

Analysis of village poultry value chain in Ethiopia: Implications for action research and development



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Acronyms

CSA	Central Statistical Authority
FAO	Food and Agriculture Organization of the United Nations
Female HHH	Female-headed household
LIVES	Livestock, Irrigation and Value Chains of Ethiopian Smallholders
Male HHH	Male-headed household
NCD	Newcastle disease
NGO	Non-governmental organization
PA	Peasant association
SFR	Scavenging feed resources
SNNPR	Southern Nations Nationalities and Peoples Regional State
SPSS	Statistical Package for Social Sciences
TLU	Tropical livestock unit

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Summary

This study aimed at developing a baseline understanding of producers, use of inputs, production performance, marketing, institutional and infrastructural environment and support services in order to identify potential areas of improvement for action research and poultry value chain system development.

The results of this study are based on analysis of data drawn from a cross sectional baseline survey of 5004 smallholder households undertaken by the LIVES project in the regional states of Tigray, Amhara, Oromia and Southern Nations Nationalities and Peoples Regional State (SNNPR). Baseline data on poultry production and marketing was collected from 2797 households in 10 zones, 71 districts and 484 peasant associations (PAs) in the four regions.

Majority (60%) of rural households in the study areas practiced village poultry. The study found out that region (location of households), age of household head, family size, education and production of other livestock affected households' involvement in poultry production. Households utilized their poultry firstly for economic and secondly for nutritional purposes. The number of birds and eggs households sold was twice higher than consumed by the households. However, the use of birds for socio-cultural functions was less common where only limited portion of the households reported they gave out live birds and eggs as gifts.

The scale of poultry production of the households in the study area was found to be small where the average flock size per household was 10 birds. About half of the households kept five or less birds. The analysis of flock dynamics showed that the inflow of flock was lower than its outflow. Mortality contributed up to 56% of the number of birds that moved out of flock, implying that disease control may be a top priority intervention area. Households reported that more than 70% and 15% of the mortality was caused, respectively, by disease and predation. The egg production per year per local layer was 46-56 of which households used only 4% of the total eggs available for hatching. A major share of the eggs was sold (62%) and consumed (32%). Bird sales and consumptions contributed to 40% of flock outflow. Thus, mortality coupled with the offtake, low egg production and hatching rates caused flock outflow to outnumber flock inflow.

The study assessed whether and how much households used inputs to overcome the constraints and improve their poultry production. A limited portion (20%) of the households reported that they purchased and used at least one type of inputs such as cereals, commercial feeds, drugs, vaccines, hatching eggs, day old chicks, watering and feeding equipment. The largest share (88%) of the households under the study said they used scavenging feeds. Although mortality contributed to 56% of the flock outflow, 70% of which is caused by diseases, a very limited part of the households (6%) used vaccines and drugs. Approximately 19% of the households reported they had both local and improved breeds. Nearly 9% of the households said they kept only improved breeds. Based on reports from the study households, the egg production per layer of improved breeds is upto three times higher than that of local breeds. It appears that households are obtaining the improved breeds in the form of cockerels or pullets as a very small portion of them (1-2%) reported to have acquired day old chicks or hatching eggs.

The study examined poultry marketing in terms of, among others, prices, market places and supply chain actors. Averagely, the price of adult birds (cocks and hens) was ETB 58–80 per bird. Depending on flock types, improved

breeds were more expensive than the local ones by 31–200%. Market places for poultry and eggs included farm gates and other market places located at own PA, in other PA, at district, zonal and regional capitals. District capitals were found to be the largest market places accounting for 43% of the bird sales. Farm gates and regional capitals were the market outlets of least importance making up, respectively, 3% and <1% of the birds sold. The types and relative importance of market places for eggs showed similar pattern as for birds. The poultry marketing chain involved actors such as farmers, assemblers, wholesalers, retailers, processors, urban consumers and cooperatives. Households sold majority of their birds (43%) and eggs (36%) directly to urban consumers. Assemblers, retailers and wholesalers together purchased about 50% and 56% of the total birds and eggs sold, respectively. In general, it can be said that the poultry supply chain is long where at least 50% of the birds and eggs sold flows from producers to consumers indirectly via a number of intermediaries.

The study has found evidence that there is special association between women and village poultry in terms of production and marketing. While the share of poultry in total tropical livestock units (TLU) per household was slightly higher in female-headed households, a smaller portion of them owned cattle (65%) than the male headed counterparts (91%). Female-headed households were more inclined towards sale than to consumption of birds. Women were responsible for selling birds in 86% and 57% of the female- and male-headed households, respectively. Women controlled more than 90% and 30% of the income from bird sales, respectively, in female- and male-headed households. They also generated relatively more income per family member from bird sales than male-headed households.

This study explored whether households had the access to institutions and infrastructure for poultry production and marketing. Development agent (DA) posts, farmers training centres (FTCs) and livestock markets were available in peasant areas of almost all the study households. About half of the households (48-55%) were able to contact development agents for advice to improve their poultry production. The proximity of the posts to the households helped women to access development agents. Women made up to 96% of family members that approached DAs for advice on, for example, buying inputs and selling outputs. Development agents followed by kebele administrators and officers of agriculture were the major sources of (market) information for households implying that these actors are the key entry points for future research and development (e.g. capacity building) in poultry production and marketing although non-governmental organizations (NGOs), friends, and media (e.g. radio) may also have important contribution. Despite their accessibility, their contribution to the improvement of household poultry production or marketing was limited. For example, development agents created linkage support to only 2- 2.5% of the households in poultry marketing and input provision and only about 1% the households reported that they received linkage support to access credit services for improved poultry and that only 13% received training.

The ultimate goal of this study was to explore existing constraints, opportunities and then identify, prioritize and recommend technological, institutional and organizational interventions for action research to facilitate poultry value chain development. Thus, recommendations are given hereunder under those domains.

