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Indigenous chicken production and marketing systems in Ethiopia: Characteristics and opportunities for market-oriented development

Improving Productivity and Market Success of Ethiopian Farmers

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Indigenous chicken production and marketing systems in Ethiopia: Characteristics and opportunities for market-oriented development

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Summary

This working paper presents a synthesis of research findings undertaken in three *woredas* or districts (Bure, Fogera in Amhara Regional State and Dale in the Southern Nations, Nationalities and Peoples Regional State) in Ethiopia. These *woredas* are Pilot Learning *Woredas* (PLWs) of the Improving Productivity and Market Success (IPMS) of Ethiopian Farmers Project being implemented by the International Livestock Research Institute (ILRI). The major objective of these studies was to assess the existing indigenous chicken production and marketing systems and identify major constraints and priorities for improvement and extension interventions. A formal survey with structured questionnaire and Participatory Rural Appraisal (PRA) methods relevant to village chicken production systems were used to collect data. The result of these studies revealed that the dominant chicken production system of the study districts is an extensive/traditional type of production, using local chicken ecotypes, managed mainly on scavenging with seasonal feed supplementation of home-grown grains and household food refusals. The purpose of village chicken keeping in their order of importance are: sale for cash income (51.4% for Bure and 44% for Dale), egg hatching for replacement (45% for Bure and 34% for Dale), home consumption (44.3% for Bure and 22% for Dale), use of chicken for socio-cultural and/or religious ceremonies (36.4% for Bure) and egg production (40.7% for Bure). Alternatively, hatching for replacement (71.7% for Bure and 47% for Dale), sale for income (51.4% for Bure and 33% for Dale) and home consumption (51.4% for Bure and 20% for Dale) are the purpose of egg production in the study areas. The flock size/household was 1–57 chicken for Bure, 1–39 chicken for Fogera and 3–26 chicken for Dale. The cock to hen ratio is 1:3.7 for Bure, 1:3.2 for Fogera and 1:2.2 for Dale. The result of the studies revealed that 22.1%, 59.7% and 97.6% of village chicken owners construct separate overnight shelter for chicken in Bure, Fogera and Dale districts, respectively. The rest of chicken owners keep chicken in various night sheltering places. The average age of local pullets at first laying is 5.74 and 7.07 months for Bure and Dale districts, respectively. The average number of eggs laid/clutch by local hens is 16 (ranged 8–28), 13.2 and 14.5 eggs (ranged 6–26) for Bure, Fogera and Dale districts, respectively. The number of total clutch periods/hen per year is 4 (ranged 2–6) and 3.7 (ranged 2–5) for Bure and Dale districts, respectively. Accordingly, the annual egg production performance of local hens, under the existing farmer's management condition, is 60, 53 and 54 eggs/hen for Bure, Fogera and Dale districts, respectively. The average hatchability performance of local broody hens in Bure district is 82.6%. However, survival rate of young chicks, up to production age is only 60.5% (ranged 0–100%) and 74.6% in Bure and Fogera districts, respectively. High hatchability performance of local hens and high mortality of young chicks are the two contradictory features of the existing village chicken

production system. Seasonal outbreaks of diseases (84.3%) and predation (11.4%) are the major causes for loss of chicks. Women are responsible in managing chicken in all the study sites. These chicken husbandry activities include cleaning the chicken house (38.6%), feeding (80.7%), selling chicken (82.9%) and selling eggs (54.6%). Men are involved mainly in shelter construction (97.5%) and taking sick chicken for treatment (89.3%). Improving the production and productivity level and market efficiency of the village poultry production system could possibly be used as a means to economically empower women. Producer–consumer, producer–middle men, middle men–retailer (local restaurants), middle men–consumer are the prevailing chicken and egg marketing channels. Plumage colour, sex, comb type, feather colour and age are important traits for socio-religious functions of chicken, as is the commitment of an individual or the household to a particular spiritual being or a cosmic force, season and traditional and/or religious festival, which in turn, have big effect on price. Regarding the quality of eggs, the average weight of eggs is 43.2 gm and 44.9 gm for Bure and Fogera districts, respectively. The average yolk colour measurement of eggs is 8.6 and 9.06 for Bure and Fogera districts, respectively. The higher yolk colour value obtained from the current study indicates that scavenging feed resource bases are rich in xanthophylls, which are the precursors of vitamin A. The deep yellow colour obtained from eggs collected from scavenging chicken is preferred by local consumers. Most of the respondent village chicken owners showed great interest to boost up indigenous chicken production and productivity. This could be an opportunity and potential to design and implement interventions, aiming at improving production and productivity and minimizing losses of chicken. Therefore, efforts have to be made to improve productivity of indigenous chicken in a sustainable way and to shift the existing extensive subsistence mode of production system to a semi intensive one, focusing on market orientation. Emphasis should be given in availing production technologies including breeding systems, organizing input supply system for chicks, feed, vaccines and veterinary drugs, and in developing market linkages for chicken and eggs. A holistic and multi-disciplinary support of services like extension, training, veterinary and credit are critical in supporting indigenous chicken improvement programs. The national research system should also consider the importance of indigenous genetic resources and strive to develop appropriate technologies targeted at conserving the unique genetic resources and improving village flock production and productivity.

Key words: village chicken production; indigenous chicken ecotypes; scavenging, egg quality; marketing systems

1 Introduction

Animal production in general and chicken production in particular play important socio-economic roles in developing countries (Alders 2004; Kondombo 2005). Nearly all rural and peri-urban families in developing countries keep a small flock of free range chicken (Branckaert and Gueye 1999; Riise et al. 2004a). Approximately 80% of the chicken populations in Africa are reared in free scavenging systems (Gueye 1998). According to Robert et al. (1992) and Sonaiya (2004), smallholder farming families, landless labourers and people with incomes below the poverty line are able to raise chicken with low inputs and harvest the benefits of eggs and meat via scavenging feed resources. In most African countries, the rural chicken population accounts for more than 60% of the total national chicken population (Sonaiya 1990). The proportional contribution of poultry to the total animal protein production of the world by the year 2020 is believed to increase to 40%, the major increase being in the developing world (Delgado et al. 1999). However, most communities lack the required husbandry skills, training and opportunity to effectively improve their household chicken production (Mlozi et al. 2003).

In Ethiopia, chicken are widespread and almost every rural family owns chicken, which provide a valuable source of family protein and income (Tadelle et al. 2003a). The total chicken population in the country is estimated at 38.1 million (CSA 2009). The majority (99%) of these chicken are maintained under a traditional system with little or no inputs for housing, feeding or health care. The most dominant chicken types reared in this system are local ecotypes, which show a large variation in body position, colour, comb type and productivity (Teketel 1986; Tadelle et al. 2003b; Halima et al. 2007). The greater part of the feed for village chicken is obtained through scavenging, which includes the household cooking waste, cereal and cereal by-products, pulses, roots and tubers, oilseeds, shrubs, fruits and animal proteins (Tadelle 1996).

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

Despite their low productivity, indigenous chicken are known to possess desirable characteristics such as thermo-tolerance, resistance to some diseases, good egg and meat flavour, presence of hard egg shells, high fertility and hatchability as well as high dressing percentage (Aberra 2000). However, according to Cumming (1992) and Panda

(1987) little research and development works have been carried out on indigenous chicken, despite the fact that they are more numerous than commercial chicken in most developing countries and they have been marginalized by decision-makers.

According to Gueye (1998) and Pedersen (2002), it is difficult to design and implement chicken-based development programs that benefit rural people without understanding village chicken production and marketing systems. Hellin et al. (2005) also reported that understanding of village chicken functioning and marketing structure are a prerequisite for developing market opportunities for rural households and could be used to inform policymakers and development workers in considering the commercial and institutional environment in which village chicken keepers have to operate. Studies on marketing of free range chicken can also provide clues for management strategies of these chicken especially in reducing chicken losses that smallholder farmers experience annually due to the threat of diseases, especially Newcastle Disease (Aklilu et al. 2007). According to Mlozi et al. (2003) information obtained from analysis of village chicken production and marketing systems study is highly required to characterize, conserve and improve the indigenous chicken genetic resource and to justify resource allocation to rural poultry improvement and conservation projects.

Generally, in order for decision-makers to address poultry related challenges in production and marketing and to improve the nutrition, food security and livelihood of rural households by enhancing the benefits from poultry through appropriate production and marketing extension, it is essential to generate appropriate technologies which are socially acceptable, environmentally sound and economically feasible. The main advantages of chicken marketing research are defining the needs and nature of customers and their ability and desire to buy, scanning the business environment, gathering needed information for decision-making, reducing risk, helping in production planning and monitoring and controlling marketing activities (Gondwe et al. 2005). Access to markets affects the price and transaction costs and is influenced by access to infrastructure and information (Aklilu et al. 2007).

Although there are some studies conducted on characterization of chicken production systems in some locations in Ethiopia, they are not comprehensive enough and did not relate production and productivity with marketing. Some of these studies were also site specific. Characterization of the prevailing chicken production and marketing system is therefore an essential prerequisite to bring this into effect. Therefore, this paper synthesises studies on indigenous chicken production and marketing systems from various parts of the country.

2 General objective

- To assess and characterize the prevailing indigenous chicken production and marketing systems in selected districts in Ethiopia.

2.1 Specific objectives

- To study the production and reproduction performance of indigenous chicken ecotypes under farmer's management conditions;
- To characterize the physical, functional and adaptive traits of indigenous chicken ecotypes and to describe economic and social functions of these traits in their production environment;
- To evaluate the external and internal qualities of eggs from indigenous hens; and
- To assess the prevailing indigenous chicken production and marketing constraints and suggest possible improvement options.

3 Background

3.1 Indigenous chicken production in Ethiopia

Family chicken production is an appropriate system that makes the best use of locally available resources (Tadelle et al. 2003a). Data on livestock populations in Africa show that chicken population is the highest (Sonaiya et al. 1998). In sub-Saharan Africa, 85% of all households keep chicken under free range/extensive system, with women owning 70% of it, providing scarce animal protein in the form of meat and eggs as well as being a reliable source of cash income (Gueye 1998; Bagnol 2000; Sonaiya et al. 2004; Abubakar et al. 2007).

Ethiopia is one of the few African countries with a significantly large population of chicken, estimated at 38.1 million (CSA 2009). However, the number of chicken flocks per household in most Ethiopian rural communities is small; constituting an average of 7–10 mature chicken, 2–4 adult hens, a male bird (cock) and a number of growers of various ages (Tadelle and Ogle 2001). Alemu and Tadelle (1997) also reported that the local chicken in Ethiopia vary widely in body size, conformation, plumage colour, comb type and feather cover.

3.2 Importance of village chicken production

According to Bishop (1995), chicken were among the most adaptable domesticated animals and more people are directly involved in chicken production throughout the world than in any other single agricultural enterprise. The impact of village chicken in the national economy of developing countries and its role in improving the nutritional status, income, food security and livelihood of many smallholders is significant owing to its low cost of production (FAO 1997; Gondwe 2004; Abdelqader 2007; Abubakar et al. 2007).

According to Moreki et al. (2001), family chicken are rarely the sole means of livelihood for the family, but is one of a number of integrated farming activities contributing to the overall well-being of the households. It provides employment and income generating opportunity and is a priority animal for holy day and religious sacrifices (Sonaiya 2000; Tadelle and Ogle 2001; Gueye 2003). Village chicken also play a role of converting household leftovers, wastes and insects into valuable and high quality protein (Doviet 2005). There are only few alternative animal protein sources available in the tropics including chicken and eggs (Odunsi 2003). Family chicken meat and eggs contribute 20–30% to the total animal protein supply in low-income and food-deficit countries. Village chicken could be particularly important in improving the diet of young children in sub-Saharan Africa (Alam 1997).

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

According to Tadelle (2003), in Ethiopia, village chicken production systems are characterized by low input–low output levels. A range of factors such as suboptimal management, lack of supplementary feed, low genetic potential and high mortality rate are the major causes for the apparent low output level. However, village chicken production is part of a balanced farming system, plays an important role in the supply of high quality protein to the family food balance, and provides small disposable cash income in addition to the socio-religious functions important in the rural people's lives.

3.3 Production and reproduction performances of village chicken

The productivity of village chicken production systems in general and the free range system in particular is low (Kondombo 2005). This is due to low egg production and high mortality rate (Nigussie et al. 2003). Teketel (1986) and Aberra (2000) also characterized the low productivity of local chicken due to low egg production performance, production of small sized eggs, slow growth rate, late maturity, small clutch size, an instinctive inclination to broodiness and high mortality of chicks.

