IN SITU CHARACTERIZATION OF LOCAL CHICKEN ECO-TYPE FOR FUNCTIONAL TRAITS AND PRODUCTION SYSTEM IN FOGERA WOREDA, AMHARA RGIONAL STATE

BOGALE KIBRET

April 2008

Haramaya University

IN SITU CHARACTERIZATION OF LOCAL CHICKEN ECO-TYPE FOR FUNCTIONAL TRAITS AND PRODUCTION SYSTEM IN FOGERA WOREDA , AMHARA RGIONAL STATE

A Thesis Submitted to the Department of Animal Science School of Graduate Studies
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By

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As thesis research advisor, I here by certify that I have read and evaluated this thesis prepared, under my guidance, by Bogale Kibret, entitled In situ Characterization of Local chicken Eco-type for Functional traits and Production system in Fogera woreda. I recommend that it be submitted as fulfilling the thesis requirement.

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As member of the Board of examiners of the MSc thesis open defiance examination, we certify that we have read, evaluated the thesis prepared by Bogale Kibret, and examined the candidate. We recommend that the thesis be accepted as fulfilling the thesis requirement for the Degree of Master of Science in Agriculture (Animal genetics and breeding)

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DEDICATION

This piece of work is dedicated to my mother the late W/ro Mintwab Yismaw (1950-2000)

STATEMENT OF AUTHOR

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BIOGRAPHICAL SKETCH

The author, Bogale Kibret was born in September 1967 in Sholite Peasant Association (PA) of Dembecha Woreda, West Gojjam Zone. He attended his elementary education in Dembecha Elementary School from 1977 to 1982 and junior high education in Dembecha Junior Secondary School from 1983 to 1984. He attended his senior secondary in two towns, Dembecha High School and Damote Senior Secondary School in Finote Selam town from 1986 to 1989.

He then joined the Alemya Universty of Agriculture (Now Haramya University) in 1990 and was awarded a BSc Degree in Animal Science. After his graduation, he was employed by the Ministry of Agriculture and served as Animal Production Expert, Animal & Fishery Resource Team Leader, Head of Woreda Agriculture and Rural Development Office (WAO) in kembata, Alaba, and tembera, East and west Gojjam Administrative Zones. He then joined the Graduate School of the Haramaya University for a Master of Science degree in Agriculture majoring in Animal Genetics and breeding in September 2005.

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LIST OF ABBREVIATIONS

AACMC:	Australian Agricultural Consulting and Management Company.
ANRS:	Amhara National Regional State.
BL:	Body Length
CL:	Comb Height
EL:	Ear Length
FAO:	Food and Agriculture Organization of the United Nations.
HB:	Height at Back
HC:	Height at Comp
HH:	Household
ILCA:	International Live Stock Research Center for Africa.
IPMS:	Improving Productivity and Market Success.
Ne :	Effective population size.
PA :	Pesant Associations.
SFR:	Source of Food Resource
SL:	Shank Length
SPL:	Spur Length
SPSS:	Statistical Package for Social Science
WADU:	Wolaita Agricultural Development Unit
WL:	Wattle Length
WS:	Wing Span
WT:	Weight

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ABSTRACT

A study on characterization of local chicken eco-type for functional traits and production system was conducted at Fogera woreda of the Amhara National Regional state. Fogera woreda is one of the eight woredas bordering Lake Tana and it is predominantly classified as woinadega ecology while the annual temperature ranges form 22ºC to 29ºC. The survey report based on 72 household having chickens revealed that the flock size rage from 1 to 39. The nutritional management practices in the study area were of scavenging (main practice) and supplementary feeding. Wells and tap were the major sources of water. Most of the respondents (59.7%) used separate houses constructed exclusively for poultry. The flock management was without separation of sex or age groups and mating was random and non-seasonal. The prices of live chickens were affected by plumage color, comb type and seasonal demands (holidays and fasting seasons). Disease and shortage of supplementary feeds were the two major production barriers of expanding poultry production. Out of the 100 birds studied, the following plumage color pattern was observed in their respective proportions: complete white (Netch) (23%), complete black (Tikure) (7%), complete red (key) (39%), white with black or red tips (Netch Teterma) (4%), grayish mixture (Gebsima) (5%), red with white trips (key teterma) (2%), black with white tips (Tikure teterma) (2%) white with Brest part golden color (Libework) (8%), multi color (Anbsema) (2%), white with red strips (seran) (4%), and red brownish (Kokima) (4%). In term of body shape, most of the chicken population observed had a body shape of wedge and a crest (Gutya) head profile.

Almost all of the male chicken had spur, while only half of the female chicken had spur. No shank feather was observed both in Male and Female chicken. For mature hens and cocks, the average shank length was 7.25 cm and 9.32 cm, respectively. The average body length was 17.75 cm and 21 cm for female and male, respectively. The ratio of cock to hen was found to be 1:3.21. On the other hand, the effective population size (Ne) and rate of change in inbreeding coefficient (△F) per year were 3.9 and 1.95, respectively. The monitoring data revealed that average number of eggs laid per clutch per hen was 13.19, while the average number of eggs incubated was 12.97, average number of chicks hatched was 10.23, the average number of chicks weaned was 7.63, the average of hen's age was 19.20 months and average weight of hens was 1.21 kg. The performance of egg production characters egg weight, yolk color, yolk weight albumin weight, shell weight and shell thickness were, 44.89m, 9.06, 16.28 gm, 22.13 gm, 5.52 gm, and 0.45 cm, respectively. On the other hand, the dressing percentage was found to be 58.5% for male and 49.38% for Female. All these findings indicated that the local eco-type, despite the relatively high temperature (it goes up to 30ºC) and the swampy (wet land) Fogera plain have good potential for egg and meat production. Thus they could be used in other places with similar weather and environmental conditions.

1. INTRODUCTION

Population growth, urbanization and rising income in many parts of the developing world have caused a growing demand for food of animal origin. Poultry meat and egg production account for more than 28% of the total animal protein produced in world in 1997. The proportional contribution of poultry by the year 2020 is believed to increase to 40%, the major increase being in the developing world (Delgado *et al.*, 1999). According to Klober *et al.* (1991) chickens, ducks and turkey are the most common of all farm stock throughout Africa, Asia and Latin America. He further noted that in most tropical countries every family-settled or nomadic-owns some kind of poultry.

In Ethiopia, the word poultry is synonymous with domestic chicken (*Gallus domesticus*) because other types of poultry are almost unknown as sources of egg and meat (Alemu, 1995). Their size bestows micro-livestock advantages including low capital, low feed requirement, and little or no labor requirement. Further more, they are "family sized,' easily killed and dressed with little or no spoilage. These poultry species help meet the protein needs of the poorest people in the world (klober, 1991). According to Kitaly (1996) village chicken products are often the only source of animal protein for resource poor households.

Many researchers have indicated that poultry are a renewable resource, easy to prepare, and are among the best source of quality protein, many vitamins and some minerals. In spite of their numbers and potentials, Sonaiya (1990) pointed out that poultry rarely accorded primary consideration in economic development activities; most countries have little knowledge of the contribution household birds actually make to the well being and diets of their peoples. In most countries even those where birds are widely kept, there is little or no research or extension. Tadelle (1996) stated that the bulk of the research effort is being focused on intensive poultry production (with modern housing, and sophisticated feeding system), while the great majority of poultry production in Ethiopia is based on extensive rural production systems. As a result, Tadelle (1996) argues that the results of

current research endeavors are often not applicable to the most common poultry production system in the country.

Most of the poultry improvement programs in developing countries have been directed towards the introduction of specialized or exotic breeds, cross breeding, and management intensification. While there have been measurable improvements in egg and poultry production in the satellite layer and broiler production units, the high mortality of the introduced breeds, low feed resource base at the village level and lack of understanding of the complex biological, cultural and socio-economic relationships have limited the success of most of these programs.

Surveys in developing countries have shown that farmers have preferred to maintain local stock i.e. the village chicken for social (e.g. wedding, religious holidays…) and economic reasons (e.g. income generation, job opportunities…) (Kitalyi, 1996). Most of the eggs and meat come from village chicken production systems with indigenous chickens. These indigenous chickens have existed for centuries as scavengers or reared in backyard in rural conditions (Parabakaran *et al.*, 2003) and they produce more than 50% of poultry meat and egg of the tropical countries (Daghir, 2001).

The over all chicken population of Ethiopia is estimated to be 55 million heads (FAO, 2000). On the other hand, the chicken population of the study area: Fogera Woreda is estimated at 246,496 (0.4%of the country's chicken population) (IPMS, 2005). Traditional chicken rearing is practiced by virtually every family in rural Ethiopia, indicating that chickens are affordable sources of animal protein (Solomon, 2003). Rural poultry production in Ethiopia represents a significant part of the national economy in general and the rural economy in particular. It contributes 98.5% and 99.2% of the national egg and poultry meat production respectively (AACMC,1984), with an annual output of 72,300 metric tons of meat and 78,000 metric tons of egg (ILCA,1993).

Despite the importance of the poultry production in the economic and socio-cultural conditions of the country, very little attempt has been made to describe the indigenous birds in Ethiopia. As a result, the local chicken eco-type are known by their color but not by their breed type because of lack of a clear phenotypic or genetic evidence. The systematic characterization and documentation of livestock biodiversity in Ethiopia is now being carried out but restricted mostly to the breeds of cattle, sheep and goat in that priority. Even though there are many ecotypes none of them is described on physical, physiological and functional bases.

Among the many prerequisites essential to frame sound poultry breeding strategy, the knowledge of prevailing agro-ecological conditions, existing poultry genetic resources, and the current poultry production systems, availability of feed and feeding, health status of poultry and market demand are important. Thus the objectives of this research work were:

- characterizing physical, functional, and adaptive traits of local ecotypes and their production system
- describing economic and social functions of these traits in their natural habitat

2. LITERATURE REVIEW

2.1. Characterization

2.1.1. Phenotypic Traits of Local Birds

Alemu and Tadelle (1997) indicated that local poultry in Ethiopia vary widely in body size, conformation, plumage color and other characteristics. Based on their color, the local chicken ecotype is known by such names as: *Tukor*, *Melata*, *Kei*, *Gebsima* and *Netch*. Besides color, people use such factors as body part, type of feathering and other phenotypic characters while naming local chicken eco-types.

2.1.2. Functional Traits

As ecotypes are not identified based on their phenotypic or functional characters using the 1999 FAO recommendation, Alemu and Tadelle (1997) argue that it is not tangible enough to show the relative effects of genetic and non-genetic factors on the performance of the local stocks in Ethiopia and design appropriate breeding strategies.

Indigenous village bird in Ethiopia lays about 36 eggs per year in three clutches of 12 to 13 eggs in about 16 days. If the hen incubates her eggs for three weeks and then rears the chicks for twelve weeks, then each reproductive cycle lasts for 17 weeks. Three cycles then make one year. Thus they are very efficient, productive and have essential traits for survival (FAO, 2004). Tables: 1 and 2 below provide reproductive performances of some chicken ecotypes of Ethiopia.

Smith (1990) reported that local male may reach 1.5 kg of live weight at 6 months of age and females about 30 % less. Teketel (1986) also found that under station condition, local birds reach 61% and 85% of white Leghorn body weight at 6 months of age and at maturity,

respectively. Abebe (1992) reported that local birds in Eastern Ethiopia attain 559g at 6 months of age, which was significantly lower than that of the white Leghorn that attains 875g at the same age (Teketel, 1986).

Table 1. Egg production traits of five Ethiopian genotypes of chickens

Traits	*Tukur*	*Melata*	*Kei*	*Gebsima*	*Netch*
24 wk body wt (gm)	960	1000	940	950	1180
Age 1st egg (d)	173	204	166	230	217
Mature body weight (kg.)					
Male	1.3	1.7	1.6	1.5	1.4
Female	1.0	1.2	1.2	1.1	1.1
Feed in take bird/year (kg)	50.9	53.2	37	36.4	39.1
Egg/bird/ year	64	82	54	58	64
Egg weight /gram/	44	49	45	44	47
Egg mass kg/ bird/ year	2.8	4	2.4	2.6	3
Egg shape index	75.4	69.3	70.3		69.0
Shell thickness/mm	0.374	0.311	0.383	-	0.317
Albumen % of egg	50	49	51	49	49
Yolk % egg	36	38	38	36	36
Fertility %	56	60	57	53	56
Hatchability %	42	41.8	44.3	39.3	39

Source: Alemu and Tadelle (1997)

2.2. Production System

Village chicken production systems are characterized by their low input- low output levels. A range of factors such as sub-optimal management, lack of supplementary feed, low genetic potential and high mortality rate are causes of the apparent low out put level. However, village chickens play important role in supplying high quality protein to balance the family

food supply, and provide small disposable cash income in addition to the socio-religious functions that are important in the rural people's lives (Tadelle, *et al.,* 2003b).

2.2.1. Village chicken production system

Family production is an appropriate system that makes the best use of locally available resources (Tadelle, 1996; Sonaiya *et al.,* 1998). It is important in low income and food deficit countries as it provides a good source of high quality protein for the rapidly growing human population and additional income to resource poor small scale farmers, especially women (Gueye, 2002). As an example, family poultry represents about 94% of the total poultry in Bangladesh (Sonaiya *et al.* 1998). In Ethiopia, of the total national egg and poultry meat production 98.5% and 99.2%, respectively are contributed by local birds (AACMC, 1984).

2.2.1.1. Flock composition and size

A study conducted by Tadelle *et al. (*2003a) in five agro-ecological regions of Ethiopia revealed that indigenous chickens are the predominant poultry species in the study villages. Rural farm households in Ethiopia do not keep other domesticated birds (such as turkey, guinea fowl, ducks or geese). The same study indicated that the mean number of breeding females per households was 5.4 $\pm$ 2; and the over all male to female ratio of the village flocks was: 1:2.5. The number of male birds in each household was more than required for breeding purpose. Having more male birds that required for breeding is a result of a preference for special colors and other features for cultural purpose and for sale in the forthcoming religious and traditional holidays to make advantage of the highest premium market price during such occasions. In another study conducted by Tadelle (1996) on village poultry production in the central highlands of Ethiopia, the typical number of birds per house hold in three study villages during 1980's was 10-15 but has decreased to: 4-10 birds per house hold. The male to female ratio of the flock was 1:3 to 1:4 (in most cases), although some families keep additional double combed male birds with special colors for cultural purposes.

Sonaiya (1990) reported that family flocks are usually integrated with crops, fishes and other livestock species such as chicken/cattle, chicken/guinea fowl, chicken/duck, chicken/turkey, duck/rice/fish, duck/pig etc. Under the extensive system, production cycles are continuous with poultry, unsorted sex, at different stages present in the flock at any given time. Flock composition is heavily skewed to wards chicken in Africa and towards ducks in Asia and Latin America. Household flock size ranges from 3 to 97 in Africa, 10-31 in South America and 50-2000 in Asia (Sonaiya *et al*., 1998). In Ethiopia the flock are small in number (an average of 7-10 mature birds) in each household consisting of 2 to 4 adult hens, a male bird and a number of growers of various age (Tadelle,1996). AACMC (1984) reported an average of six indigenous birds per household.

2.2.1.2. Ownership pattern and gender role

In rural Sub-Saharan Africa, more than 70% of chicken owners are women (Gueye, 1998). They look after the birds as earnings from sale of eggs and chicken are often a significant source of their cash income.

A study in Rushinga district of Zimbabwe shows that women dominated most of the activities around chicken production (Mapiye and S Sibanda, 2005). The women dominated in feeding (37.7 % of house hold), watering (51.2%) and cleaning (37.2%). Men dominated in the shelter construction (60%) and treatment of chicken (40.5%). In the study conducted in five agro-ecological zones of Ethiopia, Tadelle (2003 a), reported that women have better knowledge about poultry and poultry production than their man counter part. Flocks are mainly managed by women. Hence, helping women to boost rural production increases equitable distribution of food in the house hold.

2.2.1.3. Feeding and feed resources

Poultry production in tropical countries is based on the traditional scavenging system and characterized by low out put per bird (Aichi, 1998). In a study conducted by Mapiye and Sibanda (2005) in Rushinga district of Zimbabwe, about 6.2% of the households practice zero

supplementation; 96.6% partial supplementation; and 0.2% always provides supplementary feed to their chickens.

According to Tadelle (1996), in village chicken production systems, the major proportion of the feed is obtained through scavenging. Birds are usually kept in free range system, which means that they are allowed to roam more or less freely. The main scavenging chicken feed resource base was thought to be insects, worms, seeds, plant materials, *etc* with very small amount of grain and table left over supplements from the house hold.

Sonaiya *et al*. (1998) mentioned that there are three distinguishable systems for managing family poultry namely the extensive system, free range and back yard, and the small scale intensive system. In the free range and in back yard system, a bird can certainly not find all nutrients it needs for optimal production all the year round. During the dry season, poultry can quickly develop vitamin deficiency because of the scarcity of succulent vegetables on the range. There is thus a need to supplement their scavenging chickens with sources of minerals and vitamins. Most of the materials available for scavenging are not concentrating enough in terms of energy because they contain a lot of crude fiber. There is a need to supplement scavenging poultry with energy sources. That is why grains are given to poultry in the traditional village system. Making well balanced feed is uncommon if not possible for small holder farmer in the semi-intensive system. The feed situation for birds in this sub system is therefore usually poorer than for birds in the extensive or fully scavenging system. Small holders using extensive system adopt cafeteria choice of feeding of nutrients. Energy supplements such as maize, sorghum and millet are offered early in the morning and late in the evening. Birds scavenge during the day mostly for protein (insect, worm larvae, etc), minerals (stone, grits, shell) and vitamins (leafy greens, pepper, oil palm nuts) in between these meals. It has been estimated that 35g grain supplement per hen per day is given to local chicken in the free range system in south western Nigeria (Obi and Sonaiya, 1995). Insects and their larvae are identified as protein sources for scavenging poultry.