In the technical domain, challenges related to feed and feeding, genetic improvement, health control and related inputs and support services have to be addressed. Households in the study area are largely dependent on scavenging feed resources (SFR). Contents of scavenged poultry should be chemically analysed to determine and overcome lacking (deficient) nutrients by strategic feed supplementation depending on the needs of different seasons and agro-ecological zones. This will serve as an input for documenting a profile (e.g. database) of carrying capacity and quality of statistics for results (SFR) for planning and implementing village poultry research and development.

Based on analysis of SFR, situation specific and profitable supplementary feeds have to be formulated for key agro-ecological clusters using cost efficient ingredients. Through research, feed formulas might be reviewed and adjusted to meet the needs of village poultry by incorporating local raw materials based on an assessment of nutritional shortages.

Skill development and research support is needed to improve quality of feed formulations as village poultry keepers rear small flocks with different sex and age groups which require different quantities and quality of feeds. The extension agents should play an active role in training village poultry keepers on feeds, nutrition and feeding

practices to improve quality of feed formulations. Research should monitor and analyse impact of the use of various combinations of scavenging and formulated supplementary feeds on the biological and economic performance of poultry production in different agro-ecological and market zones.

Creep feeding and artificial brooding of chicks is needed as they are the highest vulnerable flock categories to mortality due to, among others, lack of high quality feed. The separation of chicks from their mother early (at three or four weeks), creep feeding of chicks and supplementary feeding of growing chicks might be an effective way to achieve higher productivity. Artificial (e.g. hay box) brooders might be used for feeding and watering chicks when separated from their mothers. On-farm studies can be carried out to explore whether and how much early weaning, creep feeding and artificial (hay box) brooding increase flock and egg production performance as well as its profitability.

Production and distribution system of improved breeds should be enhanced as egg production per layer per year was higher for improved breeds. It is expected that the demand for improved breeds will increase. In order to sustainably supply improved breeds to meet the growing demands, research should be carried out to examine the technical and organizational efficiency of the production and distribution system of improved breeds to poultry keepers. These studies should identify the requirements for producing and disseminating the most economic and productive breeds, flock types (pullets, cockerels, day old chicks, hatching eggs) and explore an organizational option for involvement of farmers in raising improved chicks and grower for distribution. Small scale and appropriate hatchery technologies have to be sought to involve farmer cooperatives in the multiplication and distribution of chicks by using mini-hatcheries like non-electrical hatcheries (e.g. rick husk incubators) or small electrically operated incubators in rural or peri-urban areas. Researchers should adapt or develop appropriate incubation technologies for poultry keepers.

As researchers and development practitioners widely recommend, the control of Newcastle disease as the most effective intervention that should be implemented before any other solution, appropriate vaccines have to be used to prevent the disease. For example, the feasibility and efficacy of the use of thermo-tolerant Newcastle Disease (NCD) vaccine has to be explored through action research especially in remote areas where refrigeration facilities are not available.

Farmers' awareness has to be raised on the importance of vaccinating their flocks. The delivery of the vaccination service might involve trained community vaccinators (and perhaps with cost recovery mechanisms). If vaccination proves to be productive and profitable, even the poor may in the course of time be willing and able to pay for the service from private providers. The role of women as vaccinators has been reported as a successful experience in Bangladesh.

The introduction of feed, health control and breeding technologies will not guarantee higher production and productivity unless they are coupled with improved capacity of farmers. FTCs, among other functions, should serve as village poultry resource centres equipped with prototype technologies (e.g. incubation technologies, feed formulations, vaccines etc.) and appropriate training manuals for experimentation, demonstration, capacity building and scaling up. Poultry specialists from various education and research institutions have to capacitate extension agents to develop village poultry resource centres.

In Ethiopia, village poultry keepers are involved almost in all stages of production. For efficient flow of products and services, it is recommended that poultry producers form groups to develop a complementary and integrated system among production and marketing actors (e.g. chick producers, distributors, traders, processors, consumers, transporters) learning from the experiences of Bangladesh, India and other countries that have widely implemented a value chain approach in village poultry. This might be initiated in selected potential areas and with highly interested target groups. The producer groups may play an important role in knowledge and experience sharing and in establishing links with the microcredit institutions. For households especially in remote areas, the formation of marketing groups could be beneficial for negotiating higher prices and for linking more directly with consumers. Such marketing arrangements are expected to motivate farmers to increase their scale of poultry production and to purchase more inputs.

Agricultural research and education and training institutions can contribute to the development of the value chain through capacity building and provision of technologies. Research is needed for enhancing efficiency of multiple interventions as fragmented interventions are unlikely to improve village poultry. Integrated implementation of interventions (e.g. use of improved breeds, supplementary feeding and vaccination) is needed for optimal production. Credit service could be part of the integrated approach. Research can make a relevant contribution by analysing effects of various combinations of interventions (inputs) on production and economic performance with the aim of identifying effective alternative options. Research and development priorities have to be geared towards understanding the characteristics that stimulate or discourage households to produce poultry and identify and support relevant target groups. Gender, age, family size, education, region and market access of households may be relevant factors to consider in village poultry research and development initiatives.

Research and development of village poultry in Ethiopia has to benefit from an accumulated international knowledge and experiences on this commodity. The International Network Family Poultry Development, The Danish Network for Poultry Production and Health, the Australian International Rural Poultry Centre (IRPC), the Bangladesh model and its replicates could serve as sources of relevant information, knowledge and experiences to develop village poultry in Ethiopia.

I. Introduction

Rising incomes, urbanization and population in many parts of the developing world are causing growing demand for animal products. Poultry is making a great contribution to meeting the increasing demand. Worldwide, the growth rate of poultry production is the highest, when compared with ruminants and pigs (Brancaert et al. 2000). Poultry meat and egg contributed more than 28% of the total animal protein produced worldwide in 1997 and for about 20% of protein consumed in developing countries (Askov and Dolberg 2002). This contribution of poultry is estimated to reach 40% by the year 2020; the major increase will be in the developing world (Delgado et al. 1999). The per capita consumption of meat increased in the developing world from 14 kg in 1980 to 29 kg in 2002 (Steinfeld et al. 2006), with an even more spectacular increase in the consumption of poultry. The amount of poultry meat produced per person was about 2 kg and 8 kg per year, in the developing and developed world, respectively (Owen et al. 2005). The large discrepancy demonstrates the vast gap in availability of protein from poultry for consumers in the south. These estimates imply that there is a great scope for increased production and consumption of poultry products in the global south.

