. Research & development interventions for Q.10----------

2. Questionnaire for the characterization of poultry types and rural poultry production and marketing systems in Goma Woreda of Jimma Zone, Ethiopia.

Farmer's Name----------Region---------- District----------*Kebele*------

Enumerator's Name---------- Date of interview----------

Agro-ecology a. Lowland b. Mid-altitude c. Highland

A. Socio-economic characteristics

1. Sex and age of the respondent 1.1.Male ----------1. 2. Female--------1.3. Age-------

2. Major occupation---------- 3. Educational level of the respondent

1. Illiterate 2. Read & write 3.1st –4th 4. 5th –8th 5. 9th-12th

4. Religion---------- 5. Marital status ----------

5. Economic status of the family (low, medium or high income) ----------

6. Land size (ha)----------

7. Family size----------

	Male	**Female**	**Total**
a) Ages under 14 years	----------	----------	-------
b) Ages between 15 to 30 years	----------	----------	-------
c) Ages between 31 to 60 years	----------	----------	--------
d) Ages above 60 years	----------	----------	--------
e) Total number	----------	----------	--------

8. Animal ownership, sale and consumption by the household

Type	Number per family	Purpose		
		Consumed	Sold	For other purposes
Cattle				
Small ruminant				
Equines				
Poultry/Chickens				

B. Production system/Husbandry practices -

1. Livestock ownership and division of labor

Type	Owner	Responsible member of the family
Cattle		
Small ruminant		
Equines		
Poultry/Chickens		

2. State the member or members provide care for Poultry? (Based on sex & age group)

Age group	Male	Female
Under 14 years		
Age between 15 and 30 years		
Age between 31 and 60 years		
Age above 61 years		

3. How long has poultry been kept in the household? ----------

4. What Chicken types do you raise? ----------

Chicken types	Sex of the owner		No.of poultry		Total No	Source of foundation stock	Source of Replacement stock
	M	F	M	F			
Starter (0-8wks)							
Grower (8-20wks							
Finisher(> 20wks)							
Layer/hen							
Breeder/cock							

Sources of Foundation or replacement stock

1. Purchase 2. Inherited 3. Hatched 4.Other, specify----------

5. Household

Type	Number	Breed	Ownership	Responsible member of the family
Chicks (0-8wks)				
Pullets (8-20wks)				
Cockerels(0-8wks)				
Adult cocks(>20wks)				
Laying hens(> 20wks)				
Breeder/cock (>20wks)				

6. Have you ever spent money on the purchase of?

Baby chicks	Yes, No	Chicken feed	Yes, No
Pullets	Yes, No	Veterinary Products	Yes, No
Cockerels	Yes, No	Poultry house construction materials	Yes, No
Laying hen	Yes, No	Poultry feed	Yes, No

7. If your answer to any of the items listed under question 6 is yes please Indicate the source of the money (Source of money to finance your poultry farming?).

Poultry sales	Crop sales	Money lender	Bank	Off-farm work
Egg sales	Livestock sales	Family or friends	Cooperatives	Others, specify

8. On average how many hours per week do you & your family spends to take care of the birds? a) 1 b) 2 c) 3 d) 4 e) 5 f) 6 g) 7

9. Do you feel there is need to improve your poultry production? Yes No

If yes, why? (Prioritize the opportunities)

1st ------ 2nd ----- 3rd ------- 4th------

If no why? (Prioritize the problems) 1st ----- 2nd ----- 3rd ----- 4th------

10. Is there any taboo/regulation concerning the raising, consumption and sale of

poultry which has special feature? 1. Yes 2.No

If yes, 1. What type of taboo/regulation is this----------

2. To which type of birds this taboo/regulation applies----------

3. To which category of people this taboo/regulation applies----------

C. Biological data

I. Housing

1. What type of management system do you practice for your poultry rising?

a) Extensive b) Intensive c) Semi-intensive d) Others

2. Do you have separate poultry house (other than family dwellings)? Yes No

3. If your answer to question 2 is no, what is a problem in the construction of separate Poultry house (Prioritize theme) 1st ----- 2nd ----- 3rd ----- 4th ----