In Ethiopia, a local scavenging hen on average lays about 36–40 eggs/year (Tadelle et al. 2000; FAO 2004). The average egg weight of local hens around Arsi, Ethiopia, was reported to be 38 gm (Brannang and Persson 1990). The average number of eggs/clutch of local hens in Burkina Faso was estimated to be 12 eggs (Kondombo 2005), which is comparable to the range of 12–18 eggs reported by Gueye (1998), but higher than that of 10 eggs/clutch reported by Mourad et al. (1997) in Guinea and 9 eggs/clutch by Kuit et al. (1986) in Mali. Halima (2007) reported an average productivity of 9–19 eggs/clutch with 2–3 clutch periods/hen per year and an average total egg production ranged from 18–57 eggs/year per hen for local hens in North-West Ethiopia. The average number of clutches/hen per year and the number of eggs/clutch of local chicken in Sudan were 3 and 12 eggs, respectively (Khalafalla et al. 2001).

According to Sonaiya et al. (1998), Aini (1990) and Gueye (2000), the annual egg production/hen of local hens in village conditions ranged from 20 to 100 eggs; with an average egg weight range of 30 to 50 gm. According to Gueye (2000), the adult male and female weight of African village chicken range from 1.2 to 3.2 kg and from 0.7 to

2.1 kg, respectively. The productivity of local chicken in Guinea (Mourad et al. 1997) is presented in Table 1.

Table 1. *Production performance of local chicken in Guinea (No. = 166)*

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

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

3.4 Challenges in village chicken production systems

The most striking problem in village chicken production systems is the high mortality rate which could reach as high as 80–90% within the first few weeks after hatching, due to diseases and predation (Wilson et al. 1987). Newcastle disease (NCD) is highly infectious and causes more losses than any other diseases in the tropics. The disease spreads rapidly through the flock and mortality could reach up to 100% (Aini 1990; Bishop 1995; Nigussie et al. 2003; Serkalem et al. 2005; Nwanta et al. 2008).

Among the infectious diseases, NCD, salmonelloses, coccidioses and fowl pox are considered to be the most important causes of mortality in local chicken while predators are an additional causes of loss (Eshetu et al. 2001). According to Tadelle (2001), the high mortality of chicks under village chicken production in the central highlands of Ethiopia is due to diseases, parasites, predation, lack of feed, poor housing and insufficient water supply.

The other major limiting factor of village chicken production is feed, in terms of both quantity and quality (Mohamed and Abate 1995). The nutritional status of local laying hens from chemical analysis of crop contents indicated that protein was below the requirement for optimum egg production and the deficiency is more serious during the short rainy and dry seasons (Tegene 1992; Alemu and Tadelle 1997).

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

3.5 Role of women in village chicken production and ownership

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

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

According to Abubakar et al. (2007), in a study conducted on village chicken production in some parts of Nigeria and Cameroon, all gender categories are involved in chicken management, with children having the highest responsibility of housing the chicken at night and letting them out in the morning. Based on the result of the study, women own the majority of chicken (52.7%) followed by children (26.9%) and men (20.4%) in Cameroon; unlike the situation in Nigeria, where the majority of the chicken are owned by men (55.6%) followed by women (38.9%) and children (11.1%). In Bangladesh, women are able to operate and manage technical enterprises like broiler farming, layer farming and duck farming efficiently with a high economic return on the investment (Riise et al. 2004b). Halima (2007) also reported that rural women in North-West Ethiopia are more responsible for chicken rearing in both male and female headed households, while men are responsible for crop cultivation and other off-farm activities.

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

According to Gueye (2003), the management of rural chicken in Africa is a family affair. Construction of chicken house and major decisions on sale of chicken and eggs and consumption of chicken products is under the control of men, while looking after chicken, controlling and utilizing the earnings from the sale of eggs and chicken belongs

to women. Similarly, Tadelle and Ogle (2001) indicated that in Ethiopia, management of chicken is fully in the domain of women, while decision on control and access to resources varies considerably. Kitalyi and Andre (1998) also reported that there is gender plurality in decision-making in village chicken production in the Gambia.

3.6 Marketing systems of village chicken and eggs in Ethiopia

In Ethiopia marketing chicken and eggs is one of the functions of keeping free range chickens by smallholder farmers. Village chicken and eggs are sold in local and urban markets to traders (collectors) or directly to consumers depending on the location of the farm dwelling. According to Assefa (2007) and Halima (2007), smallholder village chicken owners found in different parts of the country sell chicken and eggs to purchase food items, to cover school fees, to get cash for grain milling services, to purchase improved seeds and to adjust flock size. Tadelle (2001) also reported that few farmers in central highlands of Ethiopia exchanged their free range chicken for food and household items.

Most consumers in Ethiopia prefer to buy local chicken from village producers, since they are considered to be tasty and better suited for preparation of the traditional chicken sauce (locally called 'doro wot'). Eggs from local chicken are often favoured because of their deep yellow coloured yolks. As a result, free ranging local chicken are in higher demand and fetch higher market prices in urban markets (ILRI 1995). According to Halima (2007), the price of chicken is highly related to holy days, non-fasting season for the Orthodox Christians, plumage colour, comb type, size, age, sex, market site and health status of chicken. The chicken and egg marketing channels in the country are informal and poorly developed. Chicken and eggs are sold to consumers within the villages, on roadsides and in local and urban markets (ILRI 1995).

3.7 Extension interventions to improve village chicken production

Improvement of the genetic potential of the local chicken could be done through selection within and/or upgrading through crossbreeding with exotic breeds. In Ethiopia, scientists and the government have been promoting a crossbreeding scheme through distribution of cockerels from selected exotic breeds with the intention of improving the productive performance of the local chicken for the last four decades. An alternative scheme to improve poultry production is introduction of exotic poultry breeds. The extension system has been disseminating exotic chicken breeds (dominantly White Leghorn (WLH) and Rhode Island Red (RIR)) as a poultry extension package to improve the productivity of local chickens. Unfortunately, no systematic effort has been made

to evaluate the performance of these schemes. This is mainly because ownership pattern, control and access of resources, distribution of benefits and marketing have not been adequately addressed in the process of the interventions (Sonaiya 1990). Lack of recorded data on the performance of chicken and all aspects of management, lack of regular chicken health program and market information makes it difficult to assess the importance and contributions of the past attempts to improve the sector.

4 Materials and methods

4.1 Description of the study *woredas*

The Improving Productivity and Market Success (IPMS) of Ethiopian farmers project is implemented in four Regional States in Ethiopia, i.e. Tigray, Amhara, Oromia and Southern Nations Nationalities and Peoples Regional State (SNNPR) and is operational in 10 Pilot Learning *Woredas* (PLWs). This synthesis work is based on studies conducted at three PLWs (Figure 1); namely Bure and Fogera *woredas* in the Amhara National Regional State (ANRS) and Dale *woreda* in the (SNNPR). These three *woredas* were selected for the study due to the relatively high chicken population they have which is collectively estimated at 673,729.

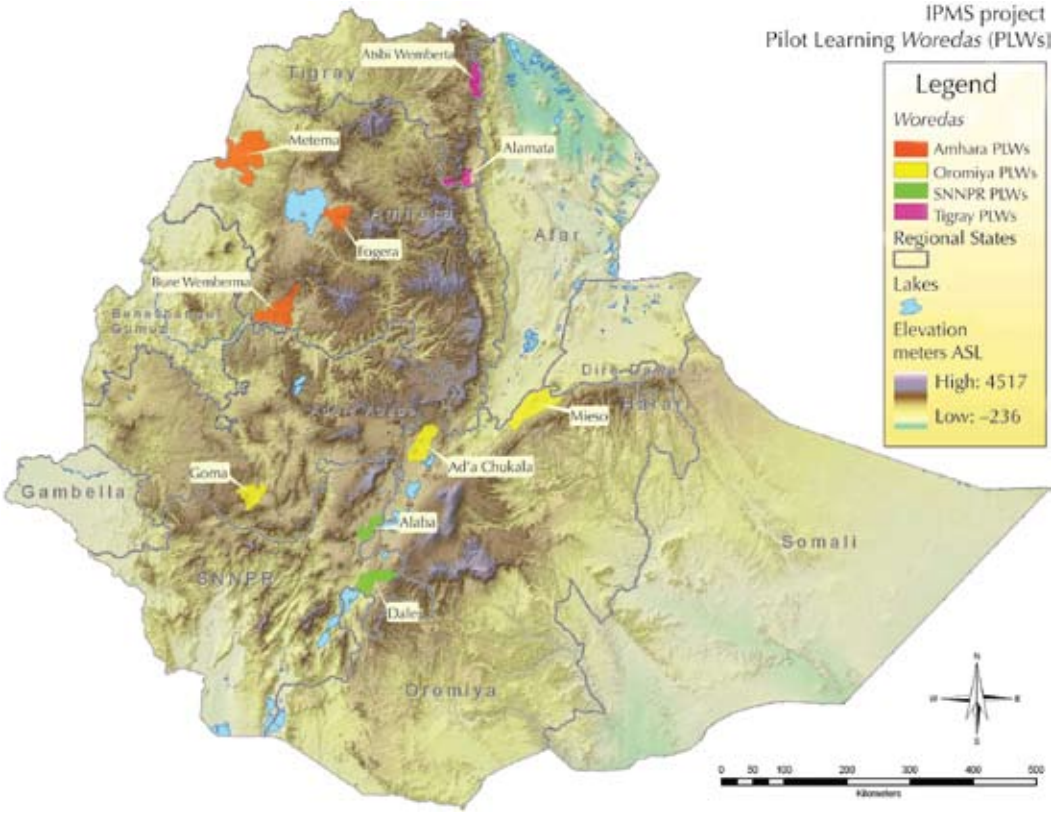

Figure 1. *Location of the study* woredas *(encircled in red)—Bure and Fogera* woredas *in the Amhara Regional State and Dale* woreda *in the Southern Nations, Nationalities and Peoples Regional State.*

4.1.1 Bure *woreda*

Bure *woreda* is found in West Gojam administrative zone of Amhara National Regional State (ANRS) (Figure 1). It is situated between 10˚15′N and 10˚42′29″N and between 36˚52′1″E and 37˚7′9″E. Bure town, the administrative centre of the district, is located 420 km from Addis Ababa and 148 km from Bahir Dar (the Regional Capital city). According to ANRS–BoFED (2007), the *woreda* has a total land area of 2207.2 km^2 and human population of 281,310 (141,683 males and 139,627 females). About 46.6% of the total area is cultivated and average household landholding is about 1.6 ha. The altitude of the *woreda* ranges from 728 to 2832 metres above sea level (masl). The mean total annual rainfall is 1689.4 mm (range from 713–2832 mm) and the average temperature is 19.0ºC (range from 13–24ºC). According to IPMS (2005), the district has 129,265 cattle, 6896 goats, 39,066 sheep, 188,310 chicken, 13,329 beehives, 16,335 donkeys and 479 mules.

4.1.2 Fogera *woreda*

Fogera is found in South Gondar administrative zone of Amhara National Regional State (ANRS) which is one of the eight districts bordering Lake Tana (Figure 1). It is situated at 11˚58″N latitude and 37˚41″E longitudes. Woreta, the capital of the *woreda* is found 625 km from Addis Ababa and 55 km from the regional capital, Bahir Dar (IPMS 2005). The total land area of the *woreda* is 117,405 ha and the human population is 233,529. Of the total land, flat land accounts for 76%, mountain and hills 11% and valley 13%. The average land holding is about 1.4 ha per household (IPMS 2005). The altitude ranges from 1774 to 2410 masl and it is predominantly classified as mid-altitude (*woina-dega)* ecology. The mean annual rainfall is 1216.3 mm and (range from 1103–1336 mm) and the annual temperature ranges from 22ºC–29ºC. According to IPMS (2005), the *woreda* has 157,128 cattle, 27,867 goats, 7607 sheep, 246,496 chicken, 21,883 beehives, 13,189 donkeys, 339 mules and 8 horses.

4.1.3 Dale *woreda*

Dale is one of the ten *woredas* found in Sidama zone of Southern Nation Nationalities and Peoples Regional States (SNNPRS). Recently, the former Dale *woreda* is divided into three distinct *woredas* namely Wonsho, Loka Abaya and Dale. The former Dale *woreda* (Figure 1) which consists the three districts lies between 9º60′45″N and 35º38′31″E, and is located 320 km south of Addis Ababa. It has a total land area of 1411 km^2 and is the biggest district in Sidama zone which is subdivided into 76 administrative *kebeles*. The human population is estimated at 369,548, of which women accounted for 57.6%

(CSA 2003). The altitude ranges from 1170 to 3200 masl with a mean annual rainfall of 1250 mm. The mean annual temperature is 20˚C. The area is classified in to three agro-ecological zones consisting 6.6% highland (*dega*), 40.6% mid altitude (*woina-dega*) and 53.36% lowland (*kola*). According to IPMS (2005), the *woreda* has 166,142 cattle, 17,248 goats, 19,492 sheep, 218,923 chicken, 10,506 beehives, 16,381 donkeys and 431 mules.