Atech and Oblogbenla (1993) reported that maggots could make up three percent of the diets of chicken with out compromising performance. In general, well fed chickens have high growth rates and are very fertile and less prone to disease and parasites. These results indicate that feeds and feeding systems are a potential for intervention since the majority of the farmers practiced supplementary feeding with locally produced feeds (Mapiye and Sibanda, 2005). Feed efficiency of local hens was also very low. About 20 kg of poultry feed was needed to produce 1kg of egg (Alemu and Tadelle, 1997). The scavenging feed resource should cover at least to their maintenance need plus the first 40 to 50 eggs, and is a system that makes the best use of source of food resource (SFR), which other wise be wasted (Tadelle, 2003a).

2.2.1.4. Housing

Usually, there is no special housing provided for birds in rural villages of Ethiopia. In most cases (88.5 %) they roost in side the family dwelling at night, the roost being made of two or three raised planks of wood placed in parallel. A few households (11.5%) have constructed a small enclosure outside the house, and the poultry night shelter is occasionally cleaned by the house wife, depending on her work load (Taddelle,1996). Mapiye and Sibanda (2005) reported that in Rushinga district of Zimbabwe all farmers provide housing to their chicken. Brick and litter types were the most popular houses because farmers felt that they provide more warmth and security from both thieves and predators than other type of housing. Proper housing must not only provide an environment that moderates environmental impact but must provide adequate ventilation for birds to lay eggs in nest boxes, as well as to feed and sleep in comfort and security (Kaite, 1990). Lack of adequate housing can partly explain chicken mortalities and thus good housing is a prerequisite for any viable and sustainable chicken project.

2.2.1.5. Health and mortality

The mortality from hatching to maturity was higher for White Leg Horn than for local chickens kept under scavenging condition with or without supplementation. The superior health status and rate of survival of local chickens compared to White Leg Horn chickens,

shows that local chickens are well adapted to the local environment and considered to be disease resistant (Solomon, 2003).

Local chickens kept under intensive management were inferior to White Leghorn chickens kept under similar conditions in health status and rate of survival. Lack of interest in their environment, wing droppings, huddling at the corners, signs of leg weakness, and cannibalism were frequently seen among local chickens kept under intensive management. Local chickens kept in captivity (managed intensively), were also slow in rate of feathering, and exhibited recurrent out breaks of disease which tended to spread to the others (Solomon, 2005). Higher mortalities and morbidities among local compared to White Leg Horn chickens kept under intensive management condition have also been reported in different parts of Ethiopia: Awassa, Debre Zeit, Arsi and Alemaya (Solomon, 2003). The reason for high mortality of local chickens under intensive management could be due to the fact that they are not used to confinement. Probably diseases which are common under confinement such as coccidiosis, chronic respiratory disease marks disease and *Salmonella pullorum* and nutritional deficiencies could cause more serious problems in local than in exotics stock (Solomon, 2003).

The problem of disease in village chickens is compounded by the interaction of different entities that are of significant importance to disease epidemiology. At village level, contacts between flocks of different households, exchange of birds as gifts or even entrusting sales and purchase are the main sources of infection transmission (Aichi, 1998; Tadelle *et al*., 2003a; Mapiye and Sibanda, 2005). According to Sonaiya (1990), the losses attributable to morbidity are not known, but it has been estimated that more than 750 million chicks, guineakeets, and ducklings in Africa die each year as a result of various infection. Similarly, Cumming (1992), and Tadelle and Ogle (2001) reported that chick mortality represents a major loss in village chicken production system. Reports from different countries show that 53% to 69% of chicks die between hatching and the end of brooding. Kingston (1980) and Kingston and Cress well (1982) in Indonesia, Roberts (1992) in Srilanka, Mathewman (1977) in Nigeria, Tadelle and Ogle (2001) in Ethiopia, reported mortality rates of chicks as big as 60 and 69 percent. Similarly, Tadelle *et al.,* (2003b) reported chick mortality rate of 49% in the first two months

after hatching with expected increase when disease outbreaks in the area. Various authors attribute these losses to different causes. For example, Robert (1992) reported that in Indonesia losses were due to a combination of poor nutrition, predators and various diseases factors and although predators were blamed for the majority of losses, other biological and environmental factors made significant contribution. The low input as regards health care may have contributed to the observed high mortality, which occurred mainly during the dry season (Mwalusanya, *et al.*, 2002). Mapiye and Sibanda (2005) reported that in Rushing a district of Zimbabwe predation and disease attribute to 40.5 and 30.2 percent of the total death respectively. Sonaiya (1990) and Aichi (1998) in Africa, Aini (1990) in Asia, Sonaiya *et al*., (1998) in sub-Saharan Africa, Mallia (1999) in America, Mwalusanya *et al.* (2002) and Tadelle (2003b) in Ethiopia reported that among the diseases of village chicken, New Castle disease was ranked as the most important.

2.3. Productivity

Poultry, in one form or another, does make a considerable contribution to improve income and satisfy the animal protein needs of rural family. Scavenging chickens are particularly appropriate because they do not compete for their food stuffs with humans. According to Prabakaran (2003), in specific areas of India, popular local breeds are reared as well as the cross breeds derived from them.

2.3.1. Egg production

In Ethiopia, a hen lays about 36 eggs in three clutches of 16 days and 12 to 13 eggs per each clutch. If the hen incubates her eggs for three weeks and then rears the chicks for twelve weeks, then each reproductive cycle lasts 17 weeks which means that three cycles lasting one year (FAO, 2004).

The average annual egg production of the native chicken was 30-60 egg under village condition and that this could be improved to 80-100 eggs on station. The other study at the Assela Livestock Farm revealed that the average egg production of local birds around Arsi

was 34 eggs /hen/year, with an average egg weight of 38 gm that is total yearly egg mass of 1.3 kgs. Local birds had high mortality when kept in confinement at the live stock farm. Testing the response of the indigenous chicken under good housing, feeding and management at the Jimma University, it was found that there was an increase in the productive performance of the chicken with improvement in environment and management but not to an economically acceptable level. Compared with the production potential under improved management condition of local strains from southern Ethiopia with White Leghorns the comparison in egg production characteristics showed that the local eco-types had poorer rate of egg production (18 versus 26%) but had the capacity of sustained egg production at times of increased environmental temperatures. In a similar study at Alemaya on local chicken from eastern Ethiopia it was found that both hen-day and hen-housed egg production in local stock was about 70% of that achieved by White Leghorn stock (cited in Alemu and Tadelle, 1997)

The average weight of eggs from local birds was found to be about 40 to 46 gram. Predictably, in view of their lower rate of productive performances local stocks produce eggs with thicker shells than leg horns, while fertility of eggs from local stocks was found to be higher than that from Leghorns, and the studies concluded that even under improved management, local stocks with their current genotypes could not compete successfully with White Leghorns (Alemu and Tadelle, 1997).

The production performance of local breeds is relatively poor. They barely produce 40-60 brown shelled eggs in two cycles from which about 10-15 chicks are hatched and the rest of the eggs are sold or consumed as table eggs. The native hens still exhibit signs of broodiness and sit on their eggs for hatching. Egg production ceases during that period. Sonaiya (1998) reported that there are three production systems for family poultry-free range, backyard and small scale intensive with productivity of 20-60, 30-100 and 80-150 eggs/hen/year, respectively.

Tadelle *et al.* (2003a) reported that a breeding female chicken can attain sexual maturity at the age of 6.8 months and the over all mean egg laying performances of hens for the first, second and third higher clutches were 17.0, 20.9 and 24.8 eggs respectively. In the same study the

hen performance history revealed that the mean flock egg number/clutch/bird, clutch number /bird/year and egg number /bird/ year were 17.7 $\pm$ 0.25, 2.6 $\pm$ 0.06 and 46.4 $\pm$ 0.86, respectively. It was noted that the productivity was related to agricultural calendar and age of birds. A laying hen needs about 120-130 days to accomplish one production cycle that is 40 - 50 days of laying, 21 days of incubation and 60 days of brooding chicks. The time taken by the laying hen to incubate eggs and brood chicks that may eventually die represents a considerable loss of eggs that would have been consumed or sold.

Studies on some of the indigenous birds have shown that their potential for egg production is very low. As an example, a study at the college of Agriculture, Alemaya, has indicated that the average annual egg production of native chicken was 40 eggs under farmer's management, but under experimental conditions with improved feeding housing and health care, the level of production was elevated to 99 eggs per hen per year (Bigbee, 1965).

In a study at Soddo, by the Wolaita Agricultural Development Unit (WADU) by Kidane (1980), it was reported that the egg production of indigenous birds was 84 eggs /bird/ year. According to the study by the Ministry of Agriculture (1980), average annual egg production of the native chicken is 30 to 40 eggs under village conditions and that this could be increased to 80 eggs when birds are provided with an improved feeding, housing and health care.

A study at the Assela Live Stock Farm revealed that the average production of local birds in Arsi was 34 eggs/ hen/ year with an average egg weight of 38gm under scavenging condition (Brannag and Pearson 1990). Similarly the average egg weight of local birds was found to be about 40g (AACMC, 1984; Abebe, 1992; Tadelle, 1996), but 46gm was also reported by Teketel (1986).

2.3.2. Meat production

The meat production ability of local stocks is limited. Local males may reach 1.5 kg live weight at 6 months of age and females about 30% less. The carcass weight of local stocks at 6 month of age was 550 gram which was significantly lower than that of Whit Leg Horn (875

gm). However, local stock has a higher dressing percentage (Alemu and Tadelle, 1997). Solomon (2003) showed that there was no difference between White Leghorn and local chickens raised under scavenging condition in mean daily body weight gain at 2 months.

According to Tadelle (1996), local chickens are sold from 6-8 months of age for meat purpose when they weigh around 700-1400g. The average age at start of lay was 195 ± 28 days, with a range of 183-245 days. Mean body weight at the start of lay was 1035 ± 34g ranging from 985 to 1113g. Body weights of 1.2 kg and 800g are obtained at 32 weeks for normal size and dwarf breeds of local chicken in free range system.

2.3. 3. Meat and egg utilization

Poultry products have social and spiritual benefits and play important role in rural economies. In many customs of indigenous people, poultry is used for ceremonies, sacrifices, gifts and as savings in the village. Chickens are given or received to show or to accept good relationship or to say thanks for a favor or help (Sonaiya *et al*., 1998). Besides, poultry can serve as a unit of exchange in societies where, there is no circulation of money (Gueye, 1998). For example, in Gambia five adult hens can be bartered for one sheep and 25 hens for one head of cattle. Under normal conditions, birds are sold when the household is in need of money. The income from the sale of chickens is an additional revenue to earnings from cash crops from the field (Sonaiya *et al*., 1998).

Tadelle's study (1996) in the central highlands of Ethiopia revealed that the main objective of keeping poultry is for the production of egg for hatching (51.8%), sale (22.6%), and home consumption (20.2%) and production of birds for sale (26.6%), sacrifice for healing ceremonies (25%), replacement (20.3%) and home consumption (19.5%). In some cases, farmers give live birds (8.6%) and eggs (5.4%) as gifts and invite especial guests to partake of the popular dish "doro watt" which contains both chicken meat and egg and is considered to be one of the most exclusive national dishes.

The sale of birds and eggs take place in the villages market. Prices fluctuate during the year-being low during the hungry season when the granaries are empty, and the crops are still growing and everybody needs ready cash. At such times, traders come to buy and to resell in big cities. Sometimes middle men are involved. Poultry products contribute about 15% of the annual financial income of the household (Sonaiya *et al.,* 1998). Similarly, Tadelle (1996) indicated that farmers sell live birds and eggs, particularly during holidays and festivals; they also sell at the on set of local disease outbreak to prevent expected financial loss. In such circumstances prices fall dramatically due to the high supply of bird's relative to demand. In another study conducted in five agro-ecological zones of Ethiopia by Tadelle (2003b), live birds and eggs are usually sold in local market, to civil servants and occasionally to middle men for retail in the larger towns and cities of the market shed

3. MATERIALS AND METHODS

3.1. Description of the Study Area

This section describes the geographical location, climate, vegetation and human and livestock demography of the study area-Fogera Woreda. The information was obtained mainly from the Agricultural and Rural Development Office of the Fogera Woreda.

3.1.1. Location

The study was conducted in Fogera Woreda of the Amhara National Regional State (ANRS). Fogera Woreda is one of the eight Woredas bordering Lake Tana. It is situated at $11^0$58"N latitude and $37^0$41"E longitudes. Woreta, capital of the Fogera Woreda is found 625 kms from Addis Ababa and 55kms from the regional capital, Bahir Dar (IPMS, 2005)

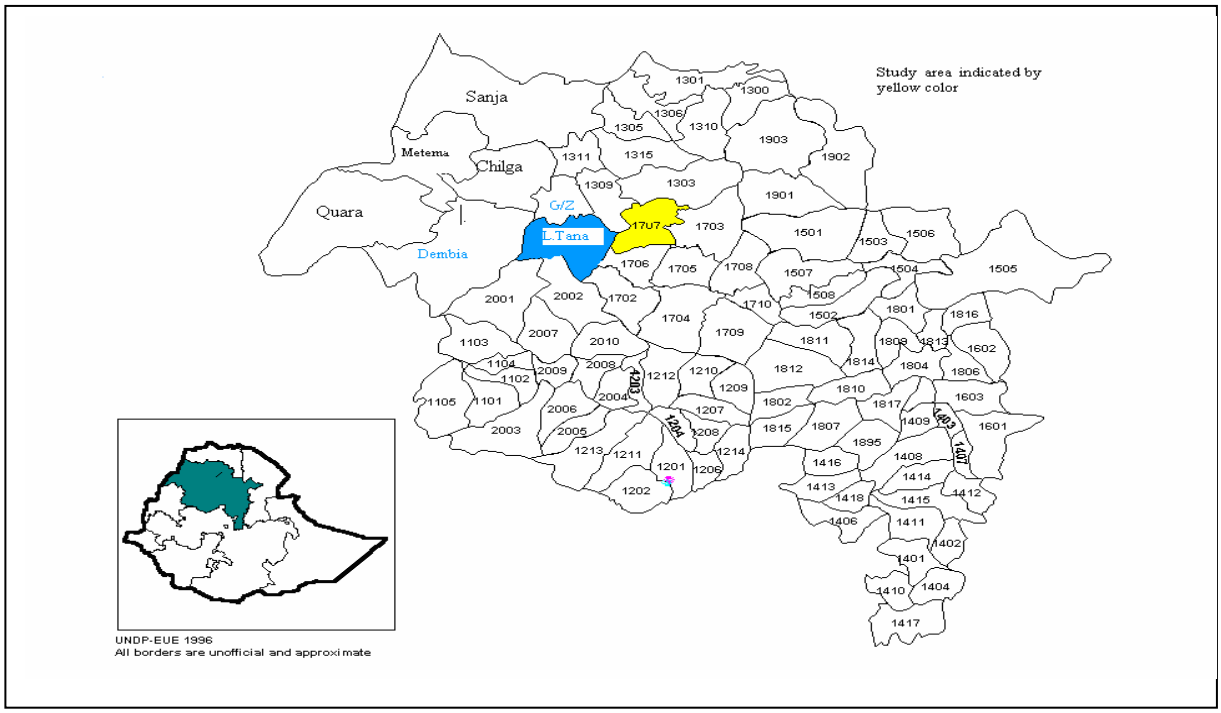

Figure 1. Map of Amhara National Regional State, Fogera Woreda

3.1.2. Climate and crop production

The altitude of Fogera ranges between 1774 m.a.s.l. and 2410 m.a.s.l. and it is predominantly classified as *woinadega* ecology, while the annual temperature ranges from 22ºC to 29ºC. The total area of land of the Woreda is estimated at 117,405 ha. Of the total land, flat land accounts for 76%, mountain and hills 11% and valley (bottom) 13%. The average landholding is about 1.4 ha per household (IPMS, 2005).

The mean annual rainfall of the area is 1216.3 mm and ranges from 1103 to 1336 mm. *Belg,* after the short rainy season between April and May, and *Meher,* after the main rainy season between June and September are the two cropping seasons. Maize, finger millet, sorghum, teff, rice, wheat and *nug* are the main crops growing in the study area (IPMS, 2005). Fogera Woreda is classified as one of the surplus producing Woredas of the ANRS.

3.1.3. Human and livestock demography

The total human population of the Woreda is estimated at 233,529. Of the total population, those living in rural areas account for 88.5% (206,717).

The Fogera Woreda has great potential for livestock production. According to IMPS (2005) estimate, the Woreda has 157,128 cattle, 27, 867goats, 7,607 sheep, 246,496 chickens, 21,883 beehives, 13,189 donkeys, 339 mules, and 8 horses.

3.2. Methods of Data Collection

Primary data for this study was collected through survey (structured questionnaire) and short period monitoring based on the 1990 Livestock Research System Manual of ILCA. Secondary data used in the literature review section and elsewhere in this paper was collected through meticulously reviewing published and unpublished information relevant to the work.

3.2.1. Survey

A rapid field survey was done before the main survey, among others, to know the distribution and concentration of local chicken eco-types and the peasant associations (PAs). The three sample PAs (Weje, Wereta Zurea, and Kidist Hana) were selected based on the information gathered through the rapid field survey and consultations with Woreda Agricultural experts, extension agents, and some farmers. The three PAs were systematically selected to represent three different agro-climatic zones and extension activities in the Woreda: Dry land (Weji), Wetland (Kidist Hana), high extension activity (Woreta Zuria).

However, the 72 households (24 HHs from each sample PA) studied were randomly selected by dividing the total number of chickens in the Woreda by the total number of households (HHs). Every 15^{th} HH (next HH if the 15^{th} one had no chicken) was surveyed in each of the three target PAs so as to have a fair geographical representation of sampled households. The survey questionnaire was pre-tested with 4 HHs from each of the target PAs and the necessary adjustments was made prior to the actual survey based on the pre-test.