4. If your answer to question 2 is no, where does your birds stay at night?

(a) In the kitchen (b) Family dwellings (c) Perch on trees (d) Under basket (e) In cages (f) Others specify -- (g) In the house purposely made for chicken

5. If your answer to question 2 is no, where does your birds stay during day times?------

6. Do you believe it is advantageous to construct separate poultry house? Yes No

7. If your answer to question 6 is yes state the advantages of separate poultry house.

8. If they rest in basket or cage, or in a separate house, do you practice cleaning of poultry house? Yes---------- No----------

9. If your answer to question 8 is yes, how often you clean poultry house (How many days in a week)----------

10. If your answer for question number 4 is choice g, the house is made from

1) Mud of blocks 2) iron sheet roof & wood 3) other----------

11. Specify any special care given/associated with birds in the area----------

II. Feed Resources and Feeding Strategy

1. Do you practice purposeful feeding of your chicken in confinement? Yes-------No-------

2. Do you practice supplementary feeding of your chicken? Yes----------No---------

3. Indicate the ingredients you use for poultry feeding using the following table

Feed	Specific name of the feed	State briefly form of consumption at different age level					Sources of the feeds		
		Chicks	Growers	Layers	Cockerel	Broilers	Purchased	from house	Others
Grains									
Vegetables									
Oil seeds									
Concentrate									
Minerals									
Vitamins									
Others by-products									

4. If you provide concentrates/industrial by-products, where do you buy these feeds?
   (a) Factories (b) Retailers (c) Commercial farms (d) Feed mills (e)Other(Specify)
5. If your answer to question 2 is yes, when do you usually offer the supplement?
   (a) In the morning before they go out for scavenging
   (b) In the evening after scavenging (c) In the afternoon while scavenging
   (d) Any time during day times (e) Others, specify----------
6. If your answer to question 1 is yes, how frequent do you feed your birds daily?
   In the morning: (a) None (b) Once (c) Twice (d) Three times or more
   In the afternoon: (a) None (b) Once (c) Twice (d) Three times or more
   In the evening: (a) None (b) Once (c) Twice (d) Three times or more
7. If your answer to question 1 and 5 are yes how do you feed your birds?
   (a) In a feeder (b) on the bare ground (c) Others, specify----------
8. How do you give the extra feeds?
   (a) Separate to different classes (b) Together for the whole groups (for group feeding)
9. What is the basis of your giving supplements?
(a) Egg yield (b) Meat yield (c) Broodiness (during incubation)
   (d) Age (e) Other, specify
10. Indicate seasonal extra feeding of your chicken using the following table. (At which season(s) do you offer more extra feed to your birds?) (Use asterisks)

Class	Short-rainy (Feb-March)	Short-dry (Apr-May)	Long-rainy(June-Sep)	Long-dry(Oct-Jan)
Layer				
Pullets				
Cocks				
Chicks				

11. Indicate priority of supplementation (Management and care) of the different classes (Rank 1 to 4) using the following table

Class	Short-rainy (Feb-March)	Short-dry (Apr-May)	Long-rainy (June-Sep)	Long-dry (Oct-Jan)
Layer				
Pullets				
Cocks				
Chicks				

12. If your answer to question 2 is no what is the reason?

(a) Lack of awareness about feed (b) Unavailability of feed and feed ingredients

(c) High cost of feed and feed ingredients (d) Shortage of time

(e) Lack or shortage of financial resource (f) others, specify-----

13. Do your birds scavenge? Yes---------- No----------

14. Do you give water to your birds? Yes No (why)----------

15. If you give water for the chickens, where do you get the water from?

(a) Rain water (b) River (c) Tap water (d) .Other, specify---------

16.If you give water for the chickens, what type of container do you use to supply water?------