It is sometimes stated that if the suppliers of poultry are smallholder farmers instead of large-scale commercial companies, poultry would better contribute to poverty reduction under conditions of expanding demand (Dolberg 2001; Garces 2002). Many rural households keep poultry in their farmyard especially in the third world where extreme poverty is a rural phenomenon. This practice which involves production of small flocks of birds largely using scavenging feed resources is commonly referred to as village poultry, rural poultry or rural family poultry (Aklilu 2007; Sonaiya 1990). Village poultry makes up the largest proportion of the national poultry population in most developing countries (Guèye 2000). In Africa, over 70% of poultry products comes from village poultry (Kitalyi 1998; Sonaiya 2000).

Village poultry play important roles nutritionally, economically and socio-culturally. Poultry provide disposable cash income to poor households (Gunaratne et al. 1993), serve as source of eggs and meat from which consumption of high quality protein has positive influence on people's health (Perry et al. 2002; Mack et al. 2005). The role of poultry as a potential tool to escape extreme poverty through its influence on improvement of livelihoods has frequently been claimed (Dolberg 2001; Kristjanson et al. 2004; Peacock 2005; Dossa et al. 2003). Additionally, many studies associated poultry particularly with the self-reliance of women (Devendra and Chantalakhana 2002; Bravo-Baumann 2000; Riise et al. 2005). In developing countries, female-headed households represent 20 to 30% of all rural households (Saleque 1999). Many poor women in developing countries are involved (and in many cases skilled) in poultry keeping. Thus, the link between poultry interventions and improvement of women's status – along with the associated improvements in terms of nutrition and other benefits for the entire family (Quisumbing and McClafferty 2006) – seems to be direct. Researchers and development practitioners advocate that interventions to improve village poultry production may be justified, as they can help women and their families to generate social capital and enter a positive spiral of events that may move them out of poverty (Jensen and Dolberg 2003).

Ethiopia is one of the largest countries in the world where village poultry plays a dominant role in total poultry production and marketing. The population of poultry is estimated to be more than fifty million (CSA 2013). Although, modern farms have recently been established and slightly expanded mainly in the capital (Addis Ababa) and nearby

cities, their share from total national poultry production is still insignificant. Village poultry contribute almost 99% of the national egg and poultry meat production (Dessie et al. 2003). Birds are owned by individual households and are maintained under a scavenging system, with few or no inputs for housing, feeding and health care.

Village poultry keeping significantly contributed to the livelihoods of poor households: economically as starter capital, as a means to recover from disasters, as an accessible protein source and for income and exchange purposes, and socio-culturally for hospitality and exchange of gifts to strengthen social relationships (Aklilu et al. 2008).

Despite its multiple roles and instrumental potential for livelihood improvements for the poor, village poultry is underestimated and neglected sub-sector in Ethiopia. There are little research and development efforts directed at village poultry in Ethiopia resulting in the sub-sector being highly underdeveloped in terms of its productivity and linkages between producers and consumers. Consequently, the nation is not benefitting much from the potential of village poultry in nutrition or income.

Even the limited research and development initiatives undertaken to improve village poultry production in the country tend to focus only on the technical aspects of poultry keeping in the belief that these constitute the principal constraints. It is, however, increasingly recognized that value chain system development including marketing opportunities and other institutional environments are crucial to capitalize on improved technologies by generating cash income (Hellin et al. 2005; Anandajayasekeram and Gebremedhin 2009). Often, farmers are not attracted by just a new technology even when it appears to be better than their current practices owing to market limitations (Diao and Hazell 2004). Value chain activities bring products from its producer to its end user and include production, marketing and distribution (Porter 1985). Poultry value chain can be defined as the range of activities required to bring poultry meat or eggs to consumers via the different phases of production, marketing and distribution. It can also be described as market focused collaboration among different stakeholders who produce and market value added products. Value chain analysis helps to understand the production system, marketing channels and their relationships, the participation of different actors, and the critical constraints that limit productivity (in this case, of poultry) and the competitiveness of smallholder farmers (Anandajayasekeram and Gebremedhin 2009).