Each flock owner was interviewed, among others, about the history of origin, composition of livestock mix, flock ownership patterns, flock demography, productivity and reproductive performance (approximate age of sexual maturity, number of eggs in one clutch per bird, number of frequent brood per year, number of egg incubated per hen, number of chicks hatched per one incubation period, number of egg incubated per hen), importance of chicken in the household, source of first foundation stock, barrier of future expansion, access to extension services, practice and character of selection, feed and feeding (type of nutrition management, time and giving of supplementary feeds, type of feed trough used, base of offering supplementary feeds, season of extra feeds offer, feed shortage season, priority of supplementing additional feed in each class, water source and distance from the homestead), and transport, health condition, cause of mortality, name of disease, access to veterinary service, season for loosing most chicken source of infection

Trained enumerator, with the close supervision of the researcher, administered the questionnaire (complete questionnaire is found in appendix 4). General information of the area, main crop, topography, climate data and population size were obtained from secondary data from Woreda office of Agriculture and Rural development.

3.2.2. Characterization

During this part of the study growth performance, reproductive performance, physical feature, some carcass characteristics, egg weight, egg shell thickness, yolk weight and albumin weight were measured. However, characterization was done only in the wetland part of the study area as it comprises more than three-fourth of the total area of the woreda.

3.2.2.1. Physical characterization

Based on the typical breed characters, from the wet land of the area, a total of 100 adult birds were selected (50 females and 50 males) and their metric characteristics (shank length, comb length, ear lob length, wattle length, wing span, body length, height at back, height at comb) and body weight measured, and categorical traits (feather characteristics, plumage color, shank color, pattern with in feather, skin color, shank color, comb type, head shape, body shape) observed using the FAO (1986) breed characterization tool. Also, slab records (elevation and topography climate, management systems, type of farm, degree of management supervision, meting systems, incubation method, flock size, nutritional management, physiology and stress tolerance) were described (Appendix 1 provides definitions and ways of measurement implemented).

3.2.2.2. Functional characterization

Out of the total surveyed HHs, 20 were randomly selected and monitored every ten days for 4 months duration to describe functional characteristics of the local chicken eco-types in the study area. During monitoring/home visits, such information as eggs laid per clutch, number

of eggs incubated, number of chicks hatched, number of eggs wasted, age and average weight of the mother chicken and egg yolk weight, albumin weight, egg shell thickness, egg shell weight and egg color have been collected using devices like sensitive balance, diagmatic micrometer and color fun for weight, egg shell thickness and egg yolk color measurement, respectively. A total of 424 birds were available for the monitoring purpose. The traits recorded were categorized in to different age groups and the age was determined by information provided by flock owners.

The complete history of productive and reproductive performances of chickens was recorded at the beginning of the study. Regular and frequent visits of sample HHs was made to collect data that need continuous monitoring/follow-up (E.g. eggs laid, number of day old chicks and their weight) by trained enumerators and the researcher.

3.2.2.3. Carcass characters

A total of ten animals (five female and five male) having typical characteristics of local birds within the age range of 8 to 12 months were purchased to see some of the carcass characteristics of local chicken eco-types in the study area. The live weight of each of the chickens was taken immediately after purchase using a weighing scale of 1gm precision. Before slaughtering them, the chickens were deprived of feed and water over night and weighted to get the slaughter live weight. Finally, all the ten chicken were slaughtered and the carcass separated from the offal. The offal in this case included feather, gastrointestinal tract, giblet shank, lung, head, kidney, and sex organ. This was collected and weighed by the same scale.

3.3. Data Analysis

All the data collected was checked for any mistake and corrected and coded. Data from the survey (physical characteristics, functional characteristics, and carcass characteristics) were analyzed descriptively by using statistical package for social science (SPSS) version 12.0 for windows. Physical features were analyzed separately for the two sexes.

Carcass weight and dressing percentage were calculated using the following formula:

Carcass weight = live weight – offal

Dressing percentage = $\frac{\text{Carcass weight}}{\text{Live weight}} \times 100$

The effective population size (Ne)and rate of inbreeding (ΔF) were calculated using the following formula $Ne = \frac{4NmNf}{Nm + Nf}$

Where Nm is the number of breeding cocks

Nf is the number of breeding hens

Rate of inbreeding = $\frac{1}{2Ne}$

4. RESULTS AND DISCUSSIONS

This section deals with: production system, reproductive performance, characterization of physical and functional traits; characters of basic temperament, and carcass characterization.

4.1. Livestock mix and Ownership Pattern

Besides chicken, keeping cattle, donkey, goat, sheep, mule and horses were reported to be common in the study area.

Most respondents had cattle (88.9%). A little less than half (47.2%) had donkeys while a little over a quarter (26.4%) of respondents had goats. On the other hand, sheep, mules and horses seemed to be not common in the study area. Only 6.9% of the respondents reported of having sheep while not more than 2% reported of owning mules and horses.

Chicken farming seems to be an important activity in the study area as indicated by the average holding by household (12.38). The average holding of the study area was, for example, higher than that reported by Dereje (2001) in East Wellega which was 7.61. The reported pattern of livestock ownership and holding per household in the study area is presented in Table 6.

Table 2. Reported number of animals holding in the survey households

Type of Animals	Household		Holding			
	Number	Percent	Minimum	Maximum	Mean	Standard Error of the Mean
Poultry	72	100	1	39	12.38	0.99
Cattle	64	88.9	1	20	7.94	0.48
Sheep	5	6.9	2	8	4.00	1.14
Goat	19	26.4	2	12	6.26	0.66
Donkey	34	47.2	1	6	1.61	0.16
Mule	2	2.8	1	1	1.00	0.00
Horse	2	2.8	1	1	1.00	0.00

4.2. Characterization of the Poultry Production System

The data on general management systems of the area and chicken performances were generated through the structured survey.

4.2.1. Local Chicken Eco- Types in the Study Area

Poultry production was a predominant farming practice in the study area. Most of the farming households kept local chicken eco-types. The most frequent local chicken eco-types reported include: *Netch and Key.* However, eco-types such as *Tikur*, *Gebsima*, *Anbesma*, *Seran*, *Libework*, *Netch Teterma*, *Tikur Teterma*, and *Key Teterma* were reported to be found but not in large numbers as that of *Netch* and *Key*. The types of breeds identified and kept by the farmers are indicated in Table 3. According to the survey findings, most farmers prefer keeping *Netch* and *Key* eco-types to the other eco-types due, primarily, to their high price in the local market. Alemu and Tdelle (1997) indicated that local poultry in Ethiopia vary widely in plumage color and provided such examples as: *Tikur, Melata, Key, Gebsima, and Netch*.

According to the respondents, the chicken population in the area is increasing. This increase was largely attributed to the growth in demand and increasing prices of chicken and chicken products. In addition, the fact that keeping chicken does not require large area encouraged households to keep more animals.

Table 3. Reported number of local breeds identified phenotypically from feather color

Type of Animals	Minimum Reported	Maximum Reported	Mean±SE
Key	1	24	4.09±0.54
Nech	1	20	4.38±0.72
Tikur	1	6	1.73±0.28
Gebsima	1	3	1.69±0.24
Anbesma	1	6	2.4±0.98
Seran	1	4	1.75±0.49
Libe Work	1	6	1.65±0.24
Netch Teterma	1	7	2.5±1.02
Tikur Teterma	1	4	1.67±0.33
Key Teterma	1	2	1.44±0.18

4.2.2. Selection traits and sexes selected

With regards the source of first foundation of birds, most of the respondents (43.7%) disclosed that they bought them. Very small proportion of respondents (5.6%) got their first chickens as gifts from friends or relatives. Close to one out of three (31%) and one out of five respondents (19.7%), respectively, disclosed that they homebred and hatched their replacement flocks. The higher prices of chicken and chicken products in area may have prevented from giving chickens as gift. Table 5 provides more information on source of first foundation and means of replacement.

Table 4. Reported source of first foundation and replacement stock in the study area

Source	Number of HHs	Percent
Home Bred	22	31.0
Hatched	14	19.7
Gift	4	5.6
Buying	32	43.7

An attempt was also made to find out the selection practices of the sampled households based on different criteria. As indicated in Table 5, almost all of the respondents (94.4%) did select chicken based on one or more of criteria like: sex, color, egg production and growth rate. In

terms of specific selection criteria, most respondents (66.7%) appeared to give priority to egg production. Next to egg production, color (66.5%) and growth rate (27.8%) were important selection criteria. Egg production was appeared to be the most important selection criteria because of the obvious benefits (selling eggs and hatching). On the other hand, color was important because such eco-types as *Key*, *Nech*, *Seran* and *Ambesima* cockerels had higher prices in the local market than other eco-types like *Tikur*, *Gebsima*, *Kokima* and *Teterima* for socio-cultural reasons.

In terms of selection by sex, the largest proportion (81.9%) of respondents reported that they select for both sexes (hens and cocks). Very few respondents reported that they select only one of the sexes i.e. cocks (9.7%) and hen (2.8%). Thus it is important to take into consideration egg production capacity and weight of chickens into consideration in the development and evaluation of breeding programs. The survey finding revealed that color is also an important factor in terms of affecting prices of a chicken. However, as this is mainly a cultural issue, it could over time be addressed through effective extension services.

Table 5. Reported practices of selection, traits of selection and type of sex selection

Type	Attribute	Number of HHs	%
Practice of selection	Yes	68	94.4
	No	4	5.6
Traits of selection	Color	20	28.16
	Egg Production	13	18.36
	Body Weight	2	2.8
	Color and egg production	16	22.53
	Egg production and weight	8	11.26
	Color, egg production and body weight	11	15.49
	Color and body weight	1	1.4
sex as a selection criteria	Cock	7	9.7
	Hen	2	2.8
	Both	59	81.9
	Not Applicable	4	5.6

4.2.3. Flock characteristics and composition

Flock structure of a species refers to the relative number of different age and sex classes of the current stock. Information on flock structure sheds light on the objective of owner management, whether the main interest is in the production of egg or meat.

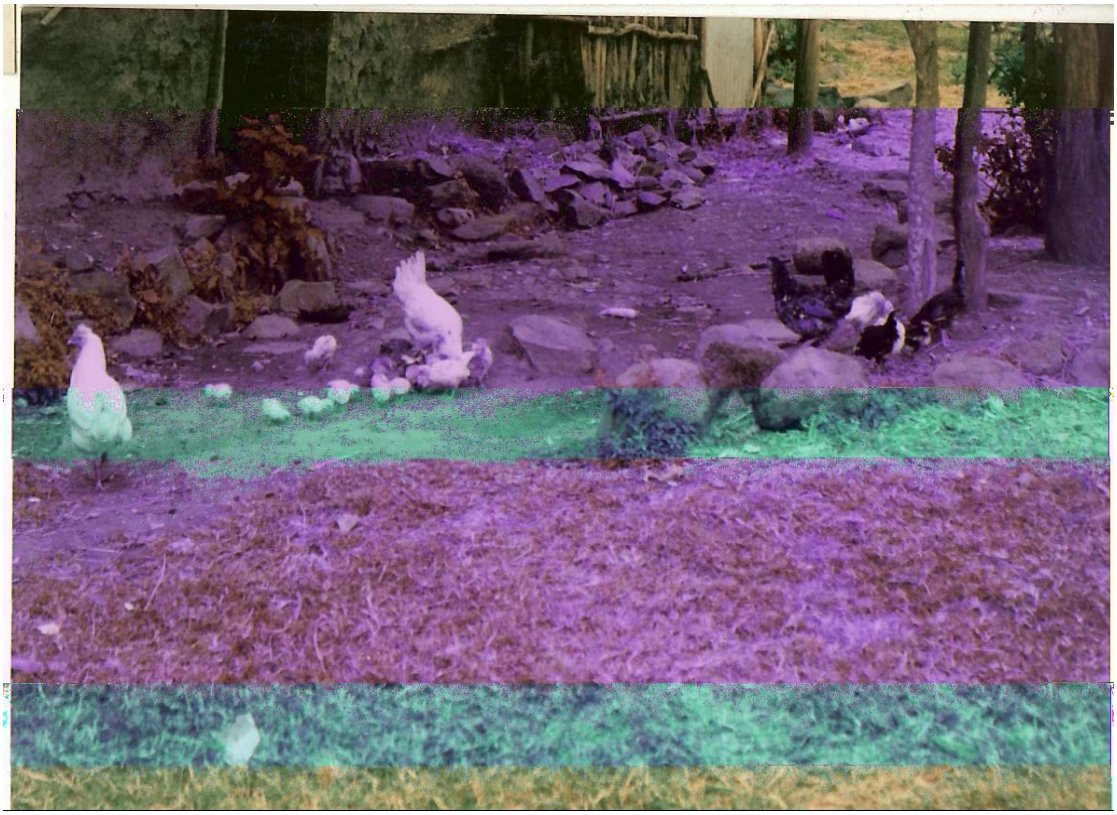

Figure 2. L**ocal chicken scavenging at a backyard**

Hens accounted for the largest portion of both the total flock and indigenous chicken flocks in the study areas. Out of the total flocks counted (822), hens accounted for 47.7%. Similarly, out of the total local flock counted (568), 46.3% were hens. On the other hand, Pullet constituted 26.6% and 26.5% of the total flock and local flock, respectively. Whereas cocks accounted for 15% of the total flock and 14.4% of the local flocks cockerels accounted for the lowest proportion of total flock (10.7%) and local flock (12.7%) of the chicken population.

The recommended cock to hen ratio is 1:10. However, the data from the survey revealed a much higher ratio of 1:3.2. This higher number of cocks compared to hens can be due to a special color preference widely practiced in the study. The ratio of cocks to hens in the study area was higher than reported by Tadelle *et al.* (2003a) i.e. 1:2.5 in the Central Highlands of Ethiopia. The flock structure of surveyed chickens based on the total number of chicken in the household and the local chicken eco-type is given in Table 7.

Table 6. Flock structure in the study households

Animal	All flock		Indigenous	
	Number	Percent of flock	Number	Percent of total flock
Cocks	123	14.96	82	14.44
Hen's	392	47.69	263	46.30
Pullet	219	26.64	151	26.58
Cockerels	88	10.71	72	12.68

4.2.4. Ownership pattern and gender role

In terms of ownership, most of the household members (55.6%) own the chickens themselves while a significant proportion of surveyed households (36.1%) also shared with other households (e.g. brothers or relatives). However, within the family, most of the chickens (50.77%) were owned by fathers, mothers and the whole family (23.88%). However, Gueye (1998) reported that more than 70% of chicken owners in rural Sub-Saharan Africa were women. Table 8 provides ownership pattern by household and family member.

Table 7. Reported flock ownership pattern in the household and ownership in the family

Type	Attribute	Number of HHs	%
Ownership pattern in the household	Owned	40	55.6
	Shared	26	36.1
	Ribi*	0	0.0
	Not Responded	6	8.3
Ownership pattern within the family	Men/Father	3	4.47
	Women/Mother	3	4.47
	Father, mother and sons	8	11.94
	Father, mother, son, daughter	16	23.88
	Father and mother	34	50.77
	Mother and son	1	1.49
	Mother, son and daughter	2	2.98

*Ribi is a so*rt of contractual arrangement where one buys and gives chickens to another person who is willing to keep the chicken. Both the buyer and the keeper will share the product as per the agreement.*

As shown in Table 9, women were used to shoulder most of the responsibilities in chicken production. Respondents revealed that 59.72% of the responsibility of feeding and providing water, 62.5% of the responsibility of cleaning the houses and 56.95% of the responsibility for selling the chicken and 63.89% of the responsibility for selling the eggs is the responsibility of women. On the other hand, their counter parts (men) were primarily responsible for the construction of poultry houses. Similarly, Mapiye and Sibada's (2005) study in the Rushinga District of Zimbabwe revealed that women were responsible for feeding (37.7%), watering (51.2%), cleaning (37.2%).

The fact that women are responsible for most of the production activity implies that women in the study area have good knowledge of poultry husbandry. The predominant role that women play in selling eggs and chicken (regardless of ownership) also signifies that women had decision making power.

From the survey result, it can safely be deduced that women have lesser ownership rights but more responsibilities in the production process than men. Their grossly disproportionate role in the production function could be due to the fact that women spend more time at home than men. Such involvement also makes women more knowledgeable in poultry production than men. Women's greater role in selling products could be due to a cultural reason. In the study area, it seems more socially acceptable for women to carry chicken and eggs to markets than men. This almost exclusive responsibility of selling seemed to provide women with access to money to purchase what is needed for the family without always consulting men/husbands.

Table 8. Reported labor allocation for poultry farming in the study area

Farming activity	Implementers							
	Men		Women		Children			
					Male		Female	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Shelter Construction	46	63.89	11	15.28	11	15.28	4	5.55
Providing feed and water	4	5.56	43	59.72	6	8.33	19	26.39
Cleaning chicken house	1	1.39	45	62.5	3	4.17	23	31.94
Selling chicken	5	6.94	41	56.95	7	9.72	19	26.39
Selling Eggs	3	4.17	46	63.89	8	11.11	15	20.83
Decision making								
Selling eggs	26	36.11	41	56.94	3	4.17	2	2.78
Selling chickens	28	38.89	40	55.55	2	2.78	2	2.78
Consuming eggs	31	43.0	39	54.17	2	2.77	0	0
Consuming chickens	37	51.39	33	45.83	2	2.78	0	0
Purchasing of drugs	42	58.33	28	38.89	2	2.78	0	0
Purchase of eggs	29	40.28	40	55.56	2	2.78	1	1.38
Purchase of chickens	34	47.22	37	51.39	1	1.39	0	0
Provide as gift	40	55.56	31	43.06	1	1.38	0	0

Any project that aims at conserving and increasing productivity of local chicken eco-types in the study area should tap the rich knowledge and experiences of women in poultry husbandry.

4.2.5. Importance and utilization of chicken and chicken product

Surveyed households reported that the two most important reasons for engaging in poultry production were: income generation (1st) and improve family nutrition (2nd). Other reasons ranked from third to 5th were: create job opportunities/full time self-employment, create-additional job/part-time work and for social functions (weddings, religious holiday), respectively.

Table 9. Reported purpose and importance of chicken farming in study households in the study area

Rank	Crop	Number of HHs who ranked	Percentage of HHs who ranked
1	Income Generation	56	77.8
2	Improve Family nutrition	43	59.7
3	Create Additional Job	16	22.2
4	Create Job Opportunity	26	36.1
5	Social Function	24	33.3

Utilization of chicken was appeared to be considerably influenced by plumage color. According to the survey participant households, *Nech, Key* and *Libe Work* eco-types were more preferred for consumption and sell. *Key* was preferred for consumption by a little under half of the respondents (48.6%) and for sell by 38.9% of the respondents. Similarly, *Netch* was reported to be preferred for consumption by 48.8% and for sell by 38.9% of the respondents.