4.2 Sampling techniques, data collection and statistical analysis

4.2.1 Bure *woreda*

A multi-stage sampling procedure (purposive and random) was applied for the study, hence the district was divided into three agro-ecologies based on altitude as; highland (>2500 masl), mid-altitude (1500–2500 masl) and lowland (<1500 masl). Then two *kebeles*[1] each from the highland and lowland and three from mid-altitude were selected purposively. Therefore, a total of seven representative farmer *kebeles* were selected based on agro-ecology representation, chicken production potential and accessibility.

A simple random sampling technique was applied to choose 40 village chicken owner respondents in each *kebele* by giving equal chance for those farmers with different flock size, chicken husbandry systems and other related practices. Hence, a total of 280 village chicken owner households were interviewed using a pre-tested structured questionnaire.

Secondary data were collected from various sources including the Bureau of Agriculture and Rural Development (BoARD). Primary data were collected through personal and household interviews. Direct observations were also made to assess available chicken feed resource, chicken feeding and housing practices, egg incubation and brooding procedures and egg handling and storage practices. Closer visits in and around the residential quarters of selected households was made in order to obtain first hand observation on all aspects of village chicken production of the district.

For marketing system study, randomly selected sellers, buyers, traders and middlemen were interviewed from each selected market place. In addition, a total of 1200 local hen eggs (600 from markets and 600 directly from farmers) were purchased and used for egg quality study. The eggs were collected in all seasons of the year and from all agro-ecologies of the three study district. Some of the internal and external egg quality traits measured in this study were:

I. External egg quality parameters:

1. *Kebele* is the lowest administrative structure in the country.

- Egg weight (gm), (measured using digital balance)
- Shell thickness (mm), (using digital calliper)
- Dried shell weight (gm), (using drying oven)
- Egg shape index (%), (calculated as: (egg width/egg length)*100)
- Egg shell colour (visual observation)

II. Internal egg quality parameters:

- Albumen height (mm), (using tripod micrometer)
- Yolk height (mm), (measured using tripod micrometer)
- Presence of blood spot and meat spot, (visual observation)
- Yolk colour (measured using colour fun, ranged 1–15)
- Hough unit (HU), (calculated using albumen height and egg weight calculated using the formula: HU = 100 log (AH–1.7 $EW^{0.37}$ + 7.6) (Hough 1937)

where HU = Hough unit, AH = Albumen height and EW = Egg weight

Data management and statistical analysis

The qualitative and quantitative data sets were analysed using appropriate statistical analysis software (SPSS 2002). The Duncan multiple range test and LSD were used to locate treatment means that are significantly different. More specifically descriptive statistics and General Linear Model (GLM) were used for this study. The following linear models were used during analysis of quantitative data:

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

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

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

2. Model statement regarding the effect of market type (ordinary weekly markets vs. holy day markets) on prices of chicken products (different age and sex of chicken and eggs)

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

where Y_{ij} is the market parameter (price) estimate for bird j on market i, μ is the overall mean, m_i is the fixed effect of market type (i = 6; ordinary weekly market day, or selected major holy day market days, i.e. eves of Ethiopian New Year, Meskel (Finding of the True

Cross), Gena (Ethiopian Christmas), Fasika (Ethiopian Easter), and Muslim holy days such as Mawlid and ε_{ij} is the residual error.

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

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

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

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

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

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

4.2.2 Fogera *woreda*

Data collection

Primary data were collected through structured questionnaire and short period monitoring based on the livestock research system manual of ILCA (ILCA 1990). Secondary data were collected through reviewing published and unpublished information relevant to the work.

A rapid field survey was done before the main survey, to map out the distribution and concentration of local chicken ecotypes and the peasant associations (PAs). Three *kebeles* (Weji, Woreta Zuria, and Kidist Hana) were selected based on the information gathered through the rapid field survey and consultations with *woreda* agricultural experts, extension agents and farmers. The three *kebeles* were systematically selected to represent three different agro-ecologies in the *woreda*: Dry land (Weji), Wetland (Kidist Hana), and Woreta Zuria (peri-urban with access to extension).

A total of 72 households (24 households from each sample *kebele*) studied were randomly selected by dividing the total number of chicken in the *woreda* by the total number of households. Every 15^{th} household (next household if the 15^{th} one had no

chicken) was surveyed in each of the three target *kebeles* so as to have a fair geographical representation of sampled households.

The survey questionnaire was pre-tested with four households from each of the target *kebeles* and the necessary adjustments were made prior to the actual survey based on the pre-test. General information of the area, main crops, topography, climate and population size were obtained from the *woreda* Office of Agriculture and Rural Development.

During this part of the study, growth, reproductive performance, physical feature, some carcass characteristics, egg weight, egg shell thickness, yolk weight and albumin weight were measured. 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*.

Based on the typical breed characteristics, from the wetlands of the *woreda*, a total of 100 adult chicken were selected (50 females and 50 males) and their metric characteristics (shank length, comb length, ear lobe length, wattle length, wing span, body length, height at back, height at comb) and body weight measured, and categorical traits (feather characteristics, plumage colour, shank colour, pattern in feather, skin colour, shank colour, comb type, head shape, body shape) observed using the FAO (1986) breed characterization tool.

Out of the total surveyed households, 20 were randomly selected and monitored every 10 days for a period of 4 months to describe functional characteristics of the local chicken ecotypes. A total of 424 chicken were available for the monitoring purpose. A total of 10 animals (5 female and 5 male) having typical characteristics of local chicken within the age range of 8 to 12 months were purchased from the local market for determination of carcass characteristics.

Data analysis

Data from the survey (physical, functional and carcass characteristics) were analysed using Statistical Package for Social Science (SPSS 2002). Physical features were analysed separately for the two sexes. Carcass weight and dressing percentage were calculated using the following formula:

$$\text{Carcass weight} = \text{live weight} - \text{offal weight}$$

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

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

$$\text{Rate of inbreeding} = 1/2Ne$$

4.2.3. Dale *woreda*

Sampling

A stratified random sampling technique was used to stratify the agro-ecological zones (Dega, Woinadega and Kola). Wonsho represented Dega agro-ecology while Dale and Loka Abaya represented Woinadega and Kola agro-ecologies, respectively. The numbers of *kebeles* surveyed were randomly selected from each stratum or *woreda* proportional to the size of the *woreda*. Thus, two *kebeles* each from Loka Abya and Wonsho, respectively and four *kebeles* from Dale *woreda* were randomly selected making a total of eight *kebeles*. From each selected *kebele*, 20 households that possessed 5 or more chicken were randomly considered for the survey study. Thus, 160 households were included in the survey. For marketing survey a random sampling technique was employed thus a randomly selected sellers, buyers and middlemen were interviewed from each selected market places.

Data collection

A structured questionnaire integrated with Participatory Rural Appraisal (PRA) method relevant to rural chicken production (ranking, key informant and group discussion, transect walking) were used in the data collection.

Information was collected from farmers, extension officers, key informants and village groups using both methods. Information on indigenous and exotic breeds of poultry including: flock characteristics and ownership, the perspectives of functional traits and flock performance, use pattern, off take and loss of chicken and all aspects of chicken managements were collected.

A separate structured questionnaire was developed to address chicken and egg marketing. Accordingly, a longitudinal data collection (repeated survey) and a participatory marketing appraisal technique were employed, 2132 chickens from the open markets were weighed and their price and colours were recorded weekly in each market for a period of six months and two holy day markets. Data on marketing chains and channels were collected. Finally, a visit to physical facility of the market and open discussion with farmers, intermediaries, buyers, and sellers were made.

Statistical analysis

Qualitative and quantitative data sets were analysed using appropriate statistical analysis procedures. Statistical Package for Social Sciences (SPSS 2002) was used for the analysis. ANOVA model statement used to investigate the effects of *woreda* difference on household characteristics (family size, farmland holding and chicken flock size per household) and various performance related parameters of chickens (age at first laying, number of clutches per year, clutch length, eggs/hen per year and inter clutch).

Statistical model

$$Yij = \mu + Ai + \epsilon ij$$

where Yij = the value of the respective variable mentioned above pertaining to the ith *woreda* (i = 3, Wonsho, Dale, or Loka Abaya), μ = overall mean of the respective variable, Ai = the effect of ith *woreda* (i = 3, Wonsho, Dale, or Loka Abaya) on the respective variable and ϵij = random error term. Mean separation was made using Tukey test.

5 Results and discussion

5.1 Household characteristics and respondents profile

The household characteristics of interviewed village chicken owners are presented in Table 2. From the total interviewed village chicken owners, 25.6 and 13.8% are female in Bure and Dale *woredas*, respectively. The average age of respondents is 40.9 years in Bure and 51.4 years in Dale. Regarding education level, 39.3 and 6.9% of the respondents are illiterate in Bure and Dale, respectively. Among the literate members in Dale, 28.1, 44.2, 14.7 and 12.7% have gone through primary first cycle (1–4), primary second cycle (5–8), high school (9–10) and above secondary school, respectively. However, among the literates in Bure district, 31.1% have basic education (reading and writing), 21.4% have primary education and 8.2% have secondary education and above.

Table 2. *Socio-economic status of village chicken owners in the study districts*

Variables	Bure (No. = 280)	Dale (No. = 160)
Sex of respondent households (%)		
Male	74.6	86.2
Female	25.4	13.8
Average age of respondents (years)	40.86	51.4
Education status of respondents (%)		
Illiterate	39.3	6.9
Reading and writing	31.1	28.1
Primary education	21.4	44.2
Secondary education and above	8.2	27.4
Average family size/hh (mean ± SD)	6.19 ± 2.17	6.95 ± 0.20
Marital status of households (%)		
Married	88.9	na
Single	1.1	na
Divorced	5.0	na
Widowed	5.0	na
Land holding/household (ha)		
Total land holding (mean ± SD)	1.23 ± 1.23	0.86 ± 0.60

na = not available.

The overall mean family size of sample households is 6.2 (ranged 1–12) in Bure and 6.9 (ranged from 2–18) in Dale district, which is higher than the national average of 5.2 persons (CSA 2003) and 5.4 for northwest Amhara (Halima 2007). However, this is similar to the findings of (Asefa 2007) who reported 7 persons per household for the Awassa Zuria *woreda* in the SNNPR.

The age composition of households in the study *woredas* resembled the typical population pyramid of most developing countries, with 47.8 to 52.4% of members of the

household being children under the age of 15 years. Youth male and female (age class of 16–30 years) accounted for 19.4–23.5% of the total household members. Husband, wife and other members of the family above 30 years old covered the remaining proportions.

The average land holding per household is 1.22 ± 1.2 ha (range 0.84–1.52 ha) in Bure and 0.86 ha (range 0.13–3 ha) in Dale. The average land holding in Bure is similar to the 1.28 ha reported by Halima (2007) in northwest Amhara, but higher than the national average of 1.02 ha (EEA 2002).

5.2 Crop and livestock production

Maize, enset (*Ensete ventricosum*) and rice are the major crops grown in Bure, Dale and Fogera, respectively. There are two cropping seasons in Dale district unlike that of Fogera and Bure districts; the short rainy season (*Belg*) from March to April and the long rainy season (*Meher*) from June to September.

Among the large livestock species, cattle dominate in all the *woredas* and the majority of the farmers used them as source of draught power and milk. The majority (99.5%) of cattle are local zebu types. The average cattle holding/household is 4.20, 7.94 and 3.12 TLU in Bure, Fogera and Dale, respectively. The average holding of small ruminants (sheep and goat) is 2.5, 10.3 and 1.5 animals for Bure, Fogera and Dale, respectively. Village chicken production seems to be an important activity in all study areas as indicated by the high average chicken holding per household of 13.1, 12.4 and 9.22 for Bure, Fogera and Dale, respectively.

Sale of animals and animal products is an important source of household cash income. In addition, livestock are vital sources of food (animal protein), prestige (determination of wealth status of households) and organic manure for soil fertility. Livestock ownership and holding per household in the study *woredas* is presented in Table 3.