17. If you give water for the chickens, how frequent do you wash the container?(per week) ---

18. If you give water for your chickens, how frequent do you provide?

(a) Every other day (b) Once/day (C) Twice/day (d)Adlib

III. Culling

1. Do you purposely cull your birds at any time? Yes No

2. For what purpose do you cull the poultry?

(a) Consumption (b) For sale (c) For sacrifice (d) other specify

3. What factors determine which bird you will cull?

(a) Poor productivity (b) Sickness (c) Lack of broodiness (d) Old age

(e) Frequent broodiness (f) Other, specify------

4. If you culled old age birds, at what age of the bird do you decide to cull it? ----

5. If you culled poor productive birds, what is their level of productivity?

a) number of eggs/clutch b) number of clutch/year c) Number of eggs/year

IV. Productivity

1. State the productivity of your birds in the following table

Chicken types	Age at sexual maturity (month)		No. of times the hen hatches per year	Average No of eggs per clutch	Average No of days per clutch	Average No of eggs per set No of chicks Hatched per set	No. of chicks Surviving to adult hood
	Hen (age at 1st egg)	Cock (age at 1st mate)					
Layers (egg types)							
Broilers (meat types)							
Dual type (egg & meat types)							

2. What is market and/or slaughter age of cock (male)? ----------

3. What is market and/or slaughter age of cock (female)? ----------

4. Current flock size? ----------

5. Frequency of egg consumption at household level? ----------

6. Frequency of poultry meat consumption at household level? ----------

8. Mortality of adult birds including predation? a) High b) low

9. Flock size/ household ----------

10. Egg characteristics

10.1 Dominant color of the shell

(a) White (b) Pale white (c) Pale (d) Pale brown (e) Dark brown (f) Others,

10.2 Dominant size of egg 1) small 2) medium 3) big

10.3 Dominant yolk color 1) light yellow 2)yellow 3) deep yellow

11. State the major potential threat/ Production constraints to chicken production and Productivity in order of economic importance

1st ------ 2nd ------ 3rd ------ 4th ------ 5th ------ 6th ------

12. What do you think about the trend of the clutch period as the age of the bird increases?

1. Increase 2. Decrease 3.No change

13. After which clutch period the hen is supposed to set eggs for hatching chicks-

V. Health and disease control

1. Do you experience serious disease outbreaks? Yes .No

2. If yes, describe the common diseases you have experienced in your flock--------

3. How do you recognize sick birds?----------

4. What do you do when birds are sick?

(a) Treat them myself (b) Call in veterinarian (c) Call in development agents

(d) Cull/kill them all immediately (e) Slaughter them all immediately for home Consumption (f) Sell them all immediately (g) Others. Specify ------

5. Do you control the free movement of chickens all the times? 1) Yes 2) No

6. If yes, would you mention the reason?

a) To protect from predators attack b) To avoid risk of contagious diseases

c) To protect from mixing with the village flock

d) To protect birds from picking and destroying crops/ vegetables

7. Do you control the free movement of chickens at a time of disease outbreak? Yes No

8. Do your chickens scavenge mixed with that of your neighbors? Yes No

9. What do you do with dead birds?----------

10. Describe the common diseases you have experienced in your flock using the following table.

Symptoms	Name of the diseases	Susceptible Poultry types (age)					Susceptible Poultry types (breeds)				Favorable seasons	Severity Death (age & breeds)	Resistance (age & breeds)
		Chicks	Growers	Layers	Cockerel	cocks	Local	RIR	WLH	Others			

D. Marketing

1. What is the current market price of eggs? ----------

2. Which of the followings is the major determinant of market price of egg in your locality? (Use 1st 2nd 3rd)

   i. Shell color ii. Size of egg iii. Yolk color

3. Is there variation of market price of eggs in your locality? Yes No

4 .If your answer is yes please write down the causes of variations in market price of eggs in terms of importance.