Tikur, Gebsima, Teterima and *Kokima* eco-types happened to be less favored by respondents for both consumption and sell. For consumption and selling purposes, *Tikur* was favored by 16.7%, *Teterima (Netch and Tekur*) by only 6.9% of the respondents.

Table 10. Reported use of different ecotypes of chicken by survey households in the study area

Type of Bird	Uses							
	Own consumption		For sell		For sacrifices		For Gift	
	Number	%	Number	%	Number	%	Number	%
Nech	33	45.8	28	38.9	1	1.4	0	0.0
Tikur	9	12.5	12	16.7	1	1.4	0	0.0
Key	35	48.6	28	38.9				
Gebsima	5	6.9	6	8.3	0	0.0	0	0.0
Anbesma	0	0.0	0	0.0	0	0.0	0	0.0
Seran	6	8.3	5	6.9	1	1.4	0	0.0
Libework	17	23.6	11	15.3	0	0.0	0	0.0
Key Teterma	5	6.9	5	6.9	0	0.0	0	0.0
Nech Teterma	4	5.6	5	6.9	0	0.0	0	0.0
Tikur Teterma	5	6.9	4	5.6	0	0.0	0	0.0
Kokma	5	6.9	5	6.9	0	0.0	0	0.0

It terms of who in the family gets priority in consuming poultry products, respondents provided the following rank: children (1st), pregnant women (2nd), women involved in breast feeding (3rd), adults (4th) and elderly people (5th) (Table 12).

Table 11. Reported priority in consumption of poultry and poultry products in the study households

Rank	Crop	Number of HHs who ranked	Percentage of HH who ranked
1	Children	51	70.8
2	Pregnant Women	37	51.4
3	Women involved in breast feeding	36	50
4	Adults	25	34.7
5	Old People	29	40.3

4.2.6. Feed resource and feeding

The nutritional management practices in the study area were of scavenging (main practice), and supplementary feeding. This finding is similar to that reported by Halima (2007) from the study in Northwest Ethiopia where (99.28%) of the farmers provided supplementary feed. Very few respondents reported of not giving any supplementary feed other than what the chicken get by scavenging (6.9%) while the preponderant majority (88.9%) reported that they gave supplementary feed on top of scavenging. Similarly, Sibanda and Mapiye (2005) also reported that about 6.2% of surveyed households practiced zero supplement; 96.6% partial supplement, and 0.2% always provided supplementary feed to their chickens in Rushinga District of Zimabwe.

The different types of feed resources reported in the area were maize, finger millet, barley, rice, *teff*, wheat, sorghum-raw and/or processed. Maize and finger millet were reported to be the most common poultry feeds in the study area. Three out of 4 (75%) and 70% of respondents reported of feeding their chicken maize and finger millet, respectively. On the other hand, such feed types as barely, rice and *Injera* (made of cereals) were reported by 22.2%, 19.4%, and 16.7% respondents, respectively. Maize and finger millet were used by the great majority of survey participants as poultry feed due to probably their relatively cheaper price and availability in the household. A. Abdelqader *et al* (2007) reported that barley was the most common supplement (57.5% of the flocks) followed by cracked wheat and wheat byproducts (35% of the flocks); the least common supplement was corn or commercial ration (7.5%) in Jordan.

As can be inferred from the survey data, the feed types used were rich in energy. However, as mentioned above, the supplementary feed they gave did not have concentrate and lack such important nutrition as protein. Sonaiya et al (1998) reported that most of the materials available for scavenging were not concentrated enough in terms of energy because they contain a lot of crude fiber. Future poultry improvement programs should thus try to address this limitation by popularizing protein rich feeds.

Table 12. Reported type of supplementary feeds provided to birds in the study area

Type	Number of HHs	Percent	Rank
Maize	54	75.00	1
Finger Millet	51	70.83	2
Barley	16	22.22	3
Rice	14	19.44	4
Teff	10	13.89	6
Wheat	2	2.78	7
Sorghum	1	1.39	8
“Injera”	12	16.67	5

When asked why they provided supplementary feed, survey participants mentioned: to increase egg yield (9.23% of respondents) and increase egg and meat yield (90.77%) were the most important ones. According to respondents, supplementary feeds were more required during the rainy/wet season than the dry season. This was because chickens could not get grain when scavenging due to the general shortage of grain during the rainy season. During wet season, the largest portion of respondents (93.1%) reported that they gave more supplementary feed during the rainy/wet season. In the same way, almost all (97.2%) of the respondents reported that food shortage occurred during the rainy season.

It is thus critical for the extension program and other poultry development initiatives in the area to focus on facilitating access to affordable and adequate quality feeds in the rain seasons as well.

Table 13. Reported reason and season of offering supplementary feeds to chicken by households in the study area

Type	Attributed	Number of HHs	%
Reason of offering supplementary feeds	to increase egg yield	6	9.23
	to increase egg and meat yield	59	90.77
Season of offering supplementary feeds	Wet season	67	93.1
	Dry season	2	2.87
	Dry and wet season	3	4.15
Feed shortage season	Wet Season	70	97.2
	Dry Season	2	2.8
Practice of nutritional management	Scavenging	5	6.9
	Scavenging with Supplementary Feed	64	88.9
	Not Responded	3	4.2

Survey participants were also asked to rank to which class of chicken they provided supplementary feeds. Out of the total respondents, 52.8% reported that they feed all classes together (make no distinction). On the contrary, 45.8% (Table 14l) of respondents reported of giving more supplementary feeds to chicks (1st) followed by hen (2nd), pullet (3rd), cocks and cockerels (4th). Chicks are given priority attention in terms of supplementary feed because they could not scavenge. Hens got the second highest attention because farmers believe that supplemented hens lay more eggs.

Table 14. Reported priority of supplementary feed to different classes of birds in the study area

Age classes of chicken	Number of HHs who ranked	Percentage of HH who ranked	Rank
Chicks	54	75.0	1
Hen	51	70.8	2
Pullet	58	80.6	3
Cocks & Cockerel	54	75	4

As to the time of supplementary feeding, the most important times appeared to be mornings, noon, evenings and afternoon, respectively. Close to a quarter of participants (23.6%) reported of providing supplementary feeds in the mornings and a little less than half (45.83%) of the respondents reported of giving supplementary feeds morning, noon and evening. Giving supplementary feeds in the afternoons is also less common than evenings.

Respondents were also asked to answer whether or not they used feeding troughs or other materials for supplementary feeds. It was found out that most farmers did not use any sort of material to feed their chicken. Of the total respondents, 81.9% reported of not using any form of feeding materials rather throwing the feed on the ground for chickens to pick from there. Only 16.7% of respondents reported of using feed troughs to feed their birds.

From the feeding practices mentioned above, it is clear that providing supplementary feeds to all classes together can create competition among the different age groups of chicken. This competition in turn results in less feed intake for chicks and over feed in take for adults. This unequal feed intake affects overall productivity of chickens. Furthermore, throwing feeds on the ground causes feed wastage and causes contamination. The practice of feeding different classes separately and using feeding trough should therefore be among the measures to be taken in order to improve poultry production in the study area.

Table 15. Reported time and way of providing supplementary feeds and type of feed trough used in the study area

Type	Attributed	Number of HHs	%
Time of the day providing supplementary feed	Morning	17	23.61
	Morning, noon and afternoon	5	6.94
	Morning, noon and evening	33	45.83
	Morning, noon, afternoon and evening	9	12.5
	Morning and evening	3	4.17
	Morning, afternoon, and evening	2	2.78
	Evening	48	66.7
	Morning and afternoon	3	4.17
Way of providing supplementary feeds	Separately for different classes	33	45.8
	All classes together	38	52.8
	Not responded	1	1.4
Type of feed trough used	Put feed in container	12	16.7
	Throw on the ground for collective feeding	59	81.9
	Not responded	1	1.4

4.2.7. Water resource and watering

As indicated in Table 17, wells and tap were the major sources of water households use for their chickens. Surveyed households reported of traveling between 4 and 45 minutes to the nearest source of water. Given the fact that almost 43.3% of the respondents reported of walking 30 minutes to the nearest water source, any future poultry development program need to consider the availability of clean and adequate water close to home.

Table 16. Reported water source and distance from the homestead area of the study households

Water Source	Number of HHs	Percent	Distance in Minutes		
			Minimum	Maximum	Standard error of the Mean
Tap	21	29.2	0	30	2.36
River	15	20.83	4	45	3.25
Well	31	43.06	0	30	1.48
Spring	3	2.78	10	45	10.93

4.2.8. Housing

Survey participants reported of using different structures to house their chicken. Most (59.7%) of the respondents used separate houses constricted exclusively for poultry. On the other hand, 37.5% were kept their chickens in the main house. A study conducted in Northwestern part of Ethiopia (Halima, 2007) also revealed that 50.77% of farmers kept their chicken outside the main house in sheds built for the same purpose.

Table 17. Reported type of housing and cleaning of poultry house in the study area.

Type of house	Number	%
Bamboo cage	1	1.4
In the Main House	27	37.5
Separate House Constructed Entirely for Poultry	43	59.7
Not well Defined	1	1.4

In terms of cleaning the poultry house/shelter, 70.8% of respondents were reported of cleaning daily while 20.8% of respondents were reported of cleaning weekly. Lack of frequent cleaning of poultry shelter can easily cause diseases and increase morbidity and mortality rate. Thus, raising the farmers' awareness on the need for cleaning of the shelters more frequently is something that all development practitioners should take seriously.

Table 18. Reported Frequency of Cleaning Poultry Houses in the Study Area

Type	Number	Percent
Daily	51	70.8
Weekly	15	20.8
Monthly	2	2.8
More than Monthly	1	1.4
Not Responded	3	4.2

4.2.9. Disease

Freedom from major diseases is regarded as a pre-requisite for poultry development. Only one disease Newcastle disease (local name: *fengil*) was known to respondents. This could be

because of the long tradition of attributing all deaths (other than those caused by predators and wild birds) to Newcastle disease. Respondents were also reported of major sources of infections and accordingly, more than half (51.4%) of the respondents mentioned incoming flocks and 37.5% own flock as the main sources of infection.

Access to veterinary services appeared to be quite limited in the study area. For example, out of the total survey participants, only 19.4% reported of getting advisory services; while only 9.7% of the respondents reported of getting diagnosis services. Also, only 22.2% of the respondents disclosed of getting drug provision services. Similarly, Abdelqader *et al* (2007) reported that only 5% of the farmers accessed veterinary extension service; 12% of respondents practiced annual vaccination against New Castle disease and infectious bronchitis in Jordan. Such limited coverage of veterinary services could negatively impact the development of poultry production in the area and deserve requisite attention from all concerned bodies.

Table 19. Reported Type of disease, source of infection and access to veterinary services

Attribute	Type	Number	%
Type of disease	Fengil	70	97.2
Source of infection	Own flock	27	37.5
	Incoming chicken e.g. from market	37	51.4
	Flocks from the Neighbors	15	20.8
	Neighborhoods Kebeles	12	16.7
	Unknown	17	23.6
Access to veterinary service	Advisory service	14	19.4
	Diagnosis	7	9.7
	Drug provision	16	22.2

4.2.10. Mortality

The principal causes of chicken loss in the study area were reported to be diseases (41.7%), wild birds (34.7%) and predators (23.7%). Even if not mentioned by respondents, it was

observed during monitoring visits other factors like biological (e.g. bacteria, protozoa) and environmental factors (draft, heat etc) could also contribute to chicken losses in the area. Disease followed by predators as major causes of death in the present study is in agreement with that reported by Halima (2007) in North West Ethiopia and Abdulkadir (2007) in Jordan.

Strengthening disease prevention measures and overcoming reducing other causes of chicken mortality will, not only help to improve production and reproduction performance, but also conserve superior germ plasm useful for genetic improvement through selection or other means of improvement.

The survey also tried to find out whether there were specific seasons for high incidence of mortality. More than half (55.6%) of the respondents said that most deaths happened during the dry season while 33.3% and 6.9% of the respondents reported rainy season and both rainy and dry seasons, respectively. The high incidence of mortality in the dry seasons could be due to high incidence of disease (particularly from March to May) and attack wild birds mainly during October to May as chicken spend most of the day scavenging outside their cages/homes. During rainy seasons, other predators cause more deaths than disease. The attack by predators gets more serious in the rainy seasons because predators have a place to easily hide near to the homestead areas unlike during the dry season.

Table 20. Reported main causes of chicken death and seasons of most chicken losses in the study area.

Type	Attributed	Number	%
Main causes of chicken death	Disease	30	41.7
	Predators	17	23.6
	Wild birds	25	34.7
Season when most deaths occurred	Rainy season	24	33.3
	Dry season	40	55.6
	Both seasons	5	6.9
	Non response	3	4.2

Availing more affordable and effective vaccines and vaccinating day old chicks by trained farmer vaccinators could significantly reduce mortality rate. On the other hand, constructing

houses and keeping the chickens inside a house, especially when there is no family member who looks after them could reduce mortality due to predators.

4.2.11. Marketing

4.2.11.1. Effect of plumage color and comb type on price variation

Key, Netch, Seran, and *Libework* eco-types had better market value and were more preferred to other eco-types for consumption. As indicated in Table 22, even if the un-preferred eco-types in general cost significantly lower (there is as much as 10 Birr difference) than the aforementioned preferred color types in the study area, the respondents reported that they preferred selling *Tikur, Gebsima, Teterima and Kokima* eco-types than consuming at home. This is due to deep-rooted stigma attached to these colors.

Table 21. Reported price of chicken by color and comp type in the study area

Color	Matured Cock				Matured Hen				Pullet				Cockerel			
	Single		Double		Single		Double		Single		Double		Single		Double	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Nech	15.28	0.69	19.54	0.84	12.72	0.59	26.50	11.72	9.88	0.43	11.70	0.43	10.76	0.76	14.19	0.96
Key	15.52	0.39	19.82	0.46	12.96	0.43	14.76	0.48	10.37	0.45	12.37	0.50	10.76	0.54	14.25	0.88
Tikur	9.75	0.63	10.64	0.97	9.55	0.57	10.31	0.68	8.00	0.78	9.30	1.23	7.86	0.68	9.00	1.13
Gebsima	11.21	0.87	12.70	1.19	10.21	0.88	12.30	1.41	9.94	0.79	12.17	0.91	10.50	0.93	13.25	0.83
Anbesma	12.36	0.81	15.88	1.72									10.29	1.22	14.00	1.73
Seran	14.32	1.42	17.50	1.87									12.25	2.29	14.88	2.55
Libe Work					10.80	0.73	13.39	0.78	8.23	1.22	10.50	1.49				
Nech Teterma	11.50	1.00	14.75	2.75	11.10	1.07	13.20	0.74	8.17	0.61	9.83	0.33	8.50	0.50	10.75	0.75
Tikur Teterma	9.25	0.75	9.00	2.50	10.20	1.11	13.70	1.64	8.83	1.74	11.17	1.49	8.00	1.04	10.33	0.73
Key Teterma	12.33	1.22	16.00	2.57	10.75	1.51	14.10	1.08	7.90	0.51	10.75	0.80	8.30	1.09	10.40	1.37
Kokma	9.75	0.79	11.38	0.83	9.38	0.99	10.88	0.91	7.50	0.45	9.50	0.83	8.63	1.71	10.88	2.37

Even within the same plumage color, prices were reported to be different due to the type of comb. As an example, non-single (Pea and Rose) comb Nech and Key cocks and cockerels had reportedly higher prices (as much as 5 Birr higher) than the single combs of the same color. On the other hand, *Tikur, Gebsima, Teterima, Kokima* eco-types had reported to have less price variations due to their comb types. The current low prices the consumer pay for *Tikur, Gebsima, Teterima, Kokima* plumage colors for such eco-types poses a huge danger to the conservation of the genes of these eco-types as farmers are less interested in keeping them.

Another question asked was where they sell their poultry products. Most of the respondents (41.7%) reported that they sold their products in the nearest market during market days. Others responded that they sold their products in the Woreda capital (33.3%) during market days and within their respective kebeles on non-market days (19.4%). Even if they could sell their products at a relatively higher price in the Woreda capital, most farmers could not go to this town to avoid travelling as far as 22 kms. In his study in Jordan, Abdulkadir (2007) also reported that farmers sold chickens to their neighbors and in the main markets to other farmers and middle men.

To help farmers get better value on all eco-types of chicken and thereby conserve the genes, it is very crucial, besides raising the awareness of farmers on selection based on color, to create market linkages with major urban centers/boarding schools, academic institutions, army basis, etc where color is not a major price determinant.

There are middle traders who buy chickens from farmers but the price they offer is generally low. Such measures as establishing poultry farmers' cooperatives, providing critical support in poultry value chain, etc. could address the marketing and related challenges that farmers in the study area are facing.

Almost all the respondents (97.2%) mentioned that they do not use other forms of transportation but carry their chickens (usually in an upside down position) by hand or on their shoulders tying them with a rope to a stick. These poor and inhuman methods of

transporting chicken to markets creates, among others, physical injury and other complications on the chickens and reduce the quality of products and the income farmers could get.

Table 22. Reported means of transportation and marketing place of chicken

Type	Attributed	Number	%
Marketing place	Within the kebele	14	19.4
	In neighborhood kebele	1	1.4
	In nearby market	30	41.7
	In the Woreda market	24	33.3
	Not responded	3	4.2
Means of transport	Carrying by themselves	70	97.2
	Using pack animals	0	0.00
	Using cars	0	0.00
	Not responding	1	1.4

Credit facility for poultry production seemed quite limited in the study area. Most of the respondents (59.7%) reported that they did not get credit for poultry production. Only 27.4% of the respondents mentioned of getting credit. Expanding credit facilities could encourage landless or small land owning farmers and unemployed youth to improve their living conditions by starting or scaling up poultry production. Appendix Table 1 summarizes the response on credit facilities.