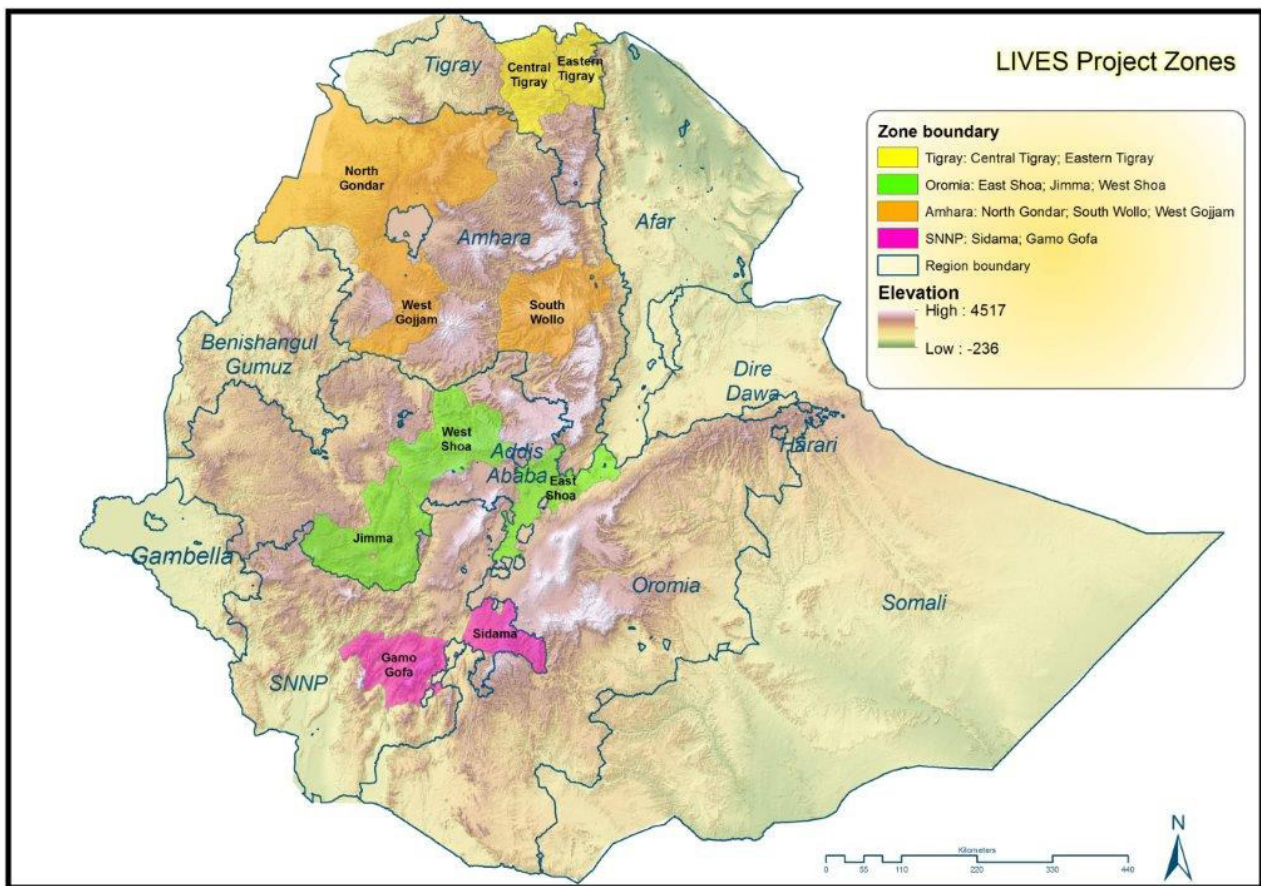
The Livestock and Irrigation Value Chains for Ethiopian smallholders (LIVES) project aims to explore and integrate the use of technological, institutional and organization approaches for development of smallholders including poultry keepers (LIVES 2011). The LIVES project conducted a baseline survey in 2012–13 to understand the poultry value chain in ten sites located in four regions of Ethiopia.

- Based on the baseline data, this study aims to develop an understanding of producers, use of inputs, production performance, marketing, institutional and infrastructural environment and support services in order to identify potential areas of improvement for action research aimed at poultry value chain system development. The specific objectives are as follows:
- To explore the status of poultry ownership, production, utilization and intensification
- To examine poultry (birds and eggs) marketing patterns in the main project sites
- To assess accessibility of institutions and infrastructures in the study areas for poultry production and marketing
- To identify interventions (innovations) for action research and development of village poultry value chain

2. Sources of data and study methodology

The LIVES) project is implemented in the regional states of Tigray, Amhara, Oromia and Southern Nations Nationalities and Peoples Regional State (SNNPR). The results of this study are based on analysis of data drawn from a cross-sectional baseline survey of 5004 smallholder households undertaken by the LIVES project in these regions of Ethiopia (Figure 1)

Figure 1: The areas (zones) of the LIVES project



The study area accounts for 13.6% of the national area. The data was collected by the LIVES project during 2012-13 from the four regional states. The four major Regional States collectively account for about 96% of the total national poultry population (CACC 2003). The LIVES project collected comprehensive data, among others, on selected high value commodities including poultry in ten sites located in the four regions. Baseline data on poultry production and marketing was collected from 2797 households in 10 zones, 71 districts and 484 PAs in the four regions.

The data collected included, among others, household characteristics, flock and egg dynamics, production inputs and information related to the availability of infrastructure and institutions. The baseline data showed that 967 (19.3%)

of sample households were female headed. The information collected was used to undertake a situation analysis and create a baseline understanding of producers, production performance, marketing, institutional and infrastructural environment and support services for poultry value chain development.

The data was analysed using Statistical Package for Social Science (SPSS 2011). Logit regression, analysis of variance, cross tabulations and other descriptive methods were used whenever appropriate.

3. Results and discussions

3.1 Profiling poultry keepers

Poultry-keeping practice

We explored whether or not households in the study areas kept poultry. In this study, a household is considered to be a poultry keeper if it had at least a chicken during the study period. The purpose of determining involvement in poultry keeping is to identify and target households and sites for future interventions by considering farmers experiences, objectives and priorities.

Table 1: Practice of poultry keeping in male-and female-headed households in different regions

Region	Sex of head	Number of households	% of regional observations	% of households with poultry
Tigray	Male	685	68.5	79.3
	Female	315	31.5	70.2
	Total	1000	100	76.4
Amhara	Male	1197	79.69	77.4
	Female	305	20.31	73.4
	Total	1502	100	76.6
Oromia	Male	1251	83.34	54.3
	Female	250	16.66	42.8
	Total	1501	100	45.2
SNNPR	Male	904	90.31	39.2
	Female	97	9.69	32.0
	Total	1001	100	38.5
All regions	Male	4037	80.68	59.4
	Female	967	19.32	60.3
	Total	5004	100	59.5

Generally, majority of the households kept poultry (Table 1). In every ten households, almost six kept at least a chicken. This is alike to previous studies which estimated that 60 to 80% of rural households worldwide raise village poultry (Dessie 1996; Kitalyi 1998; Permin and Detmer 2007). Data computed from CSA (2013) shows that approximately 57% of the rural and urban households (8,790,601 of 15,479,493 households) in the country kept poultry. The national figure (57%) is slightly lower than that of this study (60%) because the former includes also urban households where poultry keeping is less practiced. Overall, the diverse roles of poultry as a source of income, nutrition and asset-building capital as well as its low input requirements make it to be easily replicated by rural households (Guèye 2002; Dolberg 1997).