   1st ---------- 2nd---------- 3rd --------- 4th ------

5. Where do you sale your eggs? ----------

6. If you sale your eggs at local market how long do you transport to reach the market point? ---------- (m or km)

7. How do you transport the eggs? ----------

8. How long do you store your egg before sale? ---------- (days or weeks)

9. Where do you store market eggs? ----------

10. Who is your regular client (buyer) of eggs? ----------

    i. Village collectors/neighbors ii. Collector in the market iii. Sell to consumers iv. Others

11. Why do you sale eggs? 1st ------ 2nd ------- 3rd -------- 4th -------

12. Who is responsible for the sale of eggs within the family?

    1st ---------- 2nd ---------- 3rd ----------

13. What proportion of the eggs produced is sold? ----------

14. Do you purchase table eggs from market for home consumption? Yes No

15. If your answer to question 14 is yes do you test for quality before purchase? Yes No

16. if yes, how do you test it? ----------

17. State the average unit price of any of the following products that you sell

18. What is the current market price of adult male bird? ----------

Time of the year	Average (Birr/Item)												
	Male bird					Female bird							
	Small	Size	Medium	size	Large	size	Small	Size	Medium	size	Large	Chicks	Growers	Eggs
Christian festivals														
Muslim festivals														
New Year														
Traditional festival														
Year round														

19. What is the current market price of pullets? ----------

20. What is the current market price of laying hen? ----------

21. Is there variation of market price of live bird in your locality? Yes----- No--------

22. If your answer for question 21 is yes, which of the followings is the major determinant of market price of live chickens in your locality? (Use 1st 2nd 3rd)

    i. Feather color_____ (which color is the most preferable)----------
    ii. Comb type_____ (which type is the most preferable)----------
    iii. Shank color_____ (which color is the most preferable)----------
    iv. Body weight _____ (which weight is the most preferable)----------
    v. Sex _____ (which sex is the most preferable)----------

23. Where do you sale your chickens? ----------

24 If you sale your Live bird at local market how long do you transport to reach the market

point? ----------(m or km)

25. How do you transport live birds to market area? ----------

26. Who is your regular client (buyer) of live bird? ----------

i.Village collectors/neighbors ii. Collector in the market iii. Sell to consumers

27. Why do you sale live bird? ----------

1st ---- 2nd ------- 3rd -------- 4th ---------

28. Who is responsible for the sale of live bird within the family? ----------

1st ---------- 2nd ---------- 3rd ----------

29. Do you purchase live bird from market? Yes No

30. If your answer to question 29 is yes how do you select the bird to be purchased? ------

31. Write down the major problems of egg marketing in your locality in terms of

importance 1st ----- - 2nd ------- 3rd ------ 4th -------

32. Write down the major problems of live bird marketing in your locality in terms of

importance 1st ------ 2nd ------- 3rd ------ 4th ------

33. What are the problems relating to live poultry marketing in your experience?

i. Unstable bird price ii. Poor sales (demand seasonality) iii. Lack of market place

iv. Poor infrastructure (road, market) v. Lack of information vi. Others, specify------

34. What are the problems relating to egg marketing in your experience?

a) Unstable egg price b) Poor sales (demand seasonality) c) Lack of market place

d) Poor infrastructure (road, market) e) Lack of information f) Others, specify-------

35. How far the market place from the residence area? ---------- (m or km)

E. Extension contact and services

1. Have you ever discussed your poultry production & related problems with extension

agents? 1. Yes---------- 2.No----------

2. If yes how frequently do you contact the agent (days in a month) ----------

3. If no, state the reasons for not contacting the extension agent in terms of importance

(a) Have no idea about the extension in poultry (b) Could not easily reach them

(c) There is no need to contact the agent (d) Other, specify----------

4. Have you ever heard about improved poultry production practices?

1. Yes 2.No

5. If yes, what is your major source of information on improved poultry production practices?

(a)Extension agents (b) Relatives (c) Other farmers (d)Newspaper e) Market (f) Radio g)Neighbors (h) Television (i) Co-operative leader J)Other specify