Figure 3. Transportation of chickens to market tying them by rope to a stick

4.2.11.2. Seasonal price variation for different chicken eco-types

Average price of chicken reportedly varied from season to season. Over all, prices of chicken in the study area were reported to increase in the dry season. As an example, the average price of non-single comb (Pea and Rose) chicken was reported of going up from 14.38 Birr in the rainy season to an average of 17.56 Birr in the dry season. Similarly, the average price of a single comb chicken was reported to increase from 13. 38 Birr in the rainy season to an average of 16.38 Birr in the dry season. The main reasons for the seasonal price variation were socio-religious factors. During the dry season, especially in the months of October, January and April there are more religious holidays, weddings and other events that may require slaughtering chicken.. Moreover, unlike in the rainy season, farmers in the dry season have more disposable cash as it is harvest season too. More festivities and increased farmers' incomes increase the demand and price of chicken. The result of the study conducted by Tadelle (1996) and Halima, (2007) in different parts of the country also revealed that prices of live chicken are affected by season.

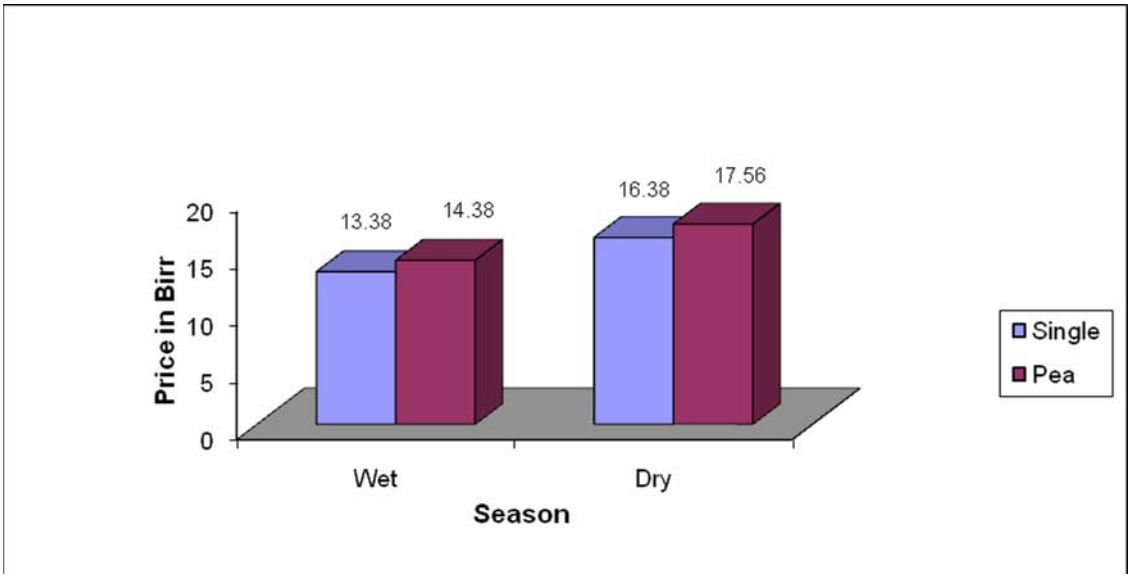

Figure 4. Average prices of local chicken by season and comp type

4.2.11.3. Seasonal egg price variation

Like chickens, the price of eggs was also reported to show seasonal variation. However, the price of eggs seemed to vary with fasting seasons. Over all, the price of egg was reported to increase in the dry season (end of December to Mid-February; and end of March to June). Egg prices tended to go down in the rainy season (End of June to mid-August) and in the dry season (Mid-February to End of March) due to Orthodox fasting seasons. Another egg price determinant factor in the study area was size. The bigger the size, the higher the price was. .

In terms of price differential, the price of a large size egg was reported to go up from 45 cents in August to 60 Cents in April. Similarly, the price of a small size eggs was reported to increase from 35 Cents in August to 45 cents in April. The price of eggs in rainy and dry seasons is shown in figures: 5 and 6. To prevent price reductions during fasting seasons, introducing appropriate and user-friendly technologies that could help farmers increase the shelf life of eggs is essential.

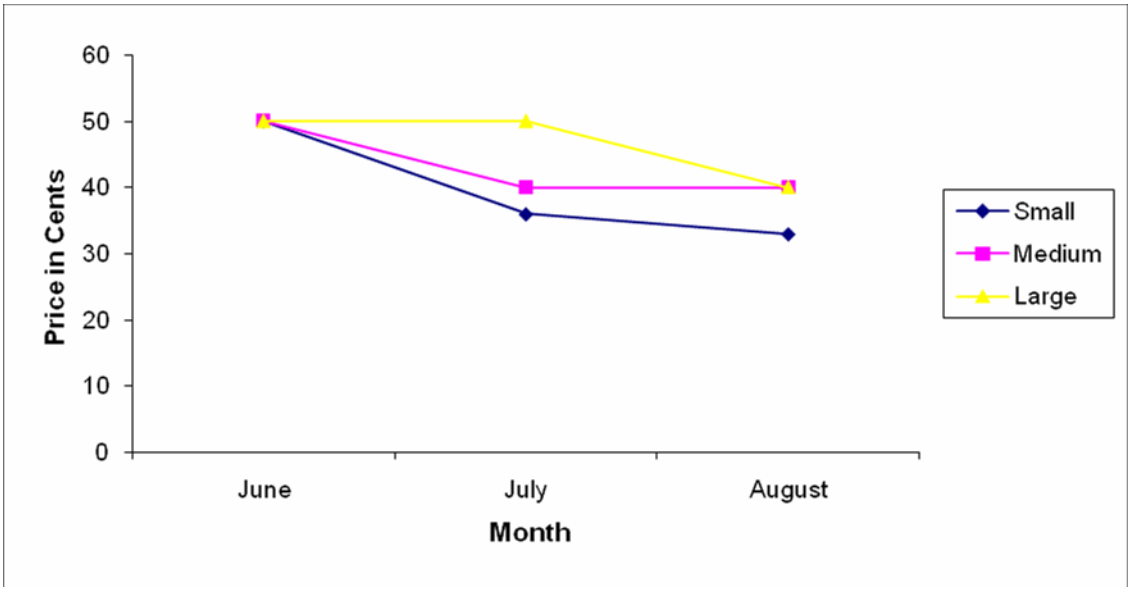

Figure 5. Egg price of on the rainy season

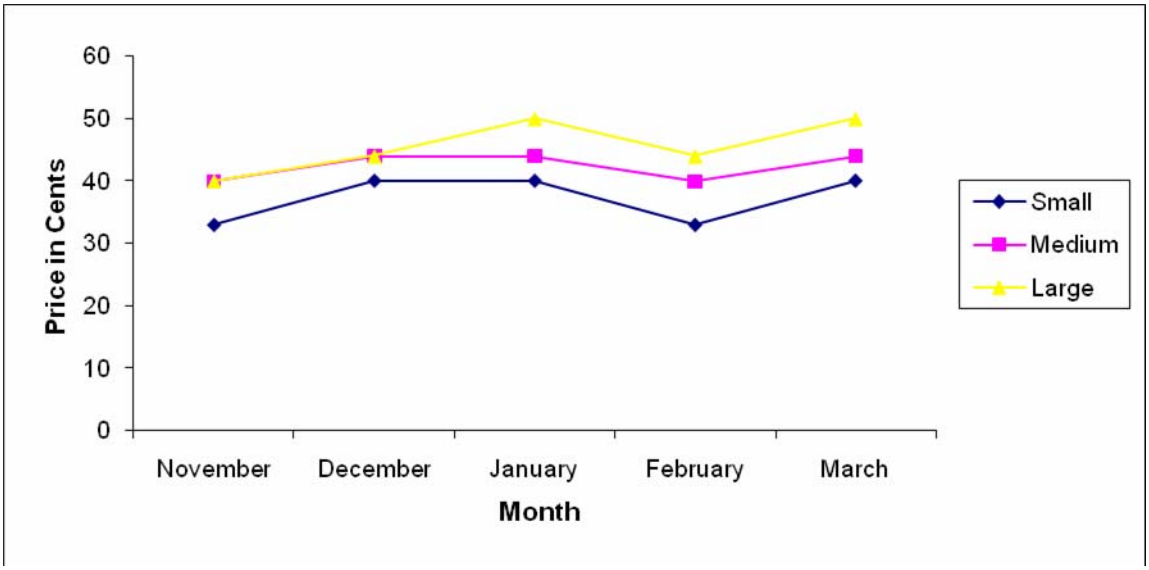

Figure 6 Egg price on the dry season

4.2.12. Constraints of chicken production

As shown in Table 24, respondents disclosed that disease (48.6%) and shortage of supplementary feed (19.4%) were the two major production barriers for expanding poultry production in the area.

Table 23. Reported barriers for future expansion of poultry production in the area

Barrier	Number of HHd	Percent
Land	4	5.6
Capital	2	2.8
Labor	6	8.3
Technical information	2	2.8
Feed	14	19.4
Marketing	1	11.4
Theft	2	2.8
Disease	35	48.6
Other	6	8.3

Farmers in the study area seemed to had very limited sources of information. Most of the survey participants (72.2%) got poultry-related information from agricultural extension agents. Others reported were radio (13.9%) and other farmers (11.1%) as sources of information. In terms of place of contract with the single most important source of information in the study area (agricultural extension agent), most common meeting place (40.3%) was reported to be extension agent's office, second common place (23.6%) reported to be at the farmers' homes; another but less common reported place of meeting place (18.1%) was meeting at crop demonstration site. This more common practice of meeting farmers outside their homes where there are no chickens will impact the farmers' ability to get more practical advice from the extension agents. In order to provide a more problem solving technical support, it would be advisable for extension agents to make their contact hours at the homes of farmers.

Table 24. Reported places of discussion with extension agents in the study area

Meeting places	Number	Percent
Extension Agent's Office	29	40.3
The Farmer's Home	17	23.6
Unintended Meeting	3	4.2
At Cooperative's Office	6	8.3
At Demonstration Places	13	18.1
Not responding	4	5.5

4.2.13. Storage, incubation practice, and type of brooder used

It seems that storing eggs in side grain and keeping eggs for sell and for incubation separately were a relatively more common practice in the study area. Out of the total respondents, 61.1% reported that they store eggs for incubation and market separately. However, 38.9% of the respondents mentioned that they store eggs for incubation and market in the same place.

Most of the farmers in the study area seem to have a preferred season for incubation. The largest proportion of respondents (81.9%) reported of doing incubation during dry season. This was probably due to the availability of more supplementary feed and less risk from predators during the dry season.

Table 25. Reported preferred season of incubation, storage of eggs for incubation and marketing.

Type	Attributed	Number	%
Preferred season of incubation	Rainy Season	19	26.4
	Dry Season	59	81.9
Storage of eggs for incubation and for marketing eggs	The Same	28	38.9
	Different	44	61.1

Farmers in the study area also seem to have good practice of selecting eggs and hens for incubation based on size. A very large proportion of respondents were reported of using large size eggs (84.7%) and large size broody hens (66.7%) for incubation. (See Appendix Table 2 for more information). Respondents disclosed that a broody hen incubated from 10 to 22 eggs and hatched 4 to 20 chicks during one incubation period (Table 24).

None of the respondents reported of using artificial incubator. In order to increase production efficiency, increased volume of operation and effectiveness, it will be important to introduce and promote artificial incubators (especially those run by solar, hay, kerosene) (Appendix 2).

Table 26. Reported number of clutch per hen and number of eggs incubated in one clutch in the study area

Character	Minimum	Maximum	Mean	Standard error of the Mean
Number of eggs in one clutch	9	30	16.36	0.44
Frequency of broodiness /year/hen	2	6	3.63	0.96
Number of eggs incubated/hen/cycle	10	22	15.17	0.32
Number of chickens hatched per cycle	4	20	12.97	0.35

All respondents were reported of using broody hens for growing chicks. However, respondents mentioned of using Solomon Hay Box Brooder only when government distributed exotic chicks. In other areas (E.g. Adet) Solomon Hay Box Brooder is very widely used even for rearing chicks from indigenous birds. Using broody hens, survey participants reported of growing 9.5 $\pm$ 0.35 chicks wile 40 $\pm$ 2.56 chicks using the Solomon Hay Box Brooder.

Table 27. Reported numbers of chicks grow using different ways of brooding in the study area

Type	Minimum	Maximum	Mean	Standard Error Of the Mean
Broody Hen	1	20	9.5	0.35
Solomon Hey Box Brooder	31	47	40	2.59

4.2.14. Culling

Culling non-productive chicken was appeared to be a common practice in the study area, almost all (97.2%) of the survey participants reported of culling chickens. There were reportedly different factors that led farmers to cull their chicken. For 46.5% of respondents: poor productivity; for 25% of respondents: old age and poor productivity; and for 5.65% of the respondents: sickness, were the reasons mentioned for culling. Another study report in Northwestern Ethiopia (Halima, 2007) also revealed that farmers cull chickens because of poor productivity and old age.

Selling and home consumption (62.59%) were reportedly the most common methods of chicken culling.

Table 28. Reported culling practice, factors determining culling, and way of culling in the study households

Type	Attributed	Number of HHs	%
Culling practice	Yes	70	97.2
	No	2	2.8
Factors determining culling	Poor productivity, old age and sickness	33	46.47
	Old age and poor productivity	18	25.53
	Poor productivity	9	12.68
	Old age and sickness	7	9.67
	Sickness	4	5.65
Way of culling	Home consumption and sell	45	62.5
	Sale	22	30.55
	Home consumption	3	4.18
	Home consumption, sale and sacrifice	2	2.77

4.3. Characterization of Reproductive Performance of Chicken in the Study Area

4.3.1. Age at sexual maturity

According to the respondents, sexual maturity is the age at first service. Acceptance of service for first time depends up on the sexual maturity and body condition. According to the survey participants, age at sexual maturity of local chicken was 5.9 ±0.11 months for female and 5.87 ±0.1 months for male. This could be taken as a good period of maturity.

Table 29. Summary of reported reproductive performance of local chicken

Character	Min	Max	Mean	SE
Age at sexual maturity for female (month)	5	6	5.91	0.11
Age at sexual maturity for male (month)	5	7	5.87	0.10
Reproductive life span of female (month)	17	30	26.61	0.93
Reproductive life span of male (month)	16	24	18.43	0.54

4.3.2. Age at first egg laying

As can be seen in Table 30, age at first egg for local chickens varied. This variation could be attributed to genotype, management, and season. The average age at first egg for local chickens in the study area was 5.9 ± 0.11. This result is much shorter than 6.10 to 8.16 months reported by Tadelle (1996). It was also found shorter than the 6.8 months reported by Tadelle *et al.* (2003). On the other hand, it is a bit longer than the 5 months average that was reported by Halima (2007) on the study report from Northwestern Ethiopia.

4.3.3. Reproductive life span of local chicken eco-types

High longevity under adverse condition is one of the adaptive traits of indigenous chicken. The average productive life span of hens and cocks, according to respondents, were: 26.61 ± 0.93 and 18.43 ± 0.54 months, respectively. According to this data, the reproductive life span

of a female local chicken seems to be quite long compared to hens from exotic origin. Long term reproductive performance (long life, high fertility, high hatchability, and high number of egg per hen per year, high number of egg mass per hen per year, less or no number of broodiness per hen) of chicken should be given more importance in selection programs. As a base for initial selection, ancestral information is more important in the absence of any records.

During monitoring, it was observed that a hen in the study area could produce 11 to 25 eggs with 2-6 clutches per hen during her reproductive life. A similar finding was reported by Tadelle *et al.* (2003) in the Central Highlands of Ethiopia i.e. mean egg number/clutch/bird, clutch number/bird/year and egg number /bird/ year were 17.7 $\pm$ 0.25, 2.6 ±0.06 and 46.4 ± 0.86, respectively.

4.4. Characterization of Physical Traits

The physical features of adult chickens were observed and measured separately for Female and Male.

4.4.1. Qualitative characters of female chicken

Female chickens have various types of plumage skin, shank, and ear lob color, comb type, and body and head shape. The plumage colors of local hens were *Key* (30%), *Netch* (18%), *Libe Work* (16%). *Tikur* (8%), *Gebsima* (6%), *Teterma* (8%) and *Kokima* (4%). *Libe Work* plumage color was observed only in the female chicken population.

Table **30**. Summary of plumage color of local Female chickens in the study flocks

Plumage color[1]	Number	Percent
Netch	14	28
Tikur	4	8
Key	15	30
Gebsima	3	6
Netch teterma	2	4
Key teterma	1	2
Tikur teterma	1	2
Libework	8	16
Kokima	2	4

Most of the local female chickens observed had bluish black (50%) skin color. Other skin colors observed were white (34%) and yellow (16%). Over all three types of shank colors of local female chickens were observed. White and bluish-black, each accounted for 38% and Yellow 24%, respectively. Red (74%) and white (26%) colors were the most common earlobe colors observed among the local female chicken population in the study area.

All female chicken observed had normal feather morphology and distribution; and fast feather growth rate. Regarding body shapes most were found to wedge (88%), while others (12%) blocky. In terms of head profile, most (86%), of the local female chickens were having crest (*gutya*) type head, while others had single (26%) and pea (24%) rose (50%) comb types. Of the 50 chickens observed, all had wattle, half of them had spur. However, no chicken had shank feather. Details of qualitative trait of Female chicken are presented in Table 32.

The presence of such large variation in plumage color might be the result of their geographical isolation as well as long periods of natural and artificial selection. The plumage colors of the eco-types observed in the study area were more or less similar to those in

[1] *Netch* = Complete white; *Tikire* = Complete Black; Key=Complete red ; Gesima = Grayish mixture; *Libe Work* = white with the Brest part golden color; *Kokima* = red brownish; *Netch Teterma* = white with black or red tips; *Tikure Teterma*= black with white trips

Northwestern Ethiopia (Halima, 2007) and Central Highland Ethiopia (Alemu and Tadele, 1997).