However, the poultry-keeping practice is not uniform across regions. While more than 75% of households in Tigray and Amhara were engaged in this farming activity, this figure was only less than 50% in Oromia (45.2%) and SNNPR

(38.5%) showing that it is a less common practice in the latter two regions. We computed from CSA (2013) that for every hundred people (with or without poultry), the numbers of chickens were 139 for Tigray, 98 for Amhara, 67 for Oromia and 64 for SNNPR. Figures drawn from this study showed that the number of chickens per hundred people from households that did or did not keep poultry was 122 for Tigray, 156 for Amhara, 73 for Oromia, 32 for SNNPR and 96 nationally. The findings of CSA (2013) and this study consistently confirmed that poultry keeping is least dense especially in SNNPR but also in Oromia as compared to Amhara and Tigray. The underlying reasons for the regional differences might need further empirical investigations.

Across all the regions, female- and male-headed households are almost equally involved in poultry production. It can be observed that the portion of female-headed households is highest in Tigray (32%) and lowest in SNNPR (about 10%) as compared to Amhara (about 20%) and Oromia (17%). A high percentage of female-headed households is attributed to permanent male migration, widowhood and divorce (Meehan 2004). The regional variation in prevalence of female-headed households is useful information for research and development initiatives interested to prioritize and target relevant groups.

Households' involvement in poultry keeping

Factors that affect whether or not households partake in poultry production were analysed. The results of the analysis are reported in Table 2. The probability of households for involvement in poultry keeping was different between regions. Households in Oromia and SNNPR were found to be significantly less likely to keep poultry than those in Tigray which is taken as a reference region in the analysis. However, households in Tigray and Amhara have similar chances of becoming poultry keepers. The regional differences in households' engagement in poultry keeping might be attributed to differences in resource endowments, production objectives and livelihood opportunities.

Table 2: Binary logistic model estimates of factors explaining households' involvement in poultry keeping (Yes= 1 No=0)

Variables	Coefficients
Region (1)*(Amhara)	0.13(0.10)
Region (2) (Oromia)	-1.37 (0.09)***
Region (3) (SNNPR)	-1.65 (0.10)***
Sex of household head (Male=1, Female = 0)	0.16(0.19)
Age (yrs)	-0.01(0.00)***
Family size (Number of members)	0.09(0.00)***
Education (Literate = 1, Not literate =0)	0.22(0.07)***
Cattle production (Y=1, No=0)	-0.343(0.10)***
Shoat production (Y=1, N=0)	-0.542(0.07)***
Constant	0.835(0.19)***
Observations	5004

*Tigray is taken as a reference region, Standard errors in parentheses, *** p<0.05

Households with younger heads were significantly positively related to poultry keeping. This shows that poultry is becoming an attractive farming activity to young families unlike in the past where the relatively older and the weaker were believed to be more associated with it (Ekin et al. 2010). The finding implies that the low labour-intensive village poultry is interesting and engaging young households as it does not compete with other livelihood activities that demand time.

Households with larger family sizes tended to be significantly more engaged in poultry keeping. As family size increases, the labour availability and the needs of rural households for food and income increases stimulating their engagement in more diversified farming activities including poultry production.

Households with more educated heads were positively related to poultry keeping. This may imply that the more educated households are being attracted to and engaged in poultry keeping perhaps due to their better awareness and knowledge of its value and production efficiency. On the other hand, village poultry does not demand high levels of skill and education (Alemu et al. 2008; Omiti and Okuthe 2008; Obi et al. 2008).

Involvement in production of cattle or sheep and goat production was negatively related to poultry keeping. Households that owned cattle or sheep and goats were less engaged in poultry production. Previous studies considered village poultry production as the first step in the ladder of livestock ownership (Gueye 2000; Aklilu et al. 2008). The households in this study might have progressed in the ladder and shifted attention from village poultry keeping to more important cattle or small ruminant production which is an indicator of more wealth. A study found out that involvement in poultry keeping was more likely associated with households with lower income per capita (Eiken et al. 2010). The poor value poultry higher and engage more in village poultry because it generates relatively high return with low investments (ibid). The low-input-low-output poultry is often considered as an efficient activity as compared to larger livestock species which the poor cannot afford to produce.

Flock size per household

We examined flock size per household of poultry-keeping households in different regions (Table 3). Generally, the average number of birds was approximately 10. Of all the households that kept poultry, 52% had five or less number of birds. About a quarter of these households kept 6-10 birds. Only 22% had beyond 10 birds. In terms of breeds, majority (91%) of households kept local poultry. While 19% of the households had both local and improved breeds, approximately 9% of them kept only improved breeds.

This average flock size per household found in this study is smaller than the figure reported almost ten years ago by Dessie (1996) which was 14 implying that population growth of humans is not matched by that of poultry in Ethiopia (Alemu et al. 2008). This indicates if this trend continues, the supply of poultry will be decreasing in the future. The flock size found out in this study is also smaller than the flock size reported in other African countries. For example, it is 21 in Kenya (Okitoi 1999), 20 in Zimbabwe (Mahaka 1990), and 18 in Tanzania (Chiligati et al. 1995). Thus, there is a need for increasing poultry production and productivity to meet the growing demand due to rising population in Ethiopia.