G. Breed/Breeding

1. Number and breeds of Poultry

Class	Local	Exotic	Cross	Total number
Hens(Layers)				
Cocks				
Pullets				
Cockerels				
Chicks				
Total number				

2) Do you select chicken for breeding? Yes No

3) If yes, on which sex do you practice selection? Male Female Both

4) Selection criteria for breeding

Character	Selected		If yes, your preference(describe or choice are given)
Feather color	Yes	No	
Body weight	Yes	No	Heavy Medium Small
Egg production	Yes	No	
Broody behavior	Yes	No	1) Frequent brooder 2)slow brooder 3) not brooder at all
Mothering ability	Yes	No	1) Good ability of sitting during hatching 2) Good feeder of the chickens after hatching 3) Good hatching history 4)Good protector from predator/aggressive weaning the bird
Comb type	Yes	No	Single Double others, specify----------

Other(Specify)

5) Specific considerations during selections of hens for brooding/incubation

a) Select hens with larger body size b) Select hens with ample plumage feather cover

c) Select on the basis of previous hatching d) Broodiness e)Other criteria

6) Are you interested to have exotic chickens? Yes No

7) If you have the opportunity to buy exotic chickens, which breed do you like to have?

(a) WLH (b) RIR (c) Both (d) Other (Specify)

8) Why did you choose the above breed?

1st ____ 2nd ____ 3rd ___ 4th __

9) If you have exotic breeds of chickens describe them

Breed	Source	When was it given	How was it given
RIR	1)MOA 2) Research center 3)NGO(which) 4)Other	1) 1ast year 2) Two years go 3) Three years ago 4)>3years	1) As fertile egg 2) Pullet 3)Cockerel 4) cock 5) layer
WLH	1)MOA 2) Research center 3)NGO(which) 4)Other	1) 1ast year 2) Two years go 3) Three years ago 4)>3years	1) As fertile egg 2) Pullet 3)Cockerel 4) cock 5) layer
Others	1)MOA 2) Research center 3)NGO(which) 4)Other	1) 1ast year 2) Two years ago 3) Three years ago 4)>3 years	1) As fertile egg 2) Pullet 3)Cockerel 4) cock 5) layer

Breeds	**Characters**								
	Egg yield	Meat yield	Egg quality (Preference)	Meat quality (Preference)	Market price of live chicken	Other attributes (Specify)	Predator attacks	Theft	Hatchability of eggs
Local									
Exotic									
Cross breeds									

10) Would you compare the performance /merits of exotic versus local chickens?
Describe as (a) Higher (**), (b) Lower (*), (c) No difference (-)

11) Do you limit the number of males running with females? Yes No

12) If yes, would you mention the ratio of male: female you normally have in your farm? ----------Male to ---------- Female.

13) How many chicken can you afford to manage under your condition? -----

14. State the major factors limiting the number of chickens to be kept in order of importance (Why not more?)

1st ---- 2nd ----- 3rd ---- 4th ----- 5th ------- 6th ------

15) Productivity report/Reproductive characteristics using the following table

Breed	**Productivity**																	
	Approximate age of sexual maturity,	Approximate age of sexual maturity,	Approximate age for [illegible]	No of egg in [illegible]	No of clutch in a year	No of eggs per year	Weaning age of chickens	Length of productive life(Years),	Length of productive
Local									
Pure									
Cross									

16) How is the preference of local cock towards exotic hen, ex. White leghorn (Mention its name)? 1) Good 2) Normal 3) Poor compared to the local hens

17) Preference exotic cocks towards the local hens (compared to the exotic hens)