Table 31. Major qualitative characters of local female population in the study area

Character	Attribute	Number	Percent
Feather morphology	Normal	50	100
Feather distribution	Normal	50	100
Feather growth rate	Fast	50	100
Skin color	White	17	34
	Yellow	8	16
	Bluish – black	25	50
Shank color	White	19	38
	Yellow	12	24
	Bluish –black	19	38
Comb type	Single	13	26
	Pea	12	24
	Rose	25	50
Ear lob color	White	13	26
	White and red	37	74
Spur	Present	25	50
	Absent	25	50
Body type	Blocky	6	12
	Wedge	44	88
Head shape	Plain (Ibab ras)	7	14
	Crest (guteya)	43	86
Shank feather	Present	-	-
	Absent	50	100
Egg shall color	Cream or tinted	450	100

Figure 7. *Libe Work*

4.4.2. Qualitative characters of male chicken

Out of the 50 cocks observed, 48% were *Key*, 18% were *Netch*, 8% were *Seran*, 4% were *Gebsima*, 3% were *Tikure*, 8% were *Teterma*, and 4% were *Kokma* plumage color. Even if most of the meat strain carry black feather (Rose, 1999), the number of this eco-type is decreasing from time to time. *Seran*[2] and *Ambesima* plumage colors were observed only in the male chicken population.

[2] Seran = white with red strips; Ambesima = multi color

Table 32. Summary of plumage color of local male chicken flocks in the study area

Plumage color	Number of birds	Percent
Netch	9	18
Tikur	3	6
Key	24	48
Gebsima	2	4
Ambesima	2	4
Netch teterma	1	2
Key teterma	1	2
Tikure teterma	2	4
Seran	4	8
Kokima	2	4

Like the females, the male chicken had normal feather morphology, feather distribution and fast feather growth type. Bluish-black (40%), white (30%) and yellow (30%) were found to be the most common skin colors observed in the male chicken population studied. Yellow (64%) was found to be the most dominant shank color of the male population. The other two common shank colors observed in the male chicken population were white (18%) and bluish-black (18%). Most of the male chicken studied had red earlobes (54%) while the rest (46%) had white and red earlobes. The male chicken population had wedge (72%), triangular (18%), blocky (10%) body shapes. Spur was observed in almost all of the cases (92%) while none had shank feather. Regarding comb type, most (56%) had rose type; others had single comb (22%), and pea (22%) comb types. All male chicken observed had crest (*gutya*) type head shape. No chicken had plain (*Ibab Iras*) type of head. The major morphological characters of male chicken are presented in Table 34.

Table 33. Summary of major morphological characters of local male chicken

Character	Attribute	Number	Percent
Feather morphology	Normal	50	100
Feather distribution	Normal	50	100
Feather growth	Fast	50	100
Skin color	White	15	30
	Yellow	15	30
	Bluish –black	20	40
Shank color	White	9	18
	Yellow	32	64
	Bluish –black	9	18
Comb type	Single	11	22
	Pea	11	22
	Rose	28	56
Ear lob color	White	-	-
	Red	27	54
	White & red	23	46
Spur	Present	46	97
	Absent	4	8
Body type	Blocky	5	10
	Triangular	9	18
	Wedge	36	72
Head shape	Plain (Ibab ras)	0	0
	Crest (gutya)	50	100
Shank feather	Present	0	0
	Absent	50	100

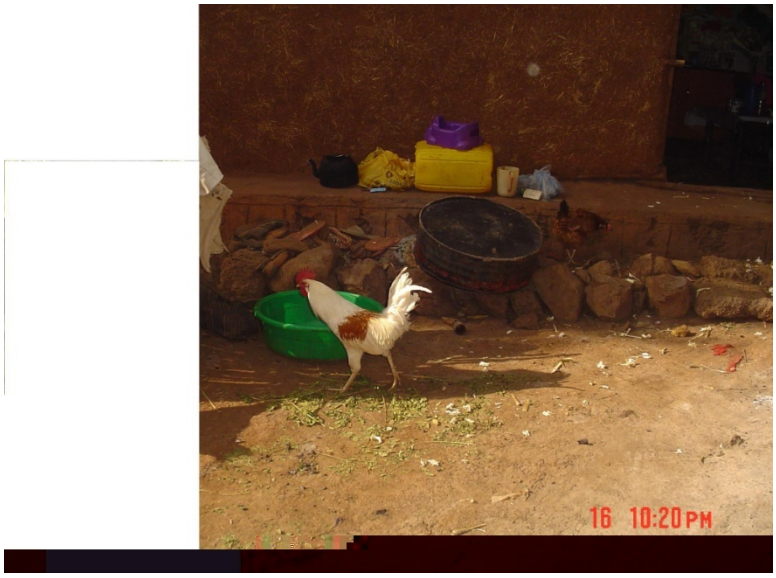

Figure 8. *Seran* chicken

Figure 9. *Gubsima* (right) and *Ambesima* (left) Chickens

4.4.3. Body Measurement and weight of local hens

As described in Table 35, the average shank length, comb length, comb height, ear lob length, spur length, wattle length, wing span, body length, pin bone to clavicle length, height at back, height at comb, and body weight were 7.25 cm, 2.31 cm, 0.68 cm, 1.17 cm, 0.27 cm, 0.59 cm, 12.57 cm, 17.75 cm, 14.71 cm, 22.50 cm, 29.87 cm, and 1180 gram, respectively.

Table 34. Average body measurement of female chicken in the study area

Length (cm)	Female				
	No.	Min	Max	Mean	Standard Error
Shank length	50	7	8	7.25	0.16
Comb length	50	1.5	3	2.31	0.18
Comb hight	50	0.2	2	0.68	0.31
Ear lob length	50	0.7	2	1.17	0.28
Spur length	50	0.1	0.5	0.27	0.08
Wattle length	50	0.1	1	0.59	0.10
Wing span	50	9	25	12.57	2.11
Body length	50	17	18	17.75	0.25
Pin bone to clavicle	50	12	18	14.71	0.92
Height at back (cm)	50	15	27	22.50	1.42
Height at comb (cm)	50	22	36	29.87	1.53
Body weight (gm)	50	900	1700	1180.00	59.52
Age (month)	50	7	30	16.61	1.93

The average body weight (1180 gram) of the local hens studied is higher than the value for the Central Highlands of Ethiopia (1,035 gram) reported by Alemu and Tadelle (1997) and less than the value obtained (1,316 gm) by Halima (2007) in Northwest Ethiopia.

4.4.4. Body measurement and weight of local cocks

The average body weight of the Fogera local cocks (1,505 gram) is slightly higher than the average weight of the indigenous chicken of the Central Highlands of Ethiopia (1.5 kg) reported by Alemu and Tadelle (1997) and much lower than the average weight of indigenous chicken in Northwest Ethiopia (2049.07gm), (Halima, 2007). The average body length of the studied Fogera local cocks was: 21 cm ± 1.46), while the average shank length was 9.32 cm. Major quantitative traits under this category are presented in table 36.

Table 35. Reported weight in different age group of male

Length (cm)	Male				
	No.	Min	Max	Mean	Standard Error
Shank length	50	9	10	9.82	0.12
Comb length	50	4	7.5	5.30	0.41
Comb height	50	0.4	5	2.67	0.64
Ear lob length	50	2	3	2.18	0.11
Spur length	50	0.1	2	0.53	0.19
Wattle length	50	3	4	3.50	0.15
Wing span	50	14	18	15.88	0.51
Body length	50	20	30	24.00	1.46
Pin bone to clavicle	50	18	22	18.64	0.38
Height at back (cm)	50	18	30	26.73	1.41
Height at comb (cm)	50	29	48	37.91	0.86
Body weight (gm)	50	1100	2000	1505.00	0.51
Age (month)	50	6	14	8.43	0.54

4.5. Characterization of Some Functional Traits in Monitored Flock

The following data was collected by monitoring a total of 424 local chicken eco-types from 20 HHs (10 from each wet and dry land parts).

4.5.1. Local hen production

According to the monitoring data, average number of eggs laid per clutch was 13.19; average number of egg incubated was 12.97; average number of chicks hatched was 10.23, average number of eggs wasted was 3.47; average number of chicks weaned was 7.63, average age of hen was 19.2 months; average weight of hen was 1.21kg and average weight of egg recorded was 46.96gm. Farmers in the study area used more eggs for incubation as can be seen from the high hatchability percentage (78.87%) recorded.

Table 36. Reported hen production every 10 days on the basis of hen history in the studied households

Type	Minimum	Maximum	Mean	Standard Error
No. of egg laid per clutch	1	25	13.19	0.37
No. of egg incubated	8	20	12.97	0.24
No. of chicks hatched	3	19	10.23	0.39
No. of eggs wasted	1	10	3.47	0.31
No. of chicks weaned	3	24	7.63	0.49
Age of hen in months	6	48	19.20	1.18
Weight of hen in kg.	0.9	2.1	1.21	0.04
Weight of egg in gm	33.3	66.6	46.96	1.31

Weight of day old chicks was varied from 22.22 gm to 43 gm depending on the size of hatched eggs. Weight of 6 month pullet and 6 month cockerel were 933.33 + 33gm and 1125 ± 25 gm ranging from 900 -1000 gm and 1100 -1150 gm, respectively. The average body weight of day old chicks in the study area was similar to that reported by Halima (2007) which was 27.3gm.

Table 37. Reported weight in different age group

Age of birds	Number of birds	Weight of birds			
		Minimum	Maximum	Mean	Standard Error
Day old chicks	33	22.22	43	28.76	2.55
2nd weeks chicks	25	25.00	50	38.01	4.14
3rd week chicks	33	45.00	125	79.72	9.87
1st month chicks	12	112.00	263	208.33	8.31
2nd month chicks	29	125.00	523	343.29	57.12
3rd month pullet	21	235	600	422.00	58.28
3rd month cockerels	14	550	625	591.67	22.05
4th month pullet	12	645	750	698.33	30.32
4th month cockerels	4	750	750	750.00	0.00
6th month pullets	12	900	1000	933.33	33.33
6th month cockerels	8	1100	1150	1125.00	25..00
1st egg laid hen	54	900	1250	992.31	38.54
12th month hen	37	1050	1350	1197.78	41.56
12th month cocks	21	1000	2750	510.00	15.99

During the time of monitoring, 28.93%, 22.22%, 34.26%, and 17.59 % of hens were in lay, sitting on eggs, looking after chicks, and idle hens, respectively. Even if the data from the questionnaire shows a high practice of culling, around 17.59% of the idle hens were found not culled at the time of monitoring.

Table 38. Reported number of hen laying, sitting on egg, looking after chicks and idle

Type of Hen	Number of hens	Percentage
Hens in lay	28	28.93
Hens sitting on eggs	24	22.22
Hens looking after chicks	37	34.26
Idle hens	19	17.59

4.5.2. Characterization of eggs

The egg characters of the study area were: average egg weight (44.80 ± 1.69 gm), yolk color (fun color 1-15) (9.6 ± 0.66), average yolk weight (16.28 ± 0.47), average albumin weight

(22.13 ± 1.04) and average shell weight (5.52 ± 0.23), and average shell thickness (0.45 ± 0.019).

Table 39. Egg production characteristics of the studied hens during the monitoring

Egg production	Minimum	Maximum	Mean	Standard Error
Age at first egg (days)	6	6	6	0.0
Egg number	12	15	13.5	1.50
Yolk color	5	14	9.06	0.66
Yolk weight	12.71	19.18	16.28	0.47
Albumin weight	16.01	29.61	22.13	1.04
Shell weight	4.1	8.22	5.52	0.23
Shell thickness (mm)	0.243	0.561	0.45	0.019

The average egg weight of the local chicken eco-type in the study area (44.80) is higher than the value (38gm) reported by Brannag and Pearson (1990) the local birds in Arsi; and as well more than the value (40gm) obtained from a study in Central Highlands of Ethiopia (AACMC, 1984; Tadelle, 1996); but a little lower than the value (46gm) obtained in southern Ethiopia (Teketel, 1986).

Yolk weight and yolk color in the study area were ranging from 12.7 to 19.18 gm and 5 to 14, respectively. These values are higher than that of Halima (2007) in Northwest Ethiopia where Yolk weight was 10.81 to 13.34gm and yolk color was 3 to 4.

Albumin weight in the study area was 16.01 to 29.61 gram. The same study (Halima, 2007) in Northwest Ethiopia revealed almost similar results of Albumin weight 17.71 to 28.7 gm.

Shell thickness and shell weight in the study area were ranged from 0.243 to 0.561 mm and 4.1 to 8.22 gms, respectively. This result was under farmer management, however, in intensive management at Andassa livestock research center, the value of egg shell thickens and egg shell weight ranged from 0.67 mm to 0.77 mm and 4.02 gm to 4.88 gm, respectively. (Halima, 2007). Good management can result in thicker shells-an important bio-economic trait during egg storage.

4.5.3. Flock size

Farmers attempted to increase flock size either by hatching eggs or by buying local chickens. To calculate the effective population size (Ne) per breeding population: 3.9 and consequently estimates the rate of change in inbreeding coefficient (△F) 1.95, only breeding cocks and breeding hens were included in the calculations. Farmers in the study area kept 1-2 breeding cocks, 1-20 breeding hens, 1-8 breeding replacement pullets and 1-3 replacement cockerels, per flock.

The effective population size (Ne) is a parameter used to estimate the rate of inbreeding and genetic drift (Abdelkader, 2007). This parameter depends on the number of breeding individual in an ideal population. The low effective population size (13.9) estimated in the current study suggests that the breeding population is small even if neighboring chickens were scavenging together which gives an opportunity for breeding cooks to mate with hens from other chickens. Inbreeding is considered among the constraints on chicken production because of its negative effects on performance (Abdekader, 2007)

Table 40. Flock size of the studied households in the study area

Size	Minimum	Maximum	Mean	Standard Error
Number of breeding male	1	2	1.2	0.1
Number of breeding Female	2	20	5	1.12
Number of breeding replacement male	1	3	1.7	0.25
Number of breeding replacement female	1	8	3.9	0.79
Number of Female for egg production	3	10	5.5	0.99
Number of birds for meat production male	2	2	2	0.00
Number of birds for meat production female				

4.6. Character of Basic Temperament, Physiology and Stress Tolerance and Conservation Status of Local Chicken Eco-Type in the Surveyed area

The basic temperament of male chicken was docile (24%) and moderately tractable (76%), respectively. However, female chickens were (100%) moderately tractable. Local chicken population represents the native breeds of chicken that are long–established in study area.

These are supposed to have good adaptation to harsh environmental conditions like heat tolerance and tolerance to swampyness.

A. Abdelqader *et al* (2007) considered the indigenous fowl populations as gene reservoirs, particularly of those genes that have adaptive values in tropical conditions.

Conservations status of local chicken in the studied area is vulnerable. Local breeds were likely to move in to endangered category in the near future if the native breed has been neglected by conservation and development programmers and instead high –input- high out-put exotic genotypes were introduced and supported by the government. Security of studies on local chicken and their production system is a feature of many developing Countries (A. Abdelqader *et al*, 2007). As its present use is that of an exhibition local chicken eco- type, in situ conservation is likely to be successful by targeting activities that center around the study area. This local chicken may be useful in the study area and other extreme hot and swampy area as well.

Table 41. Summary of Basic temperament, stress tolerance and conservation status of local chicken

Character	Attribute	Number of chicken	Percent
Basic temperament of male	Docile	12	24
	Moderately tractable	38	76
	Wild	0	0
Basic temperament of female	Docile	0	
	Moderately tractable	30	100
	Wild	0	
Heat Tolerance	High	100	100
Tolerance of Swamp ness	High	100	100
Conservation	Vulnerable	100	100

4.7. Carcass Characteristics

The summery of carcass components of slaughtered chickens are presented in figure 3. The average slaughter weight was: (1540 gm) for male and (1100 gm) for Female, carcass weight was 878.6 gm, and 543.8 gm for male and Female, respectively. The dressing percentage was 58.5 and 49.38 for male and female, respectively. Male and female chickens' estimated age was 10.6 months for male and 13.6 month for Female. The dressing percentage of male was higher than the dressing percentage of female. Local males may reach 1.5 kg live weight at 6 months of age and females about 30% less. The carcass weight of this study (878.6 gm) was higher than what was reported (550 gm) by another study (Alemu and Tadelle, 1997).

The average live weight of a male chicken at the age of 10.6 months was found to be higher by 28.6% than a female at an average age of 13.6 months.

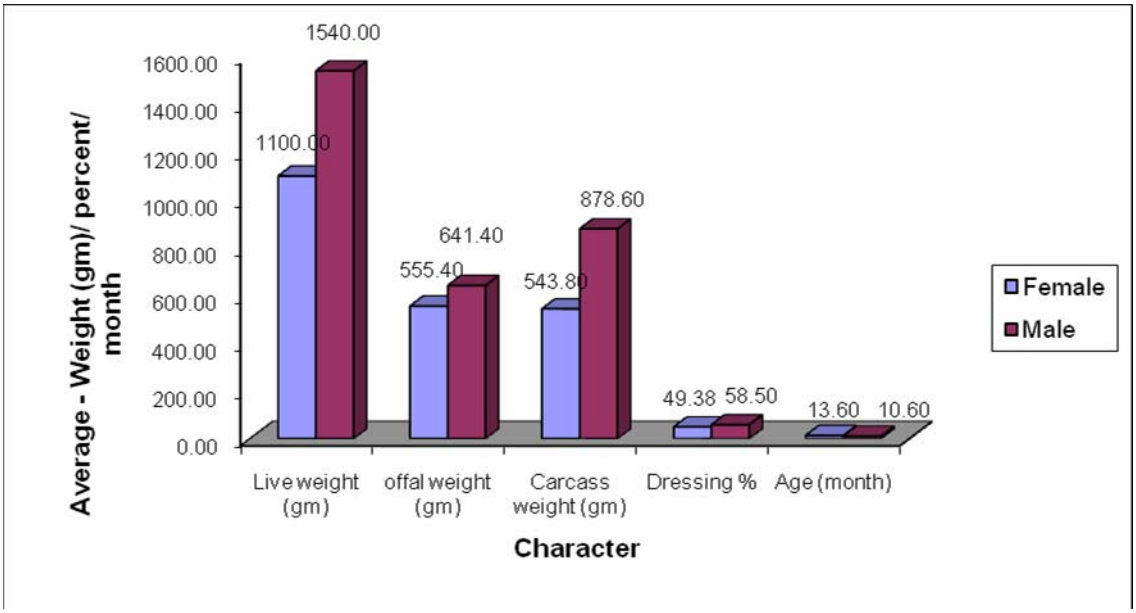

Figure 10: Caracas characters by sex (analyzed using statistical software: SPSS)

5. SUMMARY AND CONCLUSION

5.1. Summary

The research was conducted in the Fogera Woreda of the Amhara National Regional State. Fogera Woreda is predominantly lowland with an annual average temperature ranging from 22 to 29ºC . Apart from chicken, farmers in the Woreda also bred different animals (cattle, cattle, sheep, Goat, and Donkeys).