5.3 Characteristics of chicken production system and flock structure

Chicken production is a predominant farming practice in all the study *woredas* and most of the households kept local chicken ecotypes. The most dominant (82.9–95.6%) chicken production system is scavenging type of production system using indigenous chicken ecotypes (95–96.8%) with only seasonal feed supplementation. The most frequent plumage colour of indigenous chicken ecotypes is white (*Netch)* and red *(Key)*. However, ecotypes such as Black (*Tikur)*, *Gebsima*, *Anbesima*, *Seran*, *Libework*, *Netch Teterma*, *Tikur Teterma*, and *Key Teterma* are found in all study districts but not in large numbers.

Most farmers prefer to keep *Netch* and *Key* ecotypes to the other ecotypes due to the high price they fetch in the local market.

Table 3. *Livestock holdings in the survey households of Bure, Fogera and Dale woredas, Ethiopia*

Livestock holdings (No.)	Study districts		
	Bure (No. = 280)	Fogera (No. = 72)	Dale (No. = 160)
Cows	0.99	na	na
Oxen	1.73	na	na
Heifers and steers	0.62	na	na
Calves	0.81	na	na
Total cattle size/hh (mean ± SD)	4.16 ± 3.6	7.94	3.12
Sheep	2.24	4.00	0.9
Goats	0.25	6.26	0.6
Donkeys	0.54	0.16	0.7
Mules	0.02	0.00	na
Horses	0.03	0.00	na
Total chicken size/hh (mean ± SD)	13.1 ±10	12.38	9.22 ± 0.35

na = not available.

All chicken, irrespective of age and sex, move freely forming subgroups in and around the compound of households, allowing cocks and hens to mate indiscriminately. Aggressive and dominant cocks in the neighbourhood tend to be sires. Respondents indicated that the chicken population in all the study areas is increasing largely due to growth in demand and higher prices of chicken and eggs.

About 50% of the respondents started chicken rearing by their own interest and the major source of chicken for parent stock (93.9% for Bure, 43.7% for Fogera and 97.5% for Dale) is market purchase. The majority of the replacement stock (75.5–87.2%) originate from own chicken and the rest are purchased from the local market. Some farmers keep the exotic Rhode Island Red (RIR) breed that was distributed through the government extension system and in some instances these have been crossed with local chicken ecotypes.

The average chicken flock size per household and flock structure in the studied households is presented in Table 4. Out of the total flocks, hens account for 25.2, 47.7 and 33.8% for Bure, Fogera and Dale, respectively. Similarly out of the total flocks counted, young chicks accounted for 42.7 and 53.3% for Bure and Dale, respectively. Ownership of relatively higher proportion of hens and young chicks in all the study *woredas* indicates that this is purposely done by farmers to ensure production of

replacement flock in a sustainable manner (about 76% of the replacement is from own stock) and also to produce adequate number of eggs for sale and household consumption.

Table 4. *Chicken flock size/household in Bure, Fogera and Dale woredas, Ethiopia*

Chicken flock size/hh by different age and sex groups	*Woredas*		
	Bure (No. = 280) (Mean ± SD)	Fogera (No. = 72) No. (%)	Dale (No. = 160) Mean (SD)
Hens	3.3 ± 1.97	1–20 (47.7)	3.11 (1.26)
Cocks	1.0 ± 1.1	1–2 (14.96)	1.63 (0.95)
Pullets	2.3 ± 4.1	1–8 (26.64)	2.35 (1.33)
Cockerel	0.9 ± 2.3	1–3 (10.7)	2.15 (1.29)
Young chicks	5.6 ± 6.5	na	4.91 (3.13)
Total no. of chicken per household	13	12	9

na = not available.

The average male to female ratio are 1:3.3, 1:3.2 and 1:2.2 in Bure, Fogera and Dale, respectively. The recommended cock to hen ratio in modern light and heavy breeds are 1:10 and 1:8, respectively. However, a cock to hen ratio of 1:4.4 was reported in Sudan by Khalafalla et al. (2001). The majority of the respondents in Bure (83.2%) keep chicken only during the dry season, when availability of feed is better and the risk of predators is low. In all the study *woredas*, there are no cultural/religious taboos against rearing chicken and consumption or marketing of chicken and eggs.

Chicken in the study *woredas* show phenotypic heterogeneity in terms of plumage colour, shank length, comb type and growth performance. Almost all of the respondents (90.3–94.4%) indicated that they do practice selection of chicken based on one or more criteria such as colour, comb type, egg production and growth rate. Most of the respondents (61.2–66.7%) indicated that they give priority to egg production, followed by plumage colour (55.2–66.5%) and growth rate (27.8–33.1%) because of the obvious benefits of egg production (selling and hatching). The most preferred plumage colour is red (53.9%) and white (46.1%). Regarding comb types, both single and double (rose) comb types are found, and the rose comb is preferred (81.1%). This is mainly attributed to the preference of consumers in the market and cultural value in favour of rose (double) comb type of chicken. Figure 2 shows some plumage colour and comb types of local chicken found in the study *woredas*.

Red (‘*key*’), Rose comb

‘Tikur Gebsima’, Rose comb

Black (‘*Tikur*’)

Red (‘*key*’), Single comb

White (‘*Nech*’), Single comb

‘*Nech Wosera*’, Rose comb

‘Nech Gebsima’

‘Wesera’, single comb

‘Teterima’

Single comb

Rose (double) comb

Figure 2. *Some plumage colour and comb types of local chicken ecotypes in the study areas.*

5.4 Importance and utilization of chicken

Although village chicken production is a viable and promising alternative source of income for rural households in developing countries (Oh 1990), its contribution to the household cash income is generally difficult to assess. The results from this study showed that sale of live chicken for cash income is the first important function of rearing chicken in Fogera (77.8%) and Dale (43.7%) districts. In Bure, however, egg hatching for production of replacement chicks (51%) and sale for income (43.5%) are found to be important. The other purposes of chicken production identified by the respondents, in order of importance, are household consumption, use of chicken for cultural/religious ceremonies, job opportunity and egg production. The purposes of chicken production identified in the study *woredas* are presented in Table 5.

Table 5. *Purposes of chicken rearing and egg production in Bure, Fogera and Dale woredas, Ethiopia*

Variables	Study *woredas*		
	Bure (No. = 280) (%)	Fogera (No. = 72) (%)	Dale (No. = 160) Mean ± SD (%)
Purpose of egg production			
Hatching for replacement	72 (1st purpose)	na	46.59 ± 14.84 (1st purpose)
Sale for income	58 (2nd purpose)	na	32.83 ± 16.56 (2nd purpose)
Home consumption	69 (3rd purpose)	na	20.12 ± 15.69 (3rd purpose)
Purpose of chicken production			
Sale for income	43.5 (2nd purpose)	77.8 (1st purpose)	43.67 ± 18.12 (1st purpose)
Replacement (breeding)	49 (1st purpose)	65.4 (2nd purpose)	33.86 ± 16.80 (2nd purpose)
Home consumption	40 (3rd purpose)	59.7 (3rd purpose)	22.09 ± 13.50 (3rd purpose)
Cultural/religious ceremonies	44 (4th purpose)	33.3 (4th purpose)	na
Create job opportunity and additional job	na	58.3 (5th purpose)	na

na = not available.

Earnings from the sale of chicken and eggs are used to purchase food for home consumption, to cover educational expenses for children (books, pen, pencils, school uniforms and immediate cash requirements at school) and to purchase clothes and agricultural inputs. This indicates the important role village chicken production plays in supporting food security and financial contribution to support schooling of children.

Preference and utilization of chicken is influenced by plumage colour. According to the survey participant households, white (*Nech),* red *(Key)* and mixture of white and red (*Libe-Work)* plumage colours are more preferred for consumption and marketing. Black (*Tikur),* mixture of black and white *(Gebsima),* mixture of red, white and black *(Teterima)* and mixture of red and black (*Kokima)* plumage colours are less favoured by respondents for both consumption and marketing. Regarding utilization of eggs, hatching/replacement is the first function in Bure (71.7%) and Dale (46.6%) *woredas*. The second and the third purposes of egg production are for sale for cash income (58% in Bure and 32.8% in Dale) and for household consumption (68.6% in Bure and 20.1% in Dale), respectively (Table 5).

Similarly, Tadelle (1996) reported that in rural central Ethiopian highlands the major uses of eggs are for hatching for replacement (51.8%), sale for cash income (22.6%) and for household consumption (20.2%), while the major purposes of keeping village chicken are for sale for income (26.6%), sacrifice or healing ceremonies (25%), replacement (20.3%) and home consumption (19.5%).

In Bure *woreda*, out of the total of 280 chicken owners interviewed, 78% consume chicken meat during religious/cultural holy days only, 20.3% whenever available and only 0.7% reported that they do not eat chicken meat at all. Regarding consumption of eggs, 52.8% consume during religious/cultural holy days only, 42.5% whenever available, 2.5% when they get sick and only 2.2% never consume eggs. In Fogera, priority for household members in consumption of chicken and eggs is children (1st), pregnant women (2nd), women involved in breast feeding (3rd), adults (4th) and elderly people (5th).

5.5 Village chicken husbandry

5.5.1 Feeds and feeding systems

The nutritional management practised in the study *woredas* is predominantly scavenging with some sort of supplementary feeding. About 98, 93 and 98% of respondents in Bure, Fogera and Dale, respectively, offer supplementary feeds to their chicken. According to 87% of the respondents, the major supplementary feed is composed of a mix of various crops produced on-farm. About 84% the respondents in Bure and Fogera indicated that supplementary feeds are more required during the rainy/wet season (July to September) than the dry season, and this coincides with the shortage of grain during the rainy season. The amount of additional feed provided depends upon availability of resources in the house.

According to the respondents, scavenging feed resources consist of grasses, enset (*Ensete ventricosum*), insects and worms, crop leftovers and household leftovers. Wheat (70.4%), maize (75%) and household leftover including sugar beet, 'kocho' (baked enset), and 'amicho' (cooked enset) (68.8%) are the major types of feeds supplemented to chicken. Other minor feed types include finger millet, barely, rice and 'injera' (local bread made of cereals) and bran.

Young chicks are given priority in supplementary feeding in all the study *woredas* (for instance 82.9% in Bure) because they could not scavenge. Hens get the second priority because farmers believe that hens provided with supplementary feed lay more eggs. Nevertheless, respondents have no clear idea in terms of the quality and quantity of supplementary feeds they provide to their chicken. Most farmers do not use feeding troughs and simply broadcast the supplementary feed on the ground for the chicken to fetch. For example, in Fogera, only 16.7% of the respondents use locally made feeding troughs.

5.5.2 Watering

Despite variations in sources, season and frequency of watering, almost all of the respondents in the study *woredas* provide water *ad libitum* for their chicken. In Bure, 85.4% of the respondents provide water to their chicken only during the dry season and the remaining (14.3%) offered throughout the year. The major sources of household water supply in Bure are rivers (30.4%), springs (28.5%), locally constructed underground water (21.4%) and hand operated pipe water (19.7%), while in Dale the water sources are rivers (37%), ponds (35%) and boreholes (28%). About 98 and 96% of respondents have regular watering troughs in Bure and Dale *woredas*, respectively. In Bure, broken clay material (37.3%), wooden trough (32.7%) and troughs made of plastic (28.2%) are the most widely used watering troughs, while in Dale, plastic dishes (56%) and clay dish (38%) are common. Regarding the frequency of cleaning watering trough, 50% of chicken owners in Bure clean whenever they remember, 23.9% clean every day and the remaining 24.3% never clean watering troughs. In Dale, 45.7% of the respondents wash the container regularly, 50% wash occasionally and 4.4% do not wash the container at all. Unclean watering troughs are one of the major sources of contamination and infection in village chicken production.

5.5.3 Housing

In Fogera, 59.7% of the respondents provide separate overnight houses for their chicken, while only 22.1% and 2.4% of the respondents in Bure and Dale do so, respectively. The remaining respondents keep their chicken at various locations in the main house (Figure

3). Data on types of chicken houses/shelter used in the study *woredas* are presented in Table 6. In Bure, the majority (77.9%) of the respondents indicated that they keep their chicken at various night sheltering places in the main house including: perches inside the house (45.7%), on the floor covered by bamboo made materials (27.1%), on ceilings of the house (3.6%) and under locally constructed sitting place ('medeb') (1.4%). These sites are obviously the most secure overnight locations to avoid predators and theft. However, this may increase the risk of disease transmission. Farmers have various reasons for not constructing separate chicken houses. For example, in Bure respondents indicated that small flock size per household (34.6%), lack of construction materials (25%), lack of knowledge (19.6%), risk of predators (12.1%) and shortage of labour and time (5.4%) are some of the reasons for not constructing a separate house for their chicken. In Dale, the major reasons are problem of predators, fear of theft and lack of experience.