Table 3: Flock size per household in different regions

Region	Observations (N)	Average number of birds per household
Tigray	764	8.74(7.77) ^a
Amhara	1150	11.24 (12.98) ^b
Oromia	679	9.94(11.21) ^c
SNNPR	385	5.38(6.70) ^d
Total	2978	9.55(10.89)

* Standard deviations are in parentheses

Rows with different letter superscripts differ significantly (P<0.05)

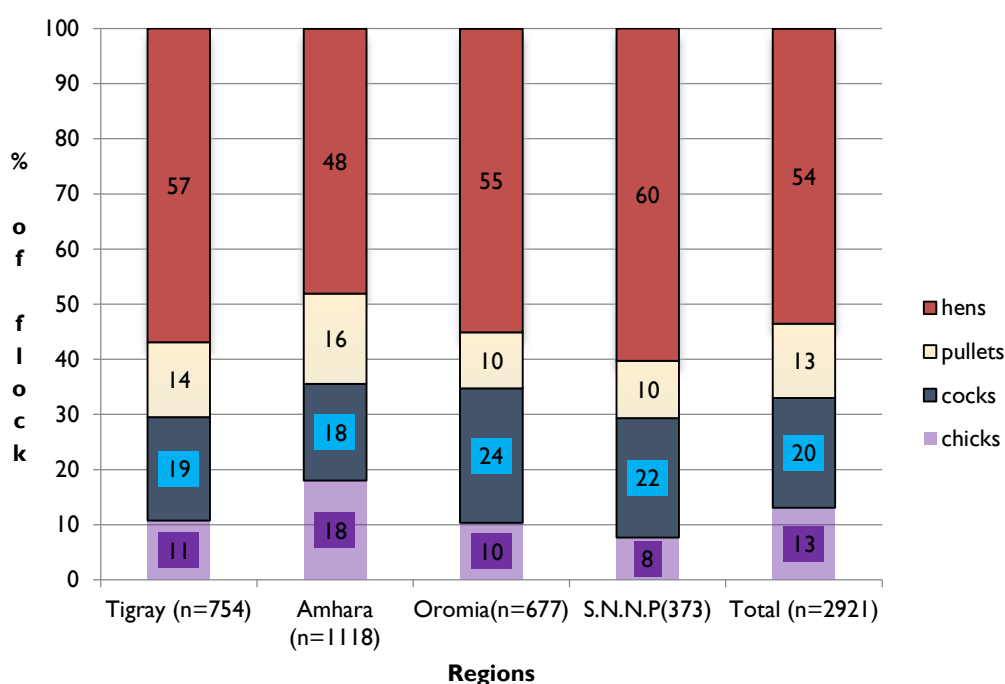
Analogously to the results of the partaking of households in poultry keeping, flock size per household varied between regions (Table 3). Flock size per household was highest in Amhara (11.24) and Oromia (9.94) and lowest in SNNPR (5.38). The Amhara region has not only the largest flock size per household but also it is one of the regions with the

highest proportion of households involved in poultry keeping and the opposite applies to SNNPR. The underlying reasons for the regional variation might be interesting to explore through future research.

Despite the establishment and expansion of commercial poultry farming in Addis Ababa and nearby cities, their contribution to total national poultry production is still insignificant. Household (family) poultry production, albeit with small flock sizes, constitutes 98.5% and 99.2% of the national egg and poultry meat production (Dessie et al. 2002). According to CSA (2014), national poultry population is estimated to be more than about fifty one million of which 96.83% are local breeds.

Figure 2 reports the structure and composition of flocks of the study households in the different regions. A typical flock consisted of young chicks (up to one month), pullets, cockerels, hens and cocks. In all regions, hens constituted the largest share (54%) of the flock and 96% of the households had at least a hen. Females (hens and pullets) made up about two-third of the flock implying households objective for reproduction.

Figure 2: Flock composition per household in different regions.



The proportion of chicks is rather low (13%) as compared to findings from previous studies in Ethiopia and elsewhere (Dessie and Ogle 2001; Dessie et al. 2003; Muchadeyi et al. 2004; Okeno et al. 2011) which reported that this age group accounts for the largest portion of flocks in village poultry. 'Chicks' refers to the age when the young birds are mothered or brooded, usually from 0-2 months (Johnston 1992).

About 70% of the households did not have a chick in the flock. The low composition of chicks might be due to the fact the information on poultry production referred to the period right after the rainy seasons which is unfavourable for incubating, hatching and brooding chicks. Incidence of diseases is high in rainy seasons. Resistance of birds, especially of chicks, to infections declines during extreme cold weather particularly in extensive systems (Abalaka et al. 2013).

About three quarters of the households had at least one cock in their flocks. The cock to hen ratio (1:2.7) appears to be slightly higher than the national ratio (1:3.2) estimated by CSA (2014). The male to female ratio in village chickens often is about 1:4 (Dessie 1996; Okitoi 1999). This could be due to farmers' priority to have a higher offtake of males than females. The apparent excessive number of cocks is due to the inclusion of cockerels which are premature for mating. Normally, a large portion of cocks is disposed through consumption and sales.

In order to explore households' tendency to expand poultry production, we examined flock sizes of poultry keepers in relation to various characteristics (Table 4). Poultry-keeping households in different regions had different effects

on flock size per household. While households in Tigray and SNNPR significantly decreased flock size per household, those in Amhara had significant positive effect on the same. The classification of regions in this study is based on administrative boundaries. Previous studies reported regional differences in productivity and flock sizes. The differences could be due to differences in household priorities (FAO 2010), market access (Aklilu *et al* 2008), natural resource endowments that affect scavenging feed resource base, for example, in semi-arid areas (Okeno *et al.* 2011; Mtileni *et al.* 2012).

Sex of household head (Female=0, Male=1) had a significant negative effect on flock size per family member. Flock size per family member is significantly higher in female-headed households. The focus of female-headed households on rearing poultry has been reported in previous researches on village poultry (Aklilu *et al.* 2007; Sonaiya 2007). The observation that the sex of the household head did not significantly influence flock size per household might imply that poultry in Ethiopia are mainly in the hands of women who are not only in the female-headed households but also in the male headed ones (Aklilu 2008). In several other studies (Ochieng *et al.* 2011; Teng 2011; Muchadeyi *et al.* 2004), flock size was also positively linked to female ownership of poultry. It estimated that women own over 70% of poultry in Africa (Alder 1996; Gueye 1998; Gueye 2000). Rural children in Ethiopia are also reported to often own birds in order to cover schooling (Hailemariam *et al* 2006).