The study on the characterization of production system was conducted through a structured survey involving 72 households that owned local chicken eco-types. Characterization of physical features was done through observation and measurement of adult local chicken (N=100; M=50, F=50) for some traits. To this effect, a total of 424 chickens from dry and wetlands were monitored every ten days for a duration of four-month.

The findings of the survey reveal that local chicken population represents the native breeds of chicken that are long–established in the study area. The local chickens of the study area had good adaptation characteristics to harsh environmental conditions (e.g. tolerance to heat and swampy conditions).

The average flock size of local chickens in the area was found to be 12.38 ranging from 1 to 39. The major reported feed resources were: maize, finger millet, barely, rice, teff, wheat, and ingera, respectively. Giving supplementary feed was found to be a common practice, more so during the rainy season. While they are rich in energy, the most common supplementary feeds in the area appeared to be poor in their protein content.

In terms of sources of water, wells, rivers and taps were reported to be the main ones. Some farmers reported of walking up to 45 minutes in search of water. As chicken production requires clean and adequate water, this relatively long distance to the nearest water source could impact on the farming activity. Most farmers reported constructing separate sheds for their chicken. However, a significant number still keep chicken in the main house.

Selection of both cocks and hens for egg and meat production was found to be a very common practice. The most important selection criteria used in the area were egg production, growth rate and color. Mating was reported and observed to random and non seasonal. The average age of sexual maturity was found to be almost similar for males (5.91 months) and females (5.87months).

The survey result also revealed that the flock management practice does not involve separation of chicken based on sex and age. The study also showed that there were more male chickens than required for breeding purposes.

Diseases, feed shortage (during rainy season), lack of information about improved poultry production practices, and lack of access to credit facilities and markets were reported as the major constraints in local poultry production in their respective order.

The plumage color pattern of local chicken consisted of: complete white *(Netch*) (23%), complete black (*Tikure*) (7%),complete red(*Key*) (39%), white with black or red tins (*Netch Teterma*) (4%), grayish mixture (*Gebsima*) (5%), red with white trips (*key Teterma*) (2%), black with white tips (*Tikure Teterma*) (2%), white with Brest part golden color (*Libework*) (8%), multi color *(Gamsema)* (2%), and white with red strips (*Seran)* (4%) and red brownish (*komkima*) (4%). In terms of body shape, most of the chicken population observed had a body shape of wedge and a crest (Gutya) head profile. Almost all of the male chickens had spur while only half of the female chicken had spur. No shank feather was observed both in male and female chicken population..

Price of chicken in the study area was appeared to be very much influenced by comb and color types. Chicken with non-single (pea and rose) comb tend to generally had higher market value than those with single comb. Similarly, *Key* and *Netch* chickens tend to had higher price than *Tikur*, *Gebsima, Kokima* and *Teterima* plumage color types.

For mature hens and cocks the average shank length were 7.25cm and 9.32cm, respectively; the average body length measured were 17.75 cm and 21 cm, respectively.

In terms of flock composition, the cock to hen ratio among the local chickens was found to be 1:3.21. On the other hand, the effective population size (Ne) per breeding population and rate of change in breeding coefficient (△F) were 3.9 and 1.95, respectively (only breeding cocks and breeding hens were included in the calculation). The average weight of day old chicks in the monitored flocks was 28.76 gm.

The monitoring data revealed that average number of eggs laid per clutch per hen was 13.19; while the average number of eggs incubated was 12.97; average number of chicks hatched was 10.23, the average number of chicks weaned was 7.63, average of age of hens was 19.20 and average weight of hens was 1.21 kg.

The performance of egg production characteristics including egg weight, yolk color, yolk weight, albumin weight, shell weight and shell thickness were 44.8 gm, 9.06, 16.28 gm, 22.13 gm, 5.52 gm, and 0.45 cm, respectively. On the other hand, the dressing percentage of chickens was found to be 58.5% for male and 49.38% for Female.

5.2. Conclusions

The local eco-types had diversified colors. As an example, eleven different types of colors were observed among the chicken population monitored. The local chicken eco-types also had normal feather morphology and distribution and fast growing feather. The comb types were varied from single, pea and rose. Almost all of the males had spur, while only half of the females had spurs. For males: red, and white and red while for females white, and red and white were the most common ear lob colors. Common shank and skin colors for both sexes were: white, yellow, and bluish-black. Most of the female and male bird populations monitored had wedged body type. Despite at differential proportion, most of the female and male chickens monitored had crest head shape. Shank feathers were not observed in both sexes.

The local chicken eco-type in the study area had high hatchability percentage, medium age of sexual maturity, and long reproductive life spans. The hens seem to be moderately tractable in terms of protecting chicks form predators and birds. Furthermore, hens was appeared to have high scavenging ability. The local eco-type chickens were seems to have good adaptation to harsh environmental conditions (e.g. tolerance to heat and swampy areas). All these findings indicated that the local eco-types, despite the relatively high temperature (it goes up to 30ºC) and the swampy (wetland), Fogera plain have good potential for egg and meat production. They could also be taken and used in other places with similar weather and environmental conditions.

5.3. Recommendation

- To conserve the diversity of eco-types like Tikur, Gebsima, Kokima and Teterima who are now becoming increasingly vulnerable (their numbers are declining progressively) because farmers are discouraged from keeping them due to their low market value, it is essential to take a number of measures sooner than later. Among the measures that can address this challenge are:
  - ✓ facilitating access to markets where weight and egg are the most important price determining factors than color of a chicken (e.g major urban centers like Bahir Dar, Gondar and Addis Ababa; boarding schools/higher institutions, uniformed groups, etc);
  - ✓ public deduction against the taboo attached not to use chicken because they have this or that color through extension agents and religious and community leaders; and
  - ✓ design and implement appropriate community based genetic improvement program for local chicken eco-types.

- To maximize the benefits that farmers could get from chicken farming, government and non-government actors better strengthen ongoing efforts and start new initiatives aimed at facilitating
  - ✓ access to adequate concentrate feeds at affordable prices all year round;

- ✓ expanding cheap and effective extension and veterinary services (including training and deploying farmer vaccinators);
- ✓ introducing environmental and user-friendly artificial incubators and brooders (run by hey, solar, kerosene, bioga);
- ✓ Linkage /access to market and up to date information.
- ✓ Improving credit services could also address the growing population pressure on the limited available farm land and youth unemployment that is growing is rural areas by encouraging such groups to engage in poultry production.

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7. APPENDICES

Appendix 1. Description of qualitative traits and respective code.

1. Sex of the animal : 1=male, 2= Female
2. Pulmage color :1 = Netch, 2= Tikure, 3= Key, 4= Gebsima, 5=Anbesima, 6= Serago, 7=Libework, 8= Key teterma 9= Netch te terma, 10= Tikur teterma, 11= Kikima.
3. Feather morphology :1 =Normal
4. Feather distribution:1 = Normal
5. Feather growth :1= Fast
6. Skin color :1= White, 2=yellow, 3=blue-black
7. Shank color :1= white, 2= yellow, 3= blue-black
8. Comb type: 1= single, 2 = pea , 3= Rose
9. Ear lob color: 1= White, 2= red, 3= white and red
10. Spur : 1= present, 2= Absent
11. Body type : 1 =Blocky, 2= triangular, 3=wedge
12. Head shape: 1 Ebab ras, 2: Gutya
13. Wattle: 1= present, 2 =Absent

Appendix 2. Definition of local language

14. Netch = complete white
15. Tikure = complete black
16. Key = complete red
17. Gebsima = Grayish mixture
18. Anbesima = Multicolor
19. Seran = white with red strips
20. Libework = White with Brest part golden color
21. Key teterma = Red with white trips
22. Netch teterma = white with black or red tips
23. Tikure teterma = black with white trips
24. Kokima = red brownish
25. Ebab ras= plan
26. Guteya = crest

Appendix 3. Definition of body measurement

27. weight (wt) : was taken on spring balance using to the nearest 100g for birds and sensitive balance for eggs
28. Shank length (SL) : From hock joint to foot
29. Comb length (CL): From beak base to head
30. Comb height (CH): from the base of comb at skill to the tip of comb using tapemater to the nearest millimeter
31. Ear lob length (EL) from the base of the ear job at the ear along dorsal to the tip of earl lob to the nearest millimeter using lapemese.
32. Spur length (SPL) from the base of spur at the shank along dorsal surface to the tip of the spur using tope meter to the nearest ailmeter.
33. Wattle length (WL) from the base of wattle at the lower part of beak along dorsal to the tip of wattle using tape meter to the nearest millimeter.
34. Wing span (WS): from the base of using span at shoulder to lip of primary flights using tempter the nearest millimeter.
35. Height at back (HB): from foot to back
36. Height at comb: from foot to base of comb
37. Body length from pin bone to calvic

Appendix 4. Questionnaire

I. INSTRUCTION TO THE ENUMERATOR

Please introduce yourself before starting to question you are working for and its purpose and objective. Pleas ask each question patiently untie the farmer gets the point. For open questions fill the farmer response in short and for closed once circle or mark () where necessary

ENUMERATOR: _____

QUESTONNAIRE ON RURAL POULTRY PRODUCTION EGENRAL

A.1 Farmers name _____

A1.1 Sex

A1.2 Age

A.2. Number of family _____

A.3. Sex of family _____

a. Male _____ Female

A.4. Level of education of respondent

a. illiterate b. Elementary school

C. junior secondary school D. secondary school

A.5. Type of farming

a. Livestock b. Livestock and crop

c. Crop production only

A.6. Number of animals

a. Cattle _____ b. Sheep _____

C. Goat _____ d. Horse _____

e. Mule _____ f. Donkey _____

g. poultry _____ h. others _____

A.7. The main crops produce in the area.

1st _____ 2 nd _____ 3 rd _____4th _____

A.8. Labor *allocation in the area in order to impertinence*

Ownership	*Women*	*Men*	*Children*	
			Male	*Female*
B.3 Llabor profile				
B3.1 Shelter construction				
B3.2 Providing feed and wetter				
B.3.3 cleaning chicken house				
B3.4 Selling chicken				
B.3.5 Selling eggs				
B.3.6 Treatment				

B.4 Decision making				
B.4.1 Selling eggs				
B.4.2 Selling chickens				
B.4.3 Home consumption eggs				
B.4.4 Home consumption chicken				
B.4.5 purchase of drugs				
B.4.6 purchase of eggs				
B.4.7 Purchase of chicken				
B.4.8 Gifted				
B.4.9 others				

level of astriks A.* * * high B. ** medium C. *low

A.9 Number of chicken A. cocks _____ B. hens _____

A.9.1 Indigenous c. cockerel's _____ Pullet _____

A.9.2 Exotic a. cocks _____ b. hens _____

c.cockerels _____ d. pullet _____

A.9.3Whiteleg horn cross a. cooks _____ b. hers _____

c. cockerel's _____ d. pullet _____

A.9.4 Rode I land red cross a. cocks _____ b.hens _____

c. cockerel's _____d pullet _____

A.10 FLOCK OWNERSHIP PATTERN AND MAMAGEMENL AT HOUSE HOLD LEVEL

A.10.1 Ownership a. Owned_____ b. share _____c. rebi_____

A.10.2 Ownership in the family

a. women ____b. men ____ c. douther ____ d. son_____

A.10.3 Number of birds and there color in the house hold

A.10.3..1 Indigenous

a. Red: male _____ b. white: male _____

Female _____ Female _____

c. Black :male _____ d. gebsima: male _____

Female _____ Female _____

e. seran male _____ f. anibesma male----------
Female_____ Female_____

g. Libe work male_____ h. key Teterma Male_____
Female_____ Female_____

I . Nitchterma male_____ j .Tikur teferma male _____
Female_____ Female_____

k. okima male_____
Female_____

A.10.3.2. Exotic (WLH) Male _____
Female_____

A.10.3..3. Cross (WLH with local) Male_____
Female_____

A.10.3.4. Exotic (RIR with local) Male_____
Female_____

A.10.3.5. Cross (RIR with local) male_____
Female_____

A.11. What are the uses and functions of chicken products?

No	Type of bird	Home food		sell		Ceremony	Gift		Other	
		Birds	eggs	birds	eggs		Bird	eggs	Bird	eggs
1	Exotic									
1.1	WLH									
1.2	RIR									
2	Indigenous									
2.1	Netch									
2.2	Tikur									
2.3	Red									
2.4	Gebsima									
2.5	Anibesma									
2.6	Seran									
2.7	Libework									
2.8	Key teferma									
2.9	Nitch farmer									
2.10	Tikur feterma									
2.11	kokima									

A.12. where do you get the first source of foundation

a. home breed b. hatched

c. gifted d. others

A.13. Do you control free movement of chicken?

a. yes b. No

A.14. If yes, what is the reason

a. To protect predator b. To prevent disease

c. Other

A.15. Do you intend to expand poultry production?

a. yes b. No

A.16. If yes, what size?

A.17. If no, why?

A.18. which of these barriers to future expansion

a. land b. Capital c. labor d. Technical in formation

e. feed f. Marketing g. Theft h. disease j. others

A.17 what are the problems facing poultry farmer in this area?

_____

_____

_____

A.18. what do you think the government should do improve poultry keeping, particularly in rural areas?

_____

_____

_____

B. Socio-economics:

B.1. Rank in order to importance of chicken?

a. Social function (ceremonies, gifts, rituals) (_____)

b. To improve family nutrition (_____)

c. To create job opportunity (_____)

d. For income generation (_____)

e. To create additional job (_____)

B.2. Please prioritize the importance poultry product in family nutrition?

a. Children (_____) b. Women (_____) c. Pregnant Women (_____) d. lactating women (_____)

e. Adalts (_____) f. Old people (_____)

B.3. What are the constraints against poultry product consumption at home?

a. The expensiveness of the materials that used prepared meat and Eggs? (_____)

b. The expensiveness of chicken and eggs itself? (_____)

c. To giving priority to cash income (_____)

d. No enough chicken & egg (_____)

e. Others (_____)

B.4. Do you have access extension service in the area?

a. yes (_____) b. No (_____)

B.5. If yes, in which?

a. Crop production (_____) b. Dairy production (_____)

c. Sheep production (_____) d. Goat production (_____)

e. Poultry production (_____)

B.6. Do you get poultry production extension service?

a. yes b. No.

B.7. If yes, in what ways?

a. Advisory b. provision of improved chicks

c. providing feed d. veterinary (medicine, vaccine)

e. Complete package f. others

B.8. what determines your personal interest in poultry farming?

a. sacrifices b. self consumption c. sales

B.9. Do you feel the need to improve your poultry production?

a. yes b. No

B.10. How much time do you spend to take care of the birds every day?

C. Breed and Breeding

C.1. Do you practice selection with in your chicken flocks?

a. yes b. No

C.2. If yes, in which sex do you practice selection?

a. male b. Female c. all

C.3. For which character is do you selection (rank)

a. color b. egg production c. weight d. other

C.4. Are you interested to have exotic birds?

a. yes b. No.

C.5 How many chickens can you managed under your condition?_____

C.6. Why not more? _____

C.7. How money birds do you have?

a. all _____

b. indigenous (cocks _____ hens _____ pullet _____ cockerel _____ chicks _____)

c. exotics (cocks _____ hens _____ pullet _____ cuckeler _____ chicks _____)

C.8. Type of local breeds identified phynotopically from feather color(order)

a. Key _____ b. Netch ____ c. Tikure ____ d. Gebsima _____

e. Anibesma ___ f. Sinar _____ g. Libework _____

h. Nitch teterma _____ i. Tikur teferma. J. Key terema ____

k. others _____

C.9. Would you compare the performance exotics vs local?

a. yes _____ b. No. _____-

C.10. If yes, which one is good?

a. exotics b. Indigenous

D. Productive and Reproductive

D.1. Approximate age of sexual maturity----------months

D.2. Age of First mating male, months _____?

D.3. Number of eggs in one clutch/bird

a. Indigenous _____ b. exotics _____

D.4. How many times brood/ year?

Indigenous _____ b. exotics _____

D.5. How many eggs incubate per hen at a time? _____

D.6. How money chicks hatch in one incubation period

E. Feed and Feeding

E.1. Nutritional management

a. Scavenging b. scavenging with supplemental feed

E.2. Do you provide supplementary feed for your birds?

a. yes b. No

E.3. If yes, describe on the following table

No.	Type of supplement	Source (house hold, harvest, purchase, donation).	If purchases, unit price		Quantity & time of feeding per day	Person who feeds chicken
			Kg.	Price		

E.4. If no, provide supplementary feed why? _____

E.5. At what time you are supplement extra feed?

a. Morning b. noon C. Afternoon D. Evening

E.6. How do you give supplementary feeds?

a. together to all groups b. Separately two different classes

E.7. How do you feed your birds?

a. Put feed in container

b. Throw on the ground for collective feeding

c. Other

E.8. What is the base of offering supplementary feeds for your birds? Please list

a. to increase egg yield b. to increase meat yield c. others

E.9. If you offer extra feed to your birds, at which season?

a. wet season b. dry season

E.10. At which season poultry feed shortage is most critical?

a. rainy season b. dry season

E.11. Please prioritizes additional supplementary feed?

a. Chicks _____ b. Pullet _____ c. hen ____

d. Cooks _____ e. Cockerel _____

E.12. Do you perceive improvement due to extra supplements?

a. egg production b. growth c. other

E.13. Do you provide water to chicken?

a. yes b. No

E.14. If yes, fill in the following table

No.	Source of water (tap, river, borehole, well)	Type of drinkers	How frequently do you provide water?	How faring the source of water from the home stead?	What is the walking distance to the water source

F. Housing

F.1. Where birds rest at night?

a. Don't know b. Kitchen c. in the main house

d. have a different shelter for night enclosure in the same house

e. separate house constructed entirely for poultry F. bamboo cage g. perch on tree

h. others

F.2. Do you clean the chicken house?

a. yes b. No

F.3. If yes, how frequently do you clean the chicken house?

a. Daily b. weekly c. Monthly d. less than once per months

G. Culling

G.1. Do you have a habit culling your birds at any time

a. yes b. No.