Figure 3. *Night shelters/houses used for indigenous chicken production in rural villages.*

Table 6. *Reported types of chicken housing in Bure, Fogera and Dale woredas of Ethiopia*

Type of house/night sheltering	Study *woredas*		
	Bure (No. = 280) (%)	Fogera (No. = 72) (%)	Dale (No. = 160) (%)
Separate house constructed entirely for chicken	22.1	59.7	3.4
Perches inside the main house	45.7	37.5	95.0
On the floor covered by bamboo material (kirchat)	27.1	1.4	–
On the ceiling of the main house	3.6	–	–
Under locally constructed sitting place (medeb)	1.4	–	–
Not well defined places	–	1.4	
On an enclosed baskets hanging in the kitchen	–	–	1.6

In Fogera, the majority of the respondents clean their chicken house/shelter daily, while the remaining (20.8%) clean weekly. The situation in the other study areas is similar. Lack of frequent cleaning of poultry shelter can easily cause diseases and increase morbidity and mortality rates of chicken. Thus, raising awareness of farmers on the need for cleaning shelters is important that all development practitioners should take seriously.

5.5.4 Chicken diseases and control measures

About 97.5, 100 and 62.9% of the respondents in Bure, Fogera and Dale *woredas*, respectively, reported that they experienced chicken disease problems. They indicated that Newcastle Disease (NCD) is the most prevalent and economically important disease that devastates village chicken production. Halima (2007) also reported that the major cause of death in local chicken in northwest Amhara is seasonal outbreak of diseases, specifically Newcastle Disease. In Fogera, 51.4 and 37.5% of the respondents mentioned incoming flocks and own flock as the main sources of infection, respectively. Farmers also acknowledged that diseases are the major cause for the loss of chicken, accounting for 66.5%, 41.7% and 23.1% of the losses in Bure, Fogera and Dale *woredas*, respectively. Respondents confirmed that the prevalence of Newcastle Disease (NCD) and chicken mortality are higher at the start of the main rainy season, mainly from April to June. They also reported that although NCD affects chicken of different age, sex and ecotypes indiscriminately, layers and brooding hens being the most vulnerable and affected groups.

Access to veterinary services is limited in all the study *woredas*. For example, in Fogera *woreda*, only 19.4 and 9.7% of the respondents get advisory and diagnostic services, respectively. Only 5, 22.2 and 12.4% of the respondents in Bure, Fogera and Dale, respectively, disclosed that they use veterinary drugs to treat sick chicken. Traditional (ethno-veterinary) treatment is used by the majority of chicken owners (95% in Bure and 87.6% in Dale) against NCD and other killer diseases. Provision of mixture of local alcoholic drink ('arekie'), lemon, garlic and onion to sick chicken against NDC is the

most widely used (42.9%) traditional treatment in Bure. Other treatments observed in Bure are use of some plant materials (herbs like 'semiza' and 'endod') (33.2%), use of antibiotics such as tetracycline (11.8%) and bleeding around the wing to remove 'infected' blood (7.1%).

The level of awareness about availability of vaccines for local chicken is low in all the study *woredas*. For example, 96.4 % of the respondents in Bure do not have any experience of getting their chicken vaccinated against diseases. Lack of awareness about the availability of vaccines (71.4%), lack of attention to village chicken (13.6%), and inaccessibility and shortage of vaccines (15%) are the major reasons mentioned by the respondents. Similarly, the level of awareness about getting treatment to sick chicken is low. For example, 91.1% of the respondents in Bure never took sick chicken to veterinary offices for veterinary treatment. Lack of awareness about availability of the service (59.1%), lack of attention to village chicken (21.2%), poor service (19.3%) and non-effectiveness of treatment (0.4%) are some of the reasons. Regarding the fate of sick chicken, 74.3% of the respondents indicated that they just leave them to die. The poor coverage of veterinary services observed in all study districts could negatively impact the development of poultry production and deserves attention from all the concerned bodies. Identifying the effectiveness of the ethno-veterinary medications could be important and needs further investigation.

5.6 Production performance

The average age of indigenous pullets at first laying is 6.42, 5.9 and 7.1 months in Bure, Fogera and Dale, respectively, while the average age of cockerels at first mating is 5.74 and 5.87 months in Bure and Fogera, respectively. These findings show that local chicken reach sexual maturity late compared to the improved exotic breeds (Table 7).

Similarly, Halima (2007) reported that 77.4% of local cocks in northwest Ethiopia reach sexual maturity at 20–24 weeks of age, which is similar with reported value of 6.10–8.16 months (Teketel 1986; Tadelle 1996; Aberra 2000). One of the expressions of the low productivity of indigenous chicken is their late sexual maturity.

The average number of eggs/hen per clutch is 15.7, 13.2 and 14.9 in Bure, Fogera and Dale *woredas*, respectively. The number of clutch periods showed by local hens per year is 3.8, 2–6 and 3.7 in Bure, Fogera and Dale, respectively. Accordingly, the total egg production/hen per year of local hens, under existing farmer management condition, is estimated to be 60, 53 and 55 in Bure, Fogera and Dale *woredas*, respectively (Table 7). The number of eggs/clutch found in the current study concurs well with the reported 9–19 eggs in northwest Ethiopia (Halima 2007), 6–20 eggs in Tanzania (Aichi 1998), 11–

15 eggs in Uganda (Ssewannyana et al. 2004) and Sudan (Khalafalla et al. 2001). These findings show that indigenous chicken have a relatively good egg production potential compared to other findings.

Table 7. *Production performance of local chicken ecotypes in Bure, Fogera and Dale woredas, Ethiopia*

Variables	Study *woredas*		
	Bure (No. = 560 hens) Mean ± SD	Fogera (No. = 144 hens) Mean	Dale (No. = 320 hens) Mean
Average age of cockerels at 1st mating (weeks)	24.6 ± 1.9	5.9	na
Average age of local pullets at 1st egg (weeks)	27.5 ± 2.4	5.9	7.07
Average number of eggs/hen per clutch	15.7 ± 3.2	13.2	14.9
Number of clutches/hen per year	3.83 ± 0.8	2–6	3.7
Total egg production/hen per year	60 ± 11	53	55
Reproductive life span of hens (months)	32.4	26.6	na
Reproductive life span of male chicken (months)	24.5	18.4	na
Clutch length (days)	na	na	26.2
Inter-clutches (days)	na	na	25.6
Weight of day old chicks (gm)	na	22.2 ± 43	na
Weight of 6 month pullet (Mean ± SD)	na	933.33 ± 33 g	1040 g
Weight of 6 month cockerel (Mean ± SD)	na	1125 ± 25 g	1050 g
Weight of matured male (Mean ± SD)	na	na	1580 g
Weight of matured female (Mean ± SD)	1210 g	na	1300 g

* na = not available.

The overall mean weight of mature pullets at about 6 months of age in Fogera and Dale *woredas* is 933 gm and 1300 gm, while the respective values for mature cockerels of the same age is 1125 gm and 1600 gm. The results show that female chicken are lighter than males in both *woredas* and chicken of both sex weigh less in Fogera than in Dale *woreda*. The relatively better performance of chicken in Dale could be attributed to non-genetic factors such as better supplementary feeding and concern and care of farmers to their chicken.

The reproductive life span of a female local chicken is longer compared to exotic hens. Long term reproductive performance (long life, high fertility, high hatchability, high number of egg/hen per year, high number of egg mass/hen per year, less or no number of broodiness per hen) of chicken should be given more importance in selection programs.

5.7 Reproductive performance

Data on hatchability and brooding performance of indigenous hens are presented in Table 8. In Bure, the average number of eggs set per hen is 13 (ranged 7–22) and 11 (ranged 0–19) hatched. In Fogera, similar numbers of eggs are set (12.97 eggs) and 10.23 chicks are hatched (Figure 4). The average hatchability percentage of eggs from local hens is 82.6, 78.9 and 89.1% in Bure, Fogera and Dale *woredas*, respectively. As cited by Aichi et al. (1998), hatchability of 83, 50–100 and 60–90% were reported for local chicken in Guinea (Mourad et al. 1997), United Republic of Tanzania (Minga et al. 1989) and Burkina Faso (Bourzat et al. 1990) respectively. The number of eggs set for natural incubation in Dale *woreda* is also in agreement with the 9.8 eggs reported by Asefa (2007) for Awassa Zuria *woreda* in southern Ethiopia.

Table 8. *Hatchability performance of local hens in Bure, Fogera and Dale woredas, Ethiopia*

Variables	Study *woredas*		
	Bure (No. = 560 hens) Mean ± SD	Fogera (No. = 144 hens) Mean	Dale (No. = 320 hens) Mean
Average number of eggs incubated	13 ± 2.2 (7–21)	13.0	9.8
Average number of eggs hatched	11 ± 2.3 (0–19)	10.2	6.7
Number of chicks weaned	6.7 ± 2.4(0–15)	7.6	4.6
Percentage of chicks weaned (%)	60.5 ± 16.4 (0–100)	74.6	54.2
Hatchability (%)	82.6 ± 11.5 (0–100)	78.9	89.1

* Numbers in bracket are ranges.

Figure 4. *Local hen with her eight chicks scavenging around the homestead.*

The average percent of survival rate of chicks is 60.5, 74.3 and 54.2% in Bure, Fogera and Dale *woredas*, respectively. High hatchability can improve poultry production when there is good chick survival. However, the high chick mortality (24–56%) could be one of

the reasons for the low flock size per households in the study areas. This chick mortality rate is higher than the value reported in Uganda (25%) by Ssewannyana et al. (2004) for village chicken but lower than the value reported (61%) for the central highlands of Ethiopia by Tadelle (1996). This indicates that there is a need to put effort on reducing chick mortality of the local ecotypes.

All respondents reported that they use broody hens for hatching eggs and growing chicks. Most farmers incubate eggs using their brooder hens during the dry seasons when there is good feed resource, less disease risk and favourable environment for growing chicks. In Bure *woreda*, April (78.9% of respondents) and July (63.2% of respondents) are the least preferred months for incubating eggs and rearing chicks. The major reasons for this are poor hatchability of eggs in April due to high ambient temperature and poor survival rate of chicks due to rain (cold stress) and high predation in July.

Though broodiness in local chicken is an important trait and the sole and essential means of egg incubation and brooding of young chicks, it is one of the major reasons for the low egg productivity. As a result, farmers use different techniques to reduce broodiness of the local hens. In Bure for example, 98.6% of the respondents use various indigenous practices to reduce broodiness. About 68.2% of the respondent indicated that changing the location of the hen's house is the most preferred and effective practice. Other practices include hanging the hen upside down for a day or two (24.3% of the respondents) and spraying water on the hen's body and its brooding site (6.1%). In Dale, farmers practice piercing the nostrils with a feather to prevent sitting (2.6%), moving the bird to a nearby house for a couple of days (39%), hanging the bird upside down for about 3 to 4 consecutive days (28.9%) and disturbing the sitting nest-boxes (29.6%) in order to break broodiness in hens.

Regarding egg production, the majority of indigenous (99.3%) and crossbred hens (90%) in Bure *woreda* lay eggs daily during periods when surplus feed is available. However, during periods of feed shortage egg production drops and the majority of local hens (76.4%) and crossbred hens (61.1%) lay eggs every other day or every three days. According to the respondents, local hens are more preferred because they are resistant and productive than crossbred hens during stress seasons.

In Bure *woreda*, 70.7% of the respondents keep their own local cocks for reproduction purpose and the rest (29.3%) use cocks from their neighbours. About 50% of cock owner households use local breeds and the rest (20.7%) used either pure exotic or crossbred cocks or a combination of local and exotic breed cocks. The major sources of local cocks are market purchase (63.2%) and home hatched/grown (36.8%). With regard to selection of cocks, 92.2% of the respondents have a tradition of selecting cocks for replacement

stock. Plumage colour (45.4%), physical stand and shank length (37.1%), type of comb (8.6%) and parent's performance or pedigree (1.1%) are some of the major criteria used by village chicken owners for selecting cocks as a replacement/breeding stock.

In relation to selection of broody hens, 86.4 and 92% of the respondents in Bure and Fogera, respectively, have a culture of selecting broody hens for breeding/egg incubation purposes. In Bure, the hen's past egg incubation performance (73.9%), large body size (7.9%), presence of thick feathers (2.1%), and size of eggs laid (2.5%) are some of the criteria used for selecting broody hens. Similarly in Fogera, 66.7% of the respondents use large body size as a selection criterion for broody hens.