Table 4: Household characteristics affecting poultry flock size per household and per family member

Variables	Coefficient (estimate for flock size per household)	Coefficient (estimate for flock size per family member)
Regions (dummy coded)		
Tigray	-1.08(0.46)**	0.18(0.11)
Amhara	2.76(0.41)**	0.52(0.10)**
Oromia	0.01(0.01)	-0.15(0.12)
SNNPR	-0.05(0.01)***	-1.12(0.14)**
Sex of household head (Male=1, Female=0)	-1.07 (0.91)	-0.45(0.17)**
Age (yrs)	-0.08(0.03)***	-0.01(0.01)
Family size (number)	0.24 (0.14)	-0.27(0.03)
Education (read =1 or not =0)	0.71 (0.61)	0.08(0.11)
Cattle (heads)	-0.34(0.09)***	0.07(0.02)
Shoat (heads)	1.3(0.45)***	0.24(0.08)***
Constant	10.81(1.8)***	3.88(0.34)
Observations	1673	1673

Standard errors in parentheses, *** p<0.01, ** p<0.05

The age of household heads varied from youth up to those in their nineties in the study areas. The age of household heads inversely affected flock size per household. Younger households tended to expand flock size per household. This seems to be aligned with many studies on village poultry in other countries in Africa.

With increasing age of household heads, productivity of family poultry declined in West Kenya (Okeno *et al.* 2012). Younger households more adopted improved management techniques in Benin and that their flock productivity decreased with increasing age of poultry keepers (Ochieng *et al.* 2012). A study conducted in households in Ethiopia, Ghana, Kenya and Nigeria found out that older heads are more likely to keep poultry as long as it is a low labour intensive activity (Ekin *et al.* 2010). This implies older households, unlike the young ones are less likely to increase the scale of operation of poultry as doing this might demand more labour. The age of rural household heads indicates the level of experience in farming. However, this does not necessarily mean that older farmers can afford to carry out farming activities that require more labour. Given that households practice diverse farming activities, understanding the wage opportunity cost of family members via future research could give further insights into the effect of age on flock size.

Family size is a proxy for available household labour as well as for household demand for food. The family size of households in the study areas ranged from 1 to 18 members. As shown on Table 4, family size tended to affect (but not significantly) flock size per household. A study predicted that, in Ethiopia, larger households are more likely to keep poultry than smaller ones (Ekin et al. 2010) which was attributed to increased household needs for food and labour availability. It appears that family size did not have a significant influence as increasing flock size did not demand more labour intense activity. Shortage of family labour can prevent implementation of agricultural practices which have the potential to increase productivity (Giller et al. 2011). The use of better management practices of poultry requires more family labour. In Benin, household size had a positively significant effect on the use of improved breeds, supplementary feed and on the construction of housing for young chicks in Benin (Sodjinou 2011). Households that employ improved management techniques invest more time on poultry tending tasks (Mtileni et al. 2012; Muchadeyi et al. 2004). In Zimbabwe, households with labour shortage shared poultry with other households (Muchadeyi et al. 2004). Informal sharing arrangements were also found in North Ethiopia where households without their own flocks engaged in joint poultry ownership and benefitted from sale and consumption. This poultry sharing arrangement was viewed as an entry point for resource-poor households who received chicks as payment-in-kind for their labour (Aklilu et al. 2007; Alem et al. 2014). The study also found that women from both male- and female-headed households engaged significantly more in sharing arrangements than men as they viewed it as an opportunity for social interaction (ibid.). Sharing was usually between related families only (Aklilu et al. 2008; Muchadeyi et al. 2004).

There was no difference in flock size between households with literate and illiterate heads. Traditional village poultry production is a low-input, low output activity, which does not require high levels of skill and education (Alemu et al. 2008; Omiti and Okuthe 2008; Obi et al. 2008). Both the educated and less educated households can practice traditional poultry production. However, it is believed that education positively influences the use of improved crop and livestock husbandry practices due to the link between education and knowledge (Knowler and Bradshaw 2007). In Vietnam, the education level of male heads of households significantly decreased flock mortality as treatment and disease prevention was the responsibility of men (Tung 2012).

Households that owned cattle had significantly smaller flock sizes than those that did not. On the other hand, ownership of sheep and goats increased flock size per household. Farmers in northern Ethiopia used metaphorical expressions to symbolize the values and comparative advantages of village poultry (Aklilu 2007). They described village poultry as *'the first and the last resource a poor household owns'* implying that poultry keeping is the first step on the ladder for poor households to climb out of poverty and that it is the last capital they use for recovery during times of crisis. Owning poultry but no other livestock, is seen as a sign of absolute poverty. Farmers explained the function of poultry as a starting capital, as *'the seeds the poor sow to get the product, cattle'*. This role of poultry as a starting capital for poor households in the livestock ownership ladder has also been reported from case studies in other countries (Gueye 2000). The ownership of cattle might signal shifting attention and priorities of households from subsidiary activities such as poultry to larger livestock asset building. On the other hand, the study quoted farmers as saying *'poultry are protectors of sheep and goats'* which implies that selling poultry prevents the sale of their breeding flock of sheep and goats when there is the need to cover immediate, but relatively small expenses, which otherwise would retard the progress towards capital development using these larger livestock. This might explain the positive effect of shoat ownership on poultry flock size.