1) Good 2) Normal 3) Poor compared to the exotic hens

H Incubation, brooding and rearing

1. Incubation of eggs 1) broody hens 2) Artificial 3) Any other----------

2. Do you have your own breeding cock? Yes No

3. If your answer to question 2 is no, how do you mate (breed) your laying hens---

4. If your answer to question 2 is yes:

Indicate the age of sexual maturity for the use of cock for breeding purpose?-

How long do you use the cock for breeding purpose? ----------

How many layers do you assign /breeding cock? ----------

5. How many times do you incubate eggs per year? ----------

6. What do you use as egg setting material? ----------

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

c) Teff straw d) wheat straw e) other (Specify)_____

7. How long do you store eggs before incubation? ----------

8. Where do you store eggs before incubation? ----------

9. What do you use as hatching eggs storage materials? ----------

10. Do you select eggs at a time or before incubation? Yes No

11. If yes to question 10 state the criterion of selecting eggs for incubation

i. ------- ii. ------ iii. ----- iv. -----

12. Do you select any specific color of eggs for incubation? Yes No

13. If yes which color do you prefer? Brown White Others --------

14. Do you practice any special treatments of eggs before incubation? Yes No

15. If yes, how do you treat?

i. Wash with cold water ii. Wash with warm water iii. Test fertility
iv. Clean using cloths or other materials v. Other_____

16. Do you select size of hens for brooding? a) Yes b) No c) Do not consider the size since any hen that manifested broody behavior is allowed to bath

17. If yes, which one do you prefer? 1) Bigger 2) Medium size 3) Smaller

18. Do you select the mother hen incubating the eggs? Yes No

19. How many eggs do you incubate under a single hen at a time? ----------

20. How many normal chicks do you collect from a single incubation? ----------

21. State the major causes for failure of hatching in order of importance

1^{st} ----- 2^{nd} ---- 3^{rd}------- 4^{th}----

22. How do you manage broody hen at a time of incubation? ----------

23. Sources of eggs for incubation

i. Purchased from market ii. Purchased from neighbor

iii. Laid at home iv. Other

24. Do you incubate eggs purchased from market? Yes No

25. Do you test eggs for fertility? Yes No

26. If yes to question 25 how do you test? ----------

If yes to question 25 when do you test? ----------

A) Before incubation B) after incubation (at what days----------)

27. How do you position the eggs while incubating?

i. Pointed end downwards ii. Pointed end upwards

iii. Position on inside iv. Do not mind position

28. Where do you set/place the broody hens?

i. In dark and protected corner ii. In light and protected corner iii.Any where in the house

29. Practices to avoid broody behavior

a) Hanging the bird up side down b) Depriving of the birds from feed & water

c) Disturbing in the nest d) Moving to neighbors e) Others_____

30. How do you store eggs to improve their shelf lives?

a. In cold room b. Inside cold container c. Any place d. Other practices----------

31. When do you usually incubate eggs (indicate season of incubation)? ----------

32. Is there seasonal variability on hatchability? Yes No

33. If yes, at which season did you have the worst (lowest) hatchability? ----------

34. When do you achieve the best results (indicate season)? ----------

35. Do you use the mother hen in raising the chicks? Yes No

36. If yes how long the hen spends weaning the chicks (in weeks)? _____

37. What do you feed them? ----------

38. When the highest chick mortality does occur after hatching? During

a) The1st week b) The2nd week c) The 3rd week d) The4th week

e) The5th week f) The6th week g) The7th week h) The8th week

39. How many chicks survive to an age of 2 months? ----------

40. State the cause of the highest chick mortality in order of importance

(1st) ------- (2nd) ------- (3rd) ------ (4th)--------

41. How many chicks survive to an age of sexual maturity (5 months?)----------

42. State the cause of the highest adult bird mortality in order of importance

(1^{st}) ------ (2^{nd}) ------ (3^{rd}) ------- (4^{th})-----

43. Hatchability

Size of broody hen	**Eggs from Local hens**		**Eggs from RIR hens**		**Eggs from WLH hens**		**Eggs from crosses**	
	No.s set	No.s hatched	No.s set	No.s hatched	No.s set	No.s hatched	No.s set	No.s hatched
Small								
Medium								
Large								