Figure 5 showed some locally made containers used for storage of eggs. According to 87.4, 38.9 and 98.1% of village chicken owners in Bure, Fogera and Dale *woredas*, respectively, eggs destined for incubation and for marketing are stored at the same place. In Bure, 71.4% of village chicken owners store eggs inside earthen material (clay) together with grains/straws. The majority of village chicken owners (>95%) in all the study *woredas* store eggs until the hen finishes lying and starts broodiness.

Figure 5. *Egg storage systems (inside clay with cereal straw—left and container made of mud—right) in Bure* woreda*, Ethiopia.*

In Bure, any old or broken earthen material is the most preferred container (57.9%) for incubating eggs, while containers made of grass or bamboo are the second and third preferred, respectively (Figure 6). Provision of some kind of bedding materials for egg incubation is made by all respondents in the three study *woredas*. In Bure, for example, cereal straw (teff, wheat or barley) and grass hay are the first and second preferred bedding materials used for egg incubation, respectively (Figure 6).

In Dale *woreda*, 86.7% of the respondents said that they remove hens from the flock when they get sick, while only 10.3% either cull or remove hens when they anticipate occurrence of disease outbreak. The remaining 3% of the respondents remove hens from the flock due to low productivity. This result indicates that farmers in the study area cull chickens of both sex for different reasons and purpose. However, most unproductive hens remain in the flock without being remove

Figure 6. *Container types and bedding materials earthen (dist) with straw (left) and bamboo made (kirchat) with straw (right) used for egg incubation in Bure, Ethiopia*

Culling of non-productive chicken is a common practice in all the study areas. Accordingly, 84.6, 97.2 and 86.9% of the respondents practice culling their chicken in Bure, Fogera and Dale, respectively. Poor productivity, old age and sickness are the major reasons for culling. Regarding utilization of culled chicken, 62.6 and 75.5% of the respondents either sale or use the culled animal for home consumption, respectively. The majority of respondents (>65%) in all the study *woredas* avoid extra cocks from the flock to avoid cannibalism**.**

5.8 Division of household labour

All members of the family in a household participate in chicken husbandry and management practice in one way or another. Table 9 shows family labour allocation and utilization in chicken husbandry and marketing. In Bure, most of the household members (55.6%) own chicken for themselves, while 36.1% share with close relatives (e.g. brothers, sisters, other relatives). In Fogera, most of the chicken (50.8%) are owned by the husband and wife and 23.9% reported that the whole family owns the chicken. Similarly, in Dale *woreda* most of the chicken are owned by the husband (35%) followed by wife (24.4%), whole family (23.8%), young boys (10%), jointly by husband and wife (4.4%) and young girls (2.5%). Hoyle (1992) also reported that in Wolaita area of southern Ethiopia, elder men and women accounted for 30% and 47% of the chicken ownership, respectively. Tadelle et al. (2003b) however, reported that in the central highlands of Ethiopia women owned and managed chicken and controlled the cash income generated from the sale of chicken and eggs. Gueye (1998) also reported that more than 70% of village chicken owners in rural sub-Saharan Africa are women.

Table 9. *Family labour allocation for village chicken husbandry in Bure, Fogera and Dale, Ethiopia*

Variables	Study districts		
	Bure (No. = 280 hh)	Fogera (No. = 72 hh)	Dale (No. = 160 hh)
Shelter construction (%)			
Men	97.5	63.9	53.1
Men and children	2	–	na
Women	0.5	15.3	na
Children	–	20.8	9.4
Cleaning chicken house (%)			
Men	–	1.4	na
Men and children	–		na
Women	38.6	62.5	9.4
Children	46	36.1	na
Women and children	15.4	–	na
Provision of supplementary feed and water (%)			
Men	–	5.6	na
Men and children	–		na
Women	80.7	59.7	73.8
Women and children	12.9	34.7	na
Men and women	1.4	–	na
All family	5	–	na
Selling of chicken (%)			
Men	1.1	6.9	na
Men and children	42	–	na
Women	46.8	56.9	na
Children	1.1	36.1	na
Women and children	1.1	–	na
Men and women	7.9	–	na
Selling of eggs (%)			
Men	–	4.2	na
Women	54.6	56.9	na
Children	1.1	31.9	na
Women and children	43.2	–	na
Men and women	1.1	–	na

* na = not available.

In Bure, men are mainly responsible for construction of shelter (97.5%) and taking sick chicken for treatment (89.3%). Women are responsible for several activities like cleaning the chicken house or shelter (38.6%), provision of supplementary feed (80.7%), and selling of chicken (46.8%) and eggs (54.6%). Children also participate, alone or with other family members, in various chicken husbandry activities like cleaning of the chicken house or shelter, and provision of supplementary feed and water. In Fogera,

women shoulder most of the responsibility in chicken production and marketing. These include feeding and providing water (59.7% of the respondents), cleaning the chicken house (62.5%), and marketing of chicken (56.9%) and eggs (63.9%). Men are primarily responsible for construction of chicken houses.

In Dale (Figure 7), with the exception of construction of chicken house (arranging roosting material to chicken), which is left for men (53.1%) and male youth (9.4%), women take the lions share in accomplishing other chicken management activities including cleaning the chicken house (74.4 %), provision of supplementary feed (65%), and water (73.8%). Bradley (1992) reported that management of village chicken is the responsibility of women for various historical and social factors. Riise et al. (2004b) and Kitalyi and Andre (1998) also reported that women and children are generally in charge of rural village chicken husbandry practices in developing countries.

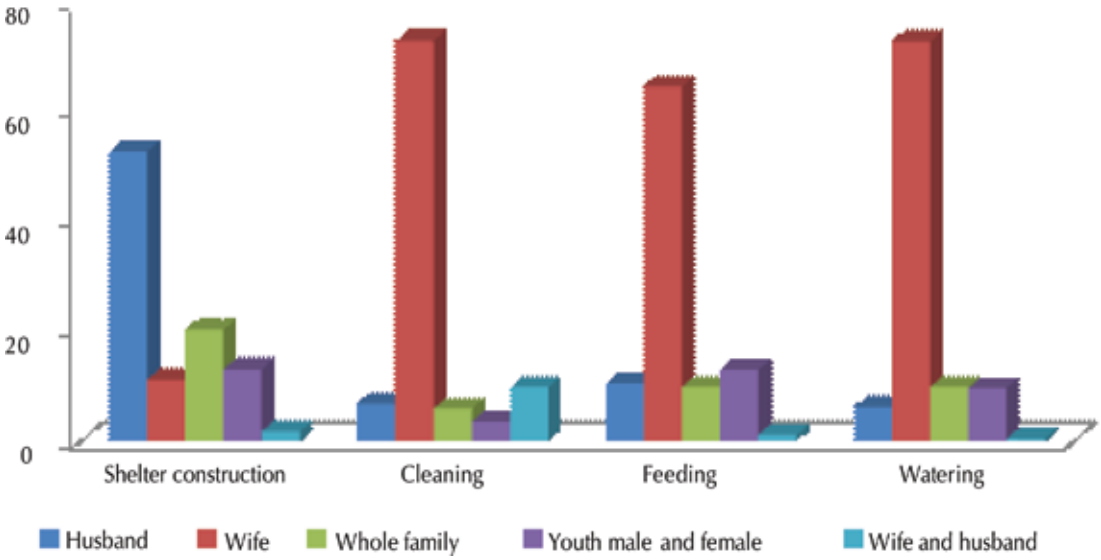

Figure 7. *Intra household division of labour in chicken husbandry in Dale, Ethiopia.*

In Bure, both men and women make joint decision on various chicken production and marketing activities including selling of eggs (78.2%) and chicken (69.3%), and consumption of eggs (93.2%) and chicken (92.9%). However, men alone take decision on purchase of veterinary drugs (88.6%) and replacement stock (67.9%). The results show that men and women together take major decisions in the sell and consumption of chicken and eggs and in purchase of foundation stock (Table 10). Though women alone have less say in decision-making on consumption and sell of chicken and eggs, they play a major role in the management of chicken.

Table 10. *Household decision-making in village chicken production and marketing in Ethiopia.*

Variables	Bure (No. = 280 hh)	Fogera (No. = 72 hh)
Selling eggs (%)		
Men	21.1	36.1
Men and women	78.2	0
Women	0.7	56.9
Children	0	6.9
Selling chicken (%)		
Men	30	38.9
Men and women	69.3	0
Women	0.7	55.6
Children	0	5.6
Home consumption of eggs (%)		
Men	6.6	43.0
Men and women	93.2	0
Women	0.4	54.2
Children	0	2.8
Home consumption of chicken (%)		
Men	6.8	51.4
Men and women	92.9	0
Women	0.3	45.8
Children	0	2.8
Purchasing of drugs (%)		
Men	88.6	40.3
Men and women	11.4	0
Women	0	55.6
Children	0	2.8
Purchasing of replacement stock (%)		
Men	67.9	47.2
Men and women	32.1	0
Women	0	51.4
Children	0	1.4

5.9 Village chicken and egg marketing systems

5.9.1 Characteristics of chicken and egg markets

Village chicken producers, consumers, middle men (egg and chicken collectors) and local restaurants/hotels are the main actors involved in chicken and egg marketing. Marketing of chicken and eggs is practised in various places including farm gates, local and urban markets. Two types of market days, conventional (fixed) and non-fixed (random) are identified in all the study *woredas*. Most farmers sale chicken and eggs during the conventional market days.

5.9.2 Chicken marketing

All the interviewed village chicken owners participate in chicken marketing. Sale of chicken is an important source of income. Although chicken are sold in various places, *woreda* towns are the major urban markets. Farmers on average travel 15.9 km (ranged 3–35 km), 22 km and 2.5 km to reach the *woreda* towns and sale their chicken in Bure, Fogera and Dale *woredas*, respectively. In Bure, the average distance to a nearby rural market is 5.5 ± 2.6 km. The major reasons that farmers often sale their chicken are whenever there is an instant cash need in the household (45.2% in Bure and 65.6% in Dale), when disease outbreak occurs (28.3% in Bure and 24.4% in Dale) and during the major crop planting season at the beginning of the main rains to purchase farm inputs such as fertilizer and seed (26.5% in Bure and 10% in Dale).

There is seasonal fluctuation in the prices of chicken, being generally low during the rainy season due to the high risk of diseases and shortage of disposable cash by farmers. During the dry season prices of chicken are high, especially in the months of October, January and April due to observation of more religious holy days, weddings and other social events that require slaughtering of chicken to make the special Ethiopian chicken dish or dorro wot. Moreover, unlike in the rainy season, farmers in the dry season have more disposable cash from harvest of crops and can spend money on more 'luxurious' food items. More festivities and better farmers' incomes increase the demand and price of chicken in the dry season.

More than half of the respondents (65%) in Dale do not have any market information about the price of the chicken. Only 35% of the respondents get price information either from their neighbours (43.3%) or from the markets (56.7%).

Women and children are key members of the household involved in chicken marketing. The priority markets preferred by farmers for sale of chicken are the nearest urban market followed by local markets and farm gate. In Bure, 37.9% of the respondents stated that they sell their chicken directly to consumers, rural chicken collectors and traders. The rest of the respondents often sell to other urban and rural chicken producers, retailers, and hotel and restaurant owners. Rural chicken collectors in turn sale their chicken to either consumers directly or other chicken traders, who are often found at important and well known spots on main roads. Figure 8 showed details of the marketing channels of chicken and eggs in Bure *woreda*.