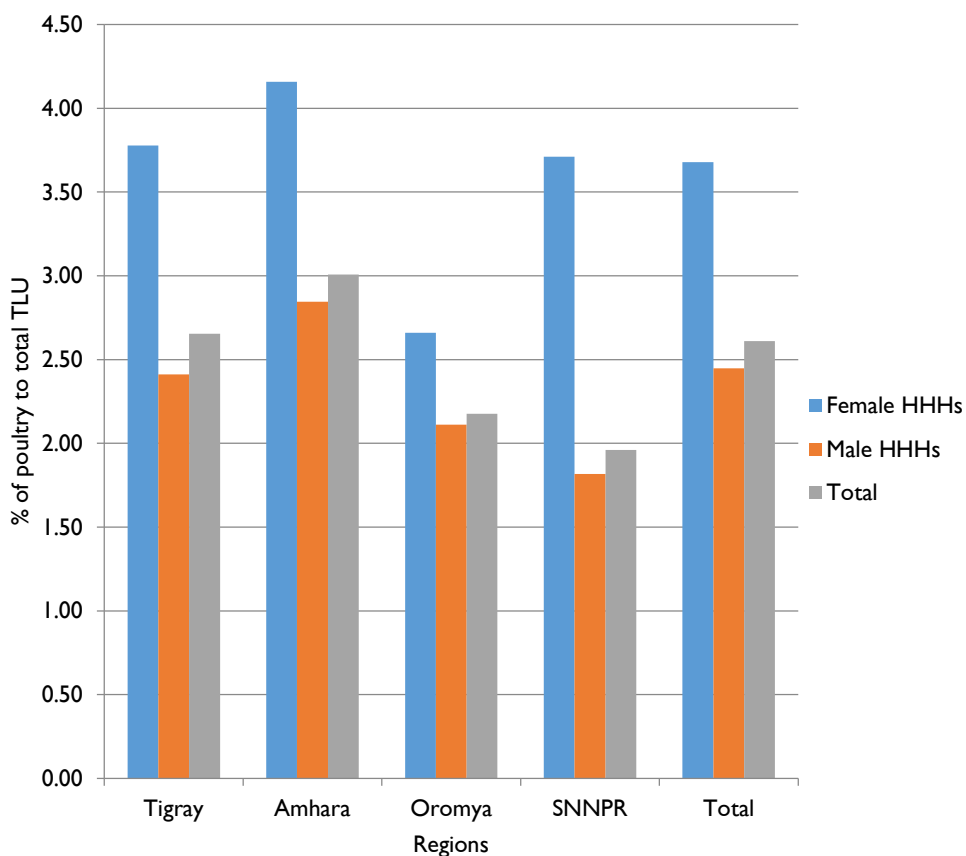
Importance of poultry as part of household livestock

We investigated the relative importance of poultry as part of household livestock production in male- and female-headed households in the different regions of the study. The contribution of poultry to total livestock production per household was estimated in terms of tropical livestock units (TLU) for comparability (Fig. 3). The livestock types included in computing the total TLU per household were cattle, sheep, goats and poultry. Generally, the share of poultry in total TLU per household is only approximately 3%. Regions and gender of household head tended to affect the contribution of poultry. Highest contributions of poultry were observed in Amhara followed by Tigray regions. This observation is consistent with the finding that these two regions had the highest proportion of households

keeping poultry as well as the largest flock size per household. The explanations for these regional differences are open for exploration.

The share of poultry in total TLU was higher in female-headed households than in male-headed households consistently in all regions (Figure 3). The proportion female-headed households that had cattle (65%) and sheep and goats (42%) was lower than that of male-headed households which was 91% and 55%, respectively (Figure 4). However, there was hardly any difference in the portion of households between these household groups in access to poultry production. In Ethiopia, male-headed households are considered to be wealthier than female-headed households (Aklilu 2007).

Figure 3: Share of poultry in total livestock TLU per household in male- and female-headed households (cattle = 0.7 TLU, shoat =0.1, poultry= 0.01 TLU).



For example, the higher ownership of larger livestock (e.g. cattle) in this study can explain that male-headed households have more access to resources than the female headed ones. Larger stock requires more land, feed and labour, which increased the risks of ownership and prevented poor households from owning them (Aklilu *et al* 2008). Household wealth was negatively correlated to share of income from poultry (Dessie *et al.* 2003). In Ethiopia and other countries, the ownership of only poultry was associated with poor households (Behnke *et al.* 2012; Teng 2011; Aklilu *et al.* 2008; Alders 2004).

Figure 4: Availability of cattle, sheep or goats and poultry in male (N= 4037) and female (N= 967) headed households.

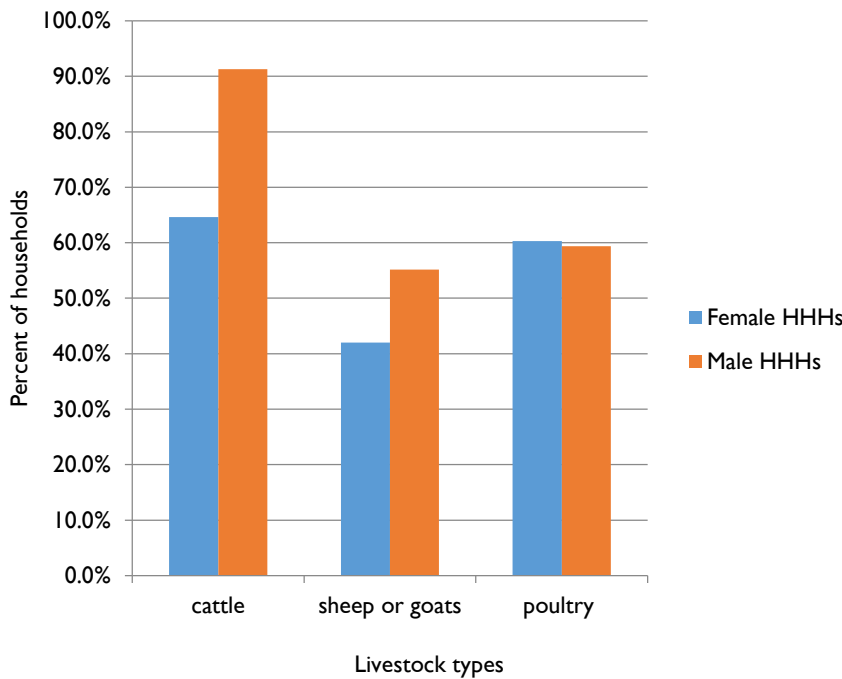