Size determined by the farmers

44. What are your selection criteria of eggs before incubating?

Criterion	**Selected**	**Why?**	**Rejected**
Egg size	1) Big 2) Medium 3) Small		
Egg shape	1) oval 2) circular (Kib)		
Age of egg	1) 1 week 2) 2weeks 3) 3weeks		
Type of eggs	1)From local pullet 2) From mature local hen 3)From RIR pullets 4)From mature RIR hens 5) Other		

45. Placement of the eggs in the brooder hen

a) Eggs positions side ways b) Eggs positions pointed end down

c) Eggs positions blunt end down d) Do not mind about positioned eggs

46. How do you test and prepare eggs before incubation?

a) Visual examination through the sun light c) Eggs will be cleaned before incubation

b) Floating eggs in a bucketed filled with water d) Other (Specify)

I. Other General Issues

1. Do you intend to expand poultry production as a business? Yes No
2. If yes, indicate flock size of your interest ----------
3. What are your barriers to future expansion of poultry production?

   1st ------ 2nd ----- 3rd ----- 4th ----- 5th ----- 6th ----

4. What do you think the government should do to improve poultry keeping,

   Particularly in rural areas? ----------

II. Other information

1. Household Structure Household head Name ----------Sex----------Age ------

Age	Sex		Educational background						
	M	F	Did not attend school	Read & write	1-4	5-8	9-10	11-12	Above 12
Under 10									
10-14									
15-64									
Older than 64									
Total									

2. Types of farming a) Crop-Livestock b) Only livestock c) Only Crop
3. Measurement System a) Intensive (Confined) b) Semi intensive (Partially confined)
   c) Extensive (Kept outdoor & confined)
4. Purpose of keeping poultry

   a) Home consumption b) Sale c) religious d) Scarifies e) other

5. What is the role of the family in the production and sale of the chicken?

	Tasks								
	Owner of chickens	House construction	Feeding, watering	Cleaning	Slaughtering	Treating sick birds	Decision(selling, buying, gift)	Selling	Others
Men (husband)									
Women (wife)									
Boys									
Girls									

6. Poultry ownership

Class	Number	Ownership position		Sources			
		Owned	Shared	Hatched	Purchased	Gift	Other
Chicken<8 weeks							
Pullet,8-20 weeks							
Layers,>20 weeks							
Cockerels, (8-20 weeks)							
Cocks,>20 weeks							

7. Trend of livestock population (Since the last 2 years)

Species	Increasing	Stable	Decreasing	By how much	Reason
Cattle					
Sheep					
Goat					
Equines					
Poultry(local)					
Poultry(Exotic)					

8. Are there any institutions giving credit service to you? Yes No

9. If yes, what is the name of the institution? ----------

10. If yes, what is the objective of the institution?(for what purpose are giving?)

a) ---------- b) ---------- c) ------- ------- d) ----------

11. Are there any development/ research projects working in poultry in the area?

Yes---------- No----------

12. If yes Name of the Institution Types of service support

_____ _____

_____ _____

13. How much time do you spend each day on poultry keeping?

(a) Half of a day (b) quarter of a day (c) others specify ----------

14. Do you have any access to extension services? Yes No

15. If yes, in what aspects?

(a) Crop production (b) Dairy production (c) Sheep/goat production

(d) Poultry production (e) Others, specify---

16. If you are receiving extension services in what form?

(a) Advice only (b) Provision of improved breeds of chickens

(c) Provision of feed and veterinary service (d) Complete national poultry package

(e) Others, specify

17. What is your estimated annual income from the sale of poultry and poultry products? ------

18. For what purpose or how do you use the money from sell of poultry and poultry products

(a) Purchase of agricultural inputs (b) Payment of school fee for children

(c) To cover household expense (d) To cover medical expense

(e) Others, specify