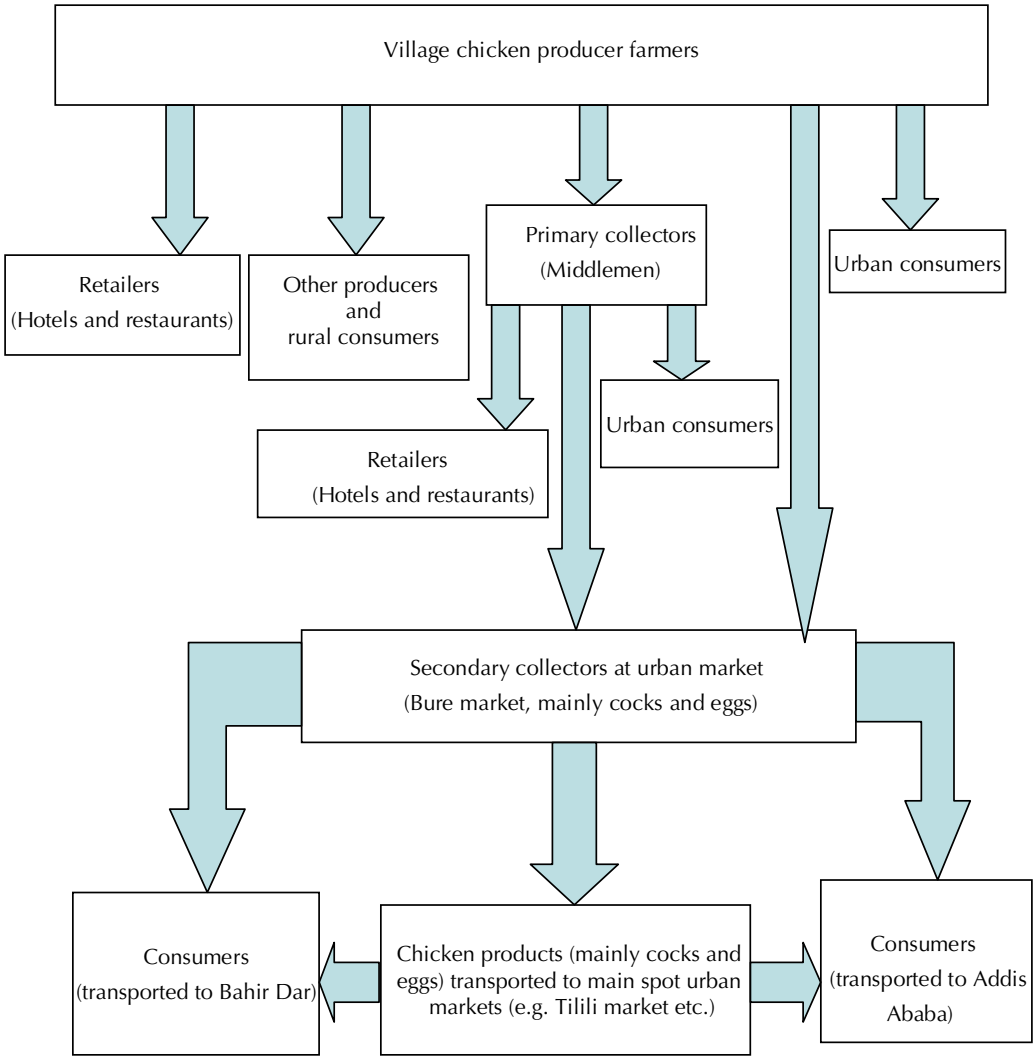

Figure 8. *Marketing channels of chicken and eggs in Bure* woreda*, northwest Ethiopia.*

Similarly, in Dale *woreda*, about 50.8% of the chicken pass through middlemen (collectors), 13.8 % to restaurants and hotels, 31.5% directly to consumers and the remaining (4.8%) are sold at farm gate to collectors and consumers. The proportion of sell to collectors increases during holy days and festivals. Village and market level collectors are key players in the marketing channel as the majority of chicken reach the consumer through them. They also play a decisive role in determining the price of chicken in the market.

Concerning mode of transportation of chicken to markets, the majority (59.3% in Bure, 97% in Fogera and 62% in Dale) of the farmers hand carry (hanging chicken on a piece of stick), their chicken usually in an upside down position. Figure 9 shows handling and transportation of chicken to local and urban markets.

Figure 9. *Different methods of handling and transporting chicken to markets.*

The majority of women in Bure (95.4%) use bamboo made material (locally called kirchat) to transport chicken to market places. Chicken collectors in Dale sometimes use hand operated cart (locally known as 'gari') along with other goods. In spite of the fact that such means of transportation causes discomfort to chicken; only 11% and none of chicken owners in Bure and Dale, respectively, reported chicken death during transportation.

The price, demand and supply of chicken are highly related to religious festivals, mainly Christian festivals. For instance, the price of chicken and eggs increases during the high-sale periods like Easter ('Fasika') and Christmas ('Gena'). On the other hand, periods of low prices coincide with low demand during fasting periods by the followers of the Orthodox Christian church. For example, in Bure, market prices during festival/holy days compared to ordinary market days show an increase of 19.2% for matured male chicken, 15.3% for matured hens, 24.2% for pullets/cockerels and 16% for eggs. Table 11 shows the average price of chicken during ordinary market days and on eves of festivals/holy days for the year 2007/2008 in Bure *woreda*.

Table 11. *Mean prices of chicken and eggs in ordinary market days and on eves of festivals at Bure, Ethiopia in the year 2007/2008, (No. = 280)*

Market time	Price in Ethiopian birr (ETB)* of chicken (by age and sex) and eggs (No. of eggs/1 ETB)			
	Mature male (mean ± SD)	Mature female (mean ± SD)	Growers (mean ± SD)	Eggs (No. of eggs for ETB 1)
Ordinary weekly market day	21.8 ± 3.3^{a}	17.9 ± 3.1^{a}	13.3 ± 2.7^{a}	2.4 ± 0.4^{b}
Market days of eves of festivals				
Ethiopian New Year (September 11)	27.5 ± 2.7^{e}	21.9 ± 3.1^{f}	17.6 ± 2.7^{f}	2 ± 0.2^{a}
Meskel (September 27)	25.6 ± 3.1 ^{c}	20.7 ± 2.9^{d}	16.4 ± 2.5^{d}	2 ± 0.2^{a}
Christmas (Gena)	25.8 ± 2.9^{dc}	20.4 ± 3.0^{cd}	16.2 ± 1.8^{cd}	2 ± 0.2^{a}
Easter (Fasika)	26.7 ± 2.6^{f}	21.3 ± 2.6^{e}	16.8 ± 2.1^{e}	2 ± 0.2^{a}
Muslim holy day (Ramadan)	24.3 ± 2.1^{b}	19.2 ± 2.6^{b}	15.6 ± 1.8^{bc}	2.1 ± 0.2^{a}
Festival mean (ETB)	26 ± 1.2	20.7 ± 1.0	16.5 ± 0.7	2 ± 0
Overall mean (ETB)	25.3 ± 2.0	20.2 ± 1.5	16 ± 1.5	2.1 ± 0.2
Mean increase of prices during festival markets (%)	19.2	15.3	24.2	16.0

Least square means with different superscripts within a column differ significantly ($P < 0.05$).
* USD 1 = ETB 8.60.

The result revealed that the major types of chicken sold in the village are surplus males, old and non productive hens and sometimes sick chicken. Young and productive chicken are often sold just before the onset of high risk period of New Castle Disease, mainly around the start of the rainy season (April–June).

In addition, chicken type (sex, age, plumage colour and comb type) play important role on market price of chicken. Most respondents in Bure and Fogera *woredas* considered plumage colour and comb type as the main determinant factors in selection of chicken for production, consumption and marketing. In these two *woredas*, red and white plumage colours and double (rose) comb are the most preferred and these traits are important and have socio-cultural values, besides attractiveness of the colours. The average market price for red and white colour local cocks with a double (rose) comb type is higher compared to cocks with same colours and single type of comb (Table 12).

Table 12. *Price of chicken by colour and comp type in Bure and Fogera woredas, Ethiopia*

Variables	Bure (No. = 280 hh) (Mean ± SD)	Fogera (No. = 72 hh) (Mean ± SE)
Price of red coloured matured male chicken		
Single comb	21.8 ± 2.9	15.52 ± 0.4
Double comb	24.7 ± 2.9	19.82 ± 0.5
Difference (%)	13.7	27.7
Price of white coloured matured male chicken		
Single comb	22.3 ± 2.9	15.28 ± 0.7
Double comb	24.8 ± 24.8	19.54 ± 0.8
Difference (%)	11.2	27.9

5.9.3 Egg marketing

All the respondents in Fogera and Dale and 69.3% of those in Bure have experience in egg marketing. Similar to chicken marketing, eggs are marketed at farm gate, local and urban markets. Women and children are responsible for egg marketing. Most consumers in the study *woredas* prefer to buy local eggs directly from producers as they are considered to be fresh and tasty with dark yellow yolk colour.

The egg marketing channel is more or less similar to that of chicken. Eggs are sold at the farm gate to egg collectors, in the open markets to middlemen and consumers and to retail shops, hotels and supermarkets in towns. Eggs pass through a relatively longer chain to reach the consumers than chicken. The main actors in egg marketing are producers, collectors, traders or (wholesalers), local kiosk, shops and supermarkets. Urban markets followed by nearest local market and farm gate are, in order of importance, the preferred outlets for egg marketing by producers. The price of eggs is generally low during the Orthodox Christian fasting months. Similarly, the supply and demand of eggs are not similar throughout the year, generally being higher in the dry and relatively low in the rainy season.

Due to the risk of breakage of eggs, farmers use different methods for transporting eggs to markets. For example, in Bure about 66.4% of the farmers hand carry eggs using a piece of cloth filled with grains/straws. In addition to its use in storage of eggs until incubation/marketing, the grain/straw also used to protect eggs from breakage during transportation. Plastic containers and local grass made bags (locally called 'kofeda') are also used to transport eggs to markets. Figure 10 shows some means of egg transportation and marketing in Bure *woreda*. Egg collectors and traders, often women, buy eggs from farmers and use cartoon or wooden containers to transport eggs (Figure 11).

Figure 10. *Egg transportation and marketing in rural Ethiopia.*

Figure 11. *Egg collectors/assemblers and traders; women play important role in this activity.*

5.10 Quality and characteristics of eggs from indigenous hens

5.10.1 External egg quality

Data on external quality of eggs in Bure and Fogera are presented in Table 13. In Bure, 49% of eggs are white shelled, 45% are light brown shelled and 6% are cream colour shelled. Similarly, Halima (2007) reported that the shell colour of eggs collected from local hens of northwest Ethiopia are mixture of white, light brown and cream colours.

Table 13. *External quality of eggs from local hens in Bure and Fogera woredas, Ethiopia*

Variables	Bure (No. = 1200 eggs) (Mean ± SD)	Fogera (No. = 1000) Mean ± SE)
Shell colour of eggs (%)		
White (W)	49	na*
Light Brown (LB)	45	na
Cream (C)	6	na
Egg weight (gm) (Mean ± SD)	43.2 ± 4.3 (34–60)**	46.96 ± 1.3
Dry shell weight (gm) (Mean ± SD)	2.3 ± 0.2 (2–2.7)	5.52 ± 0.2
Egg width (mm) (Mean ± SD)	37.2 ± 3.1 (31.6–54.5)	na
Egg length (mm) (Mean ± SD)	50.8 ± 3.9 (39.0–59.8)	na
Shape index (%) (Mean ± SD)	73.2 ± 4.2 (63.9–100)	na
Average shell thickness (mm)		
Sharp region (Mean ± SD)	0.27 ± 03	na
Equatorial region (Mean ± SD)	0.26 ± 03	na
Blunt region (Mean ± SD)	0.24 ± 03	na
Average shell thickness (Mean ± SD)	0.26 ± 0.03 (0.2–0.3)	0.45 ± 0.0

* na = not available ** Numbers in brackets are range.

The average weight of eggs from local hens is 43 gm (range 34–60 gm) and 47 gm in Bure and Fogera *woredas*, respectively. This is similar with the 42.9 gm reported by Halima (2007) for eggs collected from seven chicken ecotypes of northwest Amhara region. Teketel (1986) also reported an average egg weight of 46 gm for Ethiopian local breed chicken. Similar result of 40.6 gm was reported by Asuquo et al. (1992) for eggs of Nigerian local breed chicken. Olori and Sonaiya (1992) also reported an average egg weight of 38.9, 37.1, and 37 gm for Brown, Light Brown and White Nigerian local chicken, respectively. Ahmed (1994) reported lighter egg weight of 35–39 gm for indigenous scavenging chicken in Bangladesh. The average dry shell weight of eggs from local hens in Bure and Fogera is 2.3 gm and 5.5 gm, respectively. Halima (2007) reported a relatively higher average dry shell weight of 3.95 gm and 5.7 gm for eggs collected from intensively managed local hens of northwest Amhara and RIR chicken breeds, respectively.

The average egg shape index percentage in Bure is 73.2% (Table 13), which is higher than the reported 66.9% for eggs of Nigerian Fulani chicken ecotypes (Fayeye et al. 2005). Eggs with higher shape index percentages are more circular in shape than that of eggs with lower shape index percentages. The 'normal' chicken eggs are supposed to be elliptical (oval) in shape and eggs that are unusual in shape such as long/narrow, round and flat-sided would not be placed in grades AA or A in the developed world (Silversides 1994).