G.2. If yes, for what purpose do you cull them?

a. For consumption b. For sale

c. For sacrifice d. Other

G.3. What factors determine which bird you will cull?

a. Poor productivity b. Old age c. Sickness d. Other

G.4. If (b) is your answer at what age of the bird do you decide to cull it? _____

G.5. If © is your answer, do you cull to

a. avoid expected disease out break

b. When the bird is already sick

H. Egg storage and Transportation of egg and chicken

H.1. Do you prepare laying place nest for the layer?

a. yes b. No.

H.2. The laying nests

a. Common for all layer b. Individual

H.3. Do you prepare place for the incubating hen?

a. Yes b. No.

H.4. Do you collect the laid eggs?

a. yes b. No c. As necessary

H.5. If yes, where do you store eggs until sale

a. Grain b. clay pots C. plastic materials

d. cartoons e. Floor depression F. Others

H.6. Source these materials

a. Purchase b. freely available c. Others

H.7. Egg for setting and market are stored in

a. Same containers b. Different

H.8. For how long do you store hatching or marketing egg?

Max _____ days

Min _____ days

H.9. Do you know any problem on eggs stored for extended period?

a. yes b. No.

H.10. Position of eggs at storage

a. on side b. small end down

c. small end up d. don't know

H.11. Do you clean eggs for setting? 1, yes 2. No.

If yes, why? _____

How _____

H.12. How do you transport egg and chicken to the market?

a. Caring by yourself b. using equines

c. using car D. Other means

H.13. If you carry by yourself, what type of materials used?

a. By your hand b. By taking hand & chest

c. using stick on the shoulder d. using basket

H.14. If you use equines, how do you transport them?

_____

H.15. If you transport by car, where do you put the birds?

a. Inside the car b. on the car

H.16. If you transport birds by your self how for transport it? _____ k.m

H.17. If you transport birds by bus how for transport it? _____ k.m

H.18. If you transport birds by draft animals how for transport it? _____ k.m

I. Hatching and Brooding

I.1.Do you practice incubating hatching eggs?

a. Yes b. No.

I.2. If yes, what type of incubation do you use?

a. Natural b. Artificial

I.3. If you use natural what type of birds do you use?

a. Broody b. Non broody c. Other

I.4. If you incubate eggs by natural what type of material do you use?

I.5. If you use artificial incubator what type of incubator you use?

a. Electrical incubator b. Kerosin incubator

c. Sun power incubator c. Straw incubator

I.6. At which season you are practicing incubating eggs?

a. Rainy season b. Dry season

I.7. Do you have an experience to break broodiness?

I.8. If yes, what way do you use?

a. _____ b. _____ c. _____

d. _____ e. _____

I.9.Do you select egg for incubation?

a. yes b. No

I.10. If yes, which size do you select?

A. small b. medium c. large

I.11. Do you clean external part eggs before setting?

a. Yes b. No.

I.12. If yes, what type of material do you use? _____

I.13. Do you select the size of hen for incubation?

I.14. If yes, which size is prefered?

a. Small b. Medium c. Large

I.15. How many eggs do you set/broody hens?_____

I.16. What type of brooder used?

1. Broody hen 2. By selemon hey box brooder

I.17. If broody hen used, how many chicks grow?

I.18. When is the chicks death and at what time?

a. First week b. Second week

c. Third week d. Forth week e. Six –eight week

I.19. What are the main causes of chicks death?

a. Disease b. predators c. birds d. others

I.20. If you use selemon's hey box brooder, how many chicks grow?_____

I.21. When is the chicks death happened?

a. First week b. Second week

b. Third week d. Forth week

I.22. How long you do use in one broody time?

a. One months b. Two month's

c. Three months d. Four months e. Five month's

J. Marketing

J.1. Where do you sell most of the chicken product?

a. In the same village b. In the neighboring village

c. In the nearest market d. In the woreda market

J.2. If you sell in neighboring village what is the distance b/n villages (km)?

_____

J.3. If you sell in the nearest market how far from your house k.m _____

J.4. If you sell in the woreda market how far from your house (km) _____

J.5. Distance from the main road to your house (km)?

J.6. Are there any institution to facilitate marketing?

J.7. If yes, _____

a. When established b. The name of the institution

c. How many members are there? Male _____ Female _____

J.8. Are there any institution giving credit services to you?

a. Yes b. No

J.9. If yes,

a. When established b. The name of the institution

c. How many members are beneficial?

J.10. Sample questionnaire for market survey on village chicken and chicken product

No.	Details	Demand								Supply							
		Chicken				Egg.				Chicken				Egg.			
		Low		High		Low		High		Low		High		Low		High	
	Season																
	Main chicken category	Price		Price		Price		Price		Price		Price		Price		Price	
		netela	Dird	Netela	Dird	No.	Bir	No.	Birr	netela	Dirb	Netla	Dird	No.	Birr	No.	Birr
1.	Exotic																
1.1	WHL																
1.1.1	Mature cocks																
1.1.2	Mature hen																
1.1.3	Pullet																
1.1.4	Cockerel																
1.2	RIR																
1.2.1	Mature cocks																
1.2.2	Mature hen																
1.2.3	Pullet																
1.2.4	Cockerel																
`1.3	WHL Cross																
1.3.1	Mature cocks																
1.3.2	Mature hen																

1.3.3	Pullet																
1.3.4	Cockerel																
1.4	RIR Cross																
1.4.1	Mature cocks																
1.4.2	Mature hen																
1.4.3	Pullet																
1.4.4	Cockerel																
2.	Indigenous																
2.1	Netch																
2.1.1	Mature cocks																
2.1.2	Mature hen																
2.1.3	Pullet																
2.1.4	Cockerel																
2.2.	Key																
2.2.1	Mature cocks																
2.2.2	Mature hen																
2.2.3	Pullet																
2.2.4	Cockerel																
2.3	Tikur																
2.3.1	Mature cocks																
2.3.2	Mature hen																
2.3.3	Pullet																

2.3.4	Cockerel																
2.4	Gebsima																
2.4.1	Mature cocks																
2.4.2	Mature hen																
2.4.3	Pullet																
2.4.4	Cockerel																
2.5	Ambesima																
2.5.1	Mature cocks																
2.5.2	Mature hen																
2.5.3	Pullet																
2.5.4	Cockerel																
2.6	Seran																
2.6.1	Mature cocks																
2.6.2	Mature hen																
2.6.3	Pullet																
2.6.4	Cockerel																
2.7	Libework																
2.7.1	Mature cocks																
2.7.2	Mature hen																
2.7.3	Pullet																

2.7.4	Cockerel																
2.8	Netch Teterima																
2.8.1	Mature cocks																
2.8.2	Mature hen																
2.8.3	Pullet																
2.8.4	Cockerel																
2.9	Tikur Teterima																
2.9.1	Mature cocks																
2.9.2	Mature hen																
2.9.3	Pullet																
2.9.4	Cockerel																
2.10	Key Teterima																
2.10.1	Mature cocks																
2.10.2	Mature hen																
2.10.3	Pullet																
2.10.4	Cockerel																

J.11. What are the main delivery systems?

a. Village market b. Woreda town merchant

c. Hotels d. Consumers e. Other

J.12. Who is the main seller of chicken and chicken products?

a. Men b. Women C. Children

J.13. Which of the following item do you spend money on?

a. Purchase of birds b. Purchase of Feed

c. Purchase of veterinary product d. none at all e. Other

J.14. Where do you get money to Finance your poultry farming

a. Personal income b. Money lenders

c. Bank d. Cooperatives

e. Family or friends

J.15. What are the problems relating to poultry marketing in your experience?

a. Price b. Availability of substitute

c. Poor sale d. Other

K. Health

K.1. Have you experienced any disease problem in your poultry production

K.2. If yes, indicate the symptoms /disease and control measures take using the chart?

Name of disease	Symptoms	Age mostly affected	Loss	Local treatment

K.3. Do you have access to veterinary services?

a. Yes b. No

K.4. If yes, please fill the chart below?

No.	Center	Types of Service			Cost incurred	Frequency of visits by veterinary assistance
		Advice	Diagnosis	Giving drugs		

K.5. In which season do you lose most of your chickens?

a. Rainy season b. Dry season c. Both seasons

K.6. What was the source of infection?

a. own flock b. Incoming chicken c. Neighboring household

d. Neighboring village e. unknown

K.7. What do you think is the best disease control method?_____ _

L. Extension contact & services

L.1. Do you discuss your poultry production problems with extension agent? a. Yes b. No.

L.2. If no, state the reasons?

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

c. There is no need d. Other

L.3. If yes, where do you meet?

a. Agents office c. unintended meeting

b. Farm home d. at co-operative meeting

e. at the demonstration station

L.4. How frequently do you see the agent? _____

L.5. What is your major source of information on improved poultry production practices?

a. Do not get such information

b. Television c. Radio

d. News paper e. Other farmers

f. Extension agent g. Market women's

h. Cooperative leaders i. Neighbors

J. Relatives k. Others

II. Questionnaire for monitoring

1. Enumerator _____
2. Region _____
3. Zone _____
4. Kebele _____
5. Household _____
6. Date _____

7. Monitoring data collection matrix (to be completed every 10 days)

Mature Hen	No. of eggs laid per clutch	No. of eggs incubated	No. of chickens hatched	No. of eggs wasted	No. of chickens Weaned	Age	Weight Hen / Egg
Hen 1							
Hen 2							
Hen 3							
Hen 4							
Hen 5							
Hen 6							
Hen 7							

Hen 8							
Hen 9							
Hen 10							

8. Total no. of chicken
   8.1. No. of day old chickens _____average weight_____
   8.2. No. of second week chickens _____average weight_____
   8.3. No. of first month chickens _____average weight_____
   8.4. No of 3rd month pullets _____ average weight_____
   8.5. No of 3rd month cockles _____average weight_____
   8.6. No. of 6th month cockles _____ average weight_____
   8.7. No. of 6th month pullets _____ average weight_____
   8.8. No. of 1st egg laid hen _____ average weight_____
   8.9. No. of 12th month cooks _____average weight_____
   8.10. No. of 12th month hen _____ average weight_____

9. Record the no. hens that laid eggs since the previous vest. Also record the number no. of hens that are constantly sitting on eggs and looking after chickens.

	Hens in Lay	Hens sitting in eggs	Hens looking after chickens	Idle hens
Vest				
Vest				

III. CHICKEN DESCRPTORS MASTER RECORD

1. Breed name
2. Breed name synonyms
3. Strains with in breed
4. General information and breed description

4.1 country and population data
4.1.1. Country name
4.1.1.1. Population size
4.1.1.2. Census data
4.1.1.3. Estimated value
4.1.1.4. Unspecified
4.1.1.5. Annual population trend (+ %,-%), unknown
4.1.1.6. Flock size
4.1.1.7. Origin of breed
4.1.1.7.1. Indigenous
4.1.1.7.2. Exotic
4.1.2. Country name
4.2. Type of stock
4.2.2. Improved indigenous
4.2.3. Middle-level pure bred
4.2.4. Industrial layer
4.2.5. Industrial broiler
4.2.6. Others (specify)

4.3 Use of stock

A. Egg	C. Meat and egg
B. Meat	D. Ornamental or fancy
E. Fighting	F. Cultural (religions)
G. Others	

4.4 Origin if imported
A. North America
B. Europe
4.5 Feather Characteristics
4.5.1. Feather morphology

A. Normal	C. Silky
B. Frizzle	D. Others (specify)

4.5.2. Feather distribution

A. Normal	C. Feather shanks & Feet
B. Necked Neck	D. Muffs and bread
G. Others (specify)	F. Vultures hocks

4.5.2. Feather growth rate
A. Fast feathering
B. Slow feathering
4.6. Plumage (coat) colour

A. Complete white	E. Sindama	I. Tikur Teterama
B. Complete black	F. Ambesma	J. Wosera
C. Complete red	G. Nitchteterma	K. Sinar
D. Gibsema	H. Key teterma	L. Libework
M. Kokima	N.Dalecha	O. Zigrima

4.7. Shank colour

A. Complete white	E. Sindama	I. Tikur Teterama
B. Complete black	F. Ambesma	J. Wosera
C. Complete red	G. Nitchteterma	K. Sinar
D. Gibsema	H. Key teterma	L. Libework
M. Kokima	N.Dalecha	O. Zigrima

4.8. Skin characteristics

4.8.1 Skin colour

A, white B. Yellow C. Blue-Black D. Other

4.8.2 Shank skin colour

A. white B. Yellow C. Blue-Black D. Other

4.9. Comb type

A. single B. pea C. Rose D. Walnut F. Duplex

4.10. Earlobe colour

A. White B. Red C. white and red D. other

4.11. Shank Feather Length (cm)

4.12. Shank Length (cm)

4.13. Comb length (cm)

4.14. Earlobe Length (cm)

4.15. Spur Present (A/P)

4.16. Length of spur/cm

4.17. Wattle length/cm

4.18. Wing span (arrested) /cm

4.19. Head Shape

A. Ebab Ras B. Gutya

4.20. Body length /cm

A. Pin bone to clavicle

4.21. Height at back (arrested) /cm

4.22. Height Comb (arrested) /cm

4.23. Body Shape

A. Blocky B. Triangular C. Wedge

4.24. Body Weight

4.25. Age /Month/Week/Day

4.26. Sex

4.27. Basic temperature

A. Docile B .Moderately C. Wild

4.28. Heat tolerance

A. High B. Medium C. Low

4.29. Resistance swampiness

A. High B .Medium C. Low

4.30. Conservation status

A. Endangered B. Vulnerable C. Rare D. Note at risk

E. Out of danger F. Insufficiently Known

5. Socio- management system
    A. Indigenous stock, extensive management
    B. Indigenous stock, intensive management
    C. Middle- level stocks extensive management
    D. Middle- level stocks, intensive management
    E. Industrial stock, extensive management
    F. Industrial stock, intensive management

6. Type of Farm
    A. Peasant agriculture
    B. breeding center
    C. commercial production unit
    D. Experiment station
    E. Field experiment station
    F. Multiplication unit
    G. Other
7. Degree of management supervision
    A. Advisor
    B. Resident professional supervision
    C. Supervision by scientific staff of investigation project
    D. None
8. Meting method
    A. un controlled non- seasonal natural meting
    B. un controlled seasonal natural meting
    C. controlled natural meting
    D. Artificial insemination
    E. Other
9. Incubation method
    A. Natural incubation
    B. Artificial still-air incubation
    C. Artificial forced- air incubation
10. Flock size
    A. Number of breeding male
    B. Number of breeding Female
    C. Number of breeding replacement male
    D. Number of breeding replacement female
    E. Number of female for egg production
    F. Number of birds for meat production
        a. male b. female

11. Nutritional management
    A. Scavenging
    B. Scavenging with supplemental feeding

12. Housing
    A. Disease and parasites, and tolerance of housing conditions
    B. Measure against disease, parasites, and undesirable behaviors
13. Health
    A. vaccination and immunization
    B. curative medication
    C. Prevention medication
    D. Behavior modification
14. Performance
  14.1 egg production characteristics
    A. egg production and age
    B. Age at first egg,days
    C. egg number
    D. clutch length, days
    E. egg size
        a. egg size 32 weeks of age /gm
        b. egg size 52 weeks of age /gm
        c. egg size 72 weeks of age /gm
    F. Egg shape index
        a. Length (mm) x breadth (mm) /100
    G. shell color
        a. white _____ b. brown_____ c. cream or tinted _____
        d. blue_____ e. green_____ f. other_____
    H. shell quality
        a. specific gravity, 32 week of age
        b. specific gravity, 52 week of age
        c. specific gravity, 72 week of age
    I. Albumen quality
        a. Haugh units, 32 week of age
        b. B Haugh units, 52 week of age
        c. Haugh units, 72 week of age
    L. Egg inclusion bodies
        a. Blood spots 32, weeks of age
        b. Blood spots 52, weeks of age
        c. Blood spots 72,weeks of age

15. Reproduction characteristics
    A. Broodiness
        a. usual b. sometimes c. rare d. other
    B. Fertility and hatchability
    C. fertility
        a. hatch of fertilize egg, %
        b. hatch of total eggs set, %
16. Growth characteristics
  16.1. Growth rate

A. Body weight at hatching, gm male _____female _____mixed_____
B. Body weight at hatching, 12gm male _____female _____mixed_____
C. Body weight at hatching, 16 gm male _____female _____mixed_____
D. Body weight at hatching, 20 gm male ____ female _____mixed_____
E. Body weight at hatching, 32 gm male _____female _____mixed_____
F. Body weight at hatching, 52 gm male _____ female _____mixed_____
G. Body weight at hatching, 72 gm male _____female _____ mixed_____

17. Physiology and stress tolerance
    A. tolerances of temperature and humidity extremes
    B. tolerance of industrial floor pen housing
    C. tolerance of industrial cage housing
18. Master record prepared by:
    A. name C. Address
    B. title D. Affiliation E. Date of preparation

Appendix Tables

Appendix Table 1. Availability of marketing and credit service

Response	Market facility		Credit service facility	
	Number	%	Number	%
Yes	2	2.8	20	27.4
No	62	86.1	43	59.7
Not responded	8	11.1	9	12.5

Appendix Table 2: Size of broody hens and eggs

Size	Brood hen		Egg	
	Number	%	Number	%
Small	0	0	1	1.4
Medium	14	19.4	7	9.7
Large	48	66.7	61	84.7
Not applicable	10	13.9	3	4.2