The average shell thickness measurements of eggs collected from Bure for sharp region, equatorial region and blunt region are 0.27 mm, 0.26 mm and 0.24 mm, respectively, with average of 0.26 mm. Egg shell from the sharp region is relatively thicker than both the blunt and equatorial region shells. This result is lower than the reported 0.71 mm and 0.69 mm by Halima (2007) for eggs collected from intensively managed local chicken ecotypes of northwest Amhara and RIR chicken breeds, respectively. Similarly, Teketel (1986) reported an average egg shell thickness of 0.35 mm for Ethiopian local breed chicken eggs. Asuquo et al. (1992) also reported an average egg shell thickness of 0.30 mm and 0.35 mm for Nigerian local breeds and Isa-Brown breed chicken eggs, respectively. The lower average shell thickness (0.26 mm) found in the current study may be attributed to low calcium and phosphorous contents of scavenging feed resources.

5.10.2 Internal egg quality

Data on internal egg quality parameters are presented in Table 14. The average yolk and albumen height of eggs collected from Bure are 15.1 mm and 4.1 mm, respectively. The average calculated (± SD) Hough unit is 66.5 ± 7.2, which is higher than the value of 61.1 reported by Halima (2007) for eggs collected from local chicken ecotypes of northwest Amhara and lower than 81.0 found by the same author for eggs collected from intensively managed RIR chicken. Asuquo et al. (1992) also reported higher Hough unit values of 79.8 and 89.9 for eggs collected from Nigerian local hens and Isa-Brown chicken breeds, respectively. This study showed that eggs collected from Bure *woreda* are not good in quality based on the average Hough unit value (<72). This might be attributed to poor handling and storage of eggs until sale, since egg Hough unit value is highly correlated with storage condition and duration of eggs.

Table 14. *Internal quality of eggs from local hens in Bure and Fogera woredas, Ethiopia*

Variables	Bure (No. = 1200 eggs) (Mean ± SD)	Fogera (No. = 1000) (Mean ± SE
Yolk height (mm)	15.1 ± 1.3 (8.4–18.4)*	na**
Albumen height (mm)	4.1 ± 1.9 (2.1–7.6)	na
Hough unit (HU)	66.5 ± 7.2 (36.4–84.8)	na
Average yolk colour (1–15)	8.6 ± 1.5 (5.3–11.7)	9.06 ± 0.6
Yolk weight (gm)	14.6 ± 0.8 (12.6–18.9)	16.28 ± 0.5
Albumen weight (gm)	19.6 ± 1.8 (16.01–29.6)	22.13 ± 1.1

* Numbers in brackets are range values. ** na = not available.

The other most important internal egg quality traits considered in this study is yolk colour, estimated using roach colour fun (range 1–15). The yolk colour of each egg collected from the study districts was examined by three observers and the average

value was calculated and recorded. The result showed that the average yolk colour of eggs from local hens is 8.6 and 9.06 for Bure and Fogera *woredas*, respectively (Table 14). This is higher than the reported value of 3.5 and 4.0 by Halima (2007) for eggs collected from intensively managed local hens of northwest Amhara and RIR hens, respectively. Pavlovski et al. (1981) also reported that the yolk colour score of free range local hens is higher compared to eggs collected from hens managed under intensive chicken management condition. The higher yolk colour value obtained from the current study indicates that scavenging feed resource base of the study *woredas* are rich in xanthophylls, some of which are precursors of vitamin A.

The average albumen weight of eggs from local hens collected from Bure and Fogera is 19.6 ± 1.8 gm and 22.13 ± 1.04 gm, respectively, while the respective average egg yolk height is 14.6 ± 0.8 and 16.28 ± 0.47 mm (Table 14).

5.11 Major challenges in village chicken production and marketing

5.11.1 Diseases

High incidence of chicken diseases, mainly Newcastle Disease (NCD), is the major and economically important constraint for village chicken production system (Table 15).

Table 15. *Response of farmers (%) on barriers to expansion of village chicken production in Bure, Fogera and Dale woredas, Ethiopia*

Barriers to village chicken production	Study *woredas*		
	Bure (No. = 280 hh)	Fogera (No. = 72 hh)	Dale (No. = 160 hh)
Disease problem (mainly Newcastle disease) and lack of proper health care	46.2	48.6	✓
Predation	25.7		✓
Poor productivity of local chicken	3.5		
Land shortage		8.3	
Feed shortage	12.7	19.4	
Poor management practices (feeding, housing, disease control etc.)	10.2		✓
Others (lack of capital, lack of technical information, marketing problems, theft problem)	1.7	18.2	✓

✓ = List of problems expressed in words; hh = households.

Mortality of village chicken due to disease outbreak is higher during the short rainy season, mainly in April (66.8%) and May (31.4%). Serkalem et al. (2005) also reported that NCD is one of the major infectious diseases affecting productivity and survival of

village chicken in the central highlands of Ethiopia. The major routes of contamination and spread of NCD from village to village are contact between chicken during scavenging and exchange of chicken from a flock where the disease is incubating and during marketing.

The availability of vaccines and veterinary drugs in the study *woredas* is generally low. Lack of awareness about vaccines and vaccination and lack of attention are also the major reasons for the wide prevalence of NCD. The available vaccines and drugs are relatively expensive and sold in large quantity batches (for example, in 50 doses for NCD vaccines) and it becomes uneconomic for farmers who generally keep small flock sizes. There is need for a serious intervention in disease control and advisory services in order to minimize losses and improve chicken production and productivity. Further studies are needed on the identification of NCD virus strains and prevalence rate of Infectious Bursal Disease (IBD) in order to formulate effective preventive and control programs.

5.11.2 Predation

Although predation is not an important problem in the Fogera plains, it is identified as another economically important constraint in village chicken production system in Bure and Dale *woredas*. Halima (2007) also reported that predation is one of the major constraints in village chicken production in northwest Ethiopia. In Bure *woreda*, 59.3% of the respondents indicated that wild Egyptian Vulture (locally called 'chilfit') is a dangerous predator and attack on young chicks is higher (73.2%). In addition, mongoose (36.8%) and wild cats (3.9%) are the other important predators. Keeping chicken at home and providing feed and water (47.9%) and killing predators using toxins, dog and other materials (33.9%) are the preferred predator control systems by farmers. Construction of 'predator proof' chicken houses could help to reduce losses, especially at night. Chicks also needed to stay in protected areas for the first 4–5 weeks of life in order to avoid predators and other accidents. Protection of young chicks, especially from wild birds is critical, as this is the time when they are most vulnerable.

5.11.3 Poor productivity of local chicken ecotypes

The productive performance of village chicken in the study *woredas* is relatively low (50–60 eggs/hen per year). Although the local chicken ecotypes found in all the study districts are slow maturing, they are adapted to the agro-ecologies and the existing poor management conditions.

5.11.4 Poor chicken management (feeding, housing and health care)

According to the response of interviewed chicken owners and observations through various villages, production losses due to poor chicken management are the main constraints to village chicken production.

5.11.5 Other chicken production and marketing constraints

Shortage of feed both in quality and quantity, lack of capital, shortage of labour, lack of technical information and theft are the other constraints to village chicken production. The major constraints to chicken and egg marketing include:

- Seasonal fluctuation in prices of chicken and eggs
- Low supply (output) of chicken and eggs due to disease and predation
- Presence of only few/limited market outlets (urban market are found very far from resident areas for many village chicken producers)
- Lack of chicken and egg price information to village chicken producer farmers
- Lack of space for chicken marketing in urban markets
- Lack of credits and capital to expand chicken production and marketing activities.

5.12 Institutional support and source of information for village chicken production

Results from the current study revealed that 37.5% and 72.2% of the respondents have access to chicken related information from agricultural extension agents in Bure and Fogera *woredas*, respectively. In Fogera, farmers identified radio (13.9%) and other farmers (11.1%) as sources of information on chicken production. The extension services include advisory service, trainings, credit and input supply. Although the reason for the lower extension service in Bure is not clear, 31.8% of the farmers identified lack of access to extension agents as one of the main reasons. The proportion of farmers who obtain extension service in Bure is lower than the reported 52.5% in northwest Ethiopia by Halima (2007). In terms of place of contact with extension agents, the most common meeting place is extension agent's office (40.3%), followed by farmers' homes (23.6%) and crop demonstration sites (18.1%). In Dale, except for the little effort made to distribute exotic breeds as part of the extension package, there is no support on village chicken production and management, veterinary and marketing services. None of the respondents in Dale had any formal training on local chicken husbandry, and about 73.6% of the respondents indicated that they need proper training in local chicken production and marketing.

Credit facility for village chicken production seemed quite limited in all the study *woredas*. Most of the respondents (89.5% in Bure and 59.7% in Fogera) reported that

they did not get credit for village chicken production. This indicates that there is a gap concerning the interest of the farmers to boost their production and lack of access to credit and other extension services. Capacity building and extending credit facilities could encourage landless or small land owning farmers and unemployed youth and women to engage in chicken production and improve their livelihoods.

6 Conclusion and recommendations

6.1 Conclusion

Chicken production using indigenous ecotypes has been a long standing tradition of Ethiopian farmers. Indigenous chicken constitute about 99% of the chicken population in Ethiopia and are found in almost every rural household and are produced for various reasons. The village chicken production systems are characterized by the use of indigenous ecotypes with low input–low output levels. A range of factors such as suboptimal management, lack of supplementary feeds, low genetic potential for productive traits and high mortality rate causes the apparent low output level. However, village chicken production is part of a balanced farming system, plays an important role in supply of high quality protein to the family food balance, and provides small disposable cash income in addition to ceremonial and socio-religious functions important in the rural people's lives.

The phenotypic diversity in plumage colour, comb and wattle types is very impressive and these traits have important socio-cultural and economic values. The genetic diversity in terms of both productive and adaptive traits is yet to be unravelled. Income generation from sale of chicken and eggs and household consumption are the two major reasons for keeping indigenous chicken. Although the indigenous chicken are relatively low producers than the commercial breeds, they are more adapted to the environmental challenges and prevailing management levels practised by smallholder farmers. Indigenous chicken production plays an important role in income generation, household nutrition and food security, with special benefits to women and children, who significantly contribute to village chicken production and marketing.

Availability of village chicken resources forms the basis for transforming the subsistence mode of production to a more economically productive base. Given that the potentials, major constraints and possible solutions for improved production have been identified, it is imperative to conclude that a holistic interdisciplinary approach to rural poultry production, including institutional and organizational capacity are important to tackle the major constraints and to bring the anticipated improvements. In view of the experiences from past poultry improvement programs, which have centred on introducing commercial exotic stocks, a new approach aiming at increasing flock productivity instead of individual animal productivity using locally available resources is suggested. There are a number of key actors involved in village chicken and egg production and marketing. These include producers, middlemen (chicken and egg collectors), traders, retailers, local restaurants/hotels and direct consumers. These actors are important and play key roles in further development of chicken production in the country. Developing

schemes that aim at promoting and improving village chicken production along the value chain are essential. These schemes, however, need to incorporate local knowledge in chicken production and health management with substantial focus on rural women. This will require not only technological interventions, but also changes or adjustments in organizational and institutional arrangements in the country.

6.2 Recommendations

The following recommendations are made based on the results from the three study *woredas*:

- About 99% of Ethiopia's huge poultry population is composed of genetically diverse indigenous breeds. Past attempts to improve poultry production in Ethiopia are focused on introduction of highly productive exotic breeds that require high level of management and inputs, with very little or no attention to the indigenous breeds. Therefore, there is a need to design proper breed improvement programs in order to enhance the utilization and conservation of the huge genetic diversity of the indigenous chicken populations. Thus, designing and implementing community-based breed improvement program for local chicken ecotypes is timely and essential;
- A shift from subsistence to market-oriented production system is necessary and addressing the major constraints on production technologies, input supply and product marketing systems along the poultry value chain is critical;
- The productivity of scavenging village chicken could be enhanced by relatively simple changes in management techniques (feeding, housing and health care) that promote improvement in productivity and reduction in mortality. A little technical support to farmers' experience or knowledge of supplementary feeding and watering would substantially improve productivity of local chicken;
- There is a strong need for appropriate intervention in disease and predator control activities so as to reduce chicken mortality and improve productivity. Control of diseases, mainly NCD, could be achieved through improvement in veterinary and advisory services;
- Flock size can be increased through administering small-scale or mini-hatcheries at village level or at district level that could collect and use local eggs. To implement this there is a need to make readily available credit services;
- Training for both farmers and extension staff focusing on disease control, improved housing, feeding, market and entrepreneurship could help to improve productivity of local chicken. As most of chicken are managed by women farmers, provision of trainings on chicken husbandry practices to women is essential; and
- Formation of both input supplier and marketing groups and establishing a stable marketing chain is important so that farmers could obtain premium price for their products.

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የግብርናና ገጠር ልማት ሚኒስቴር

Federal Democratic Republic of Ethiopia
MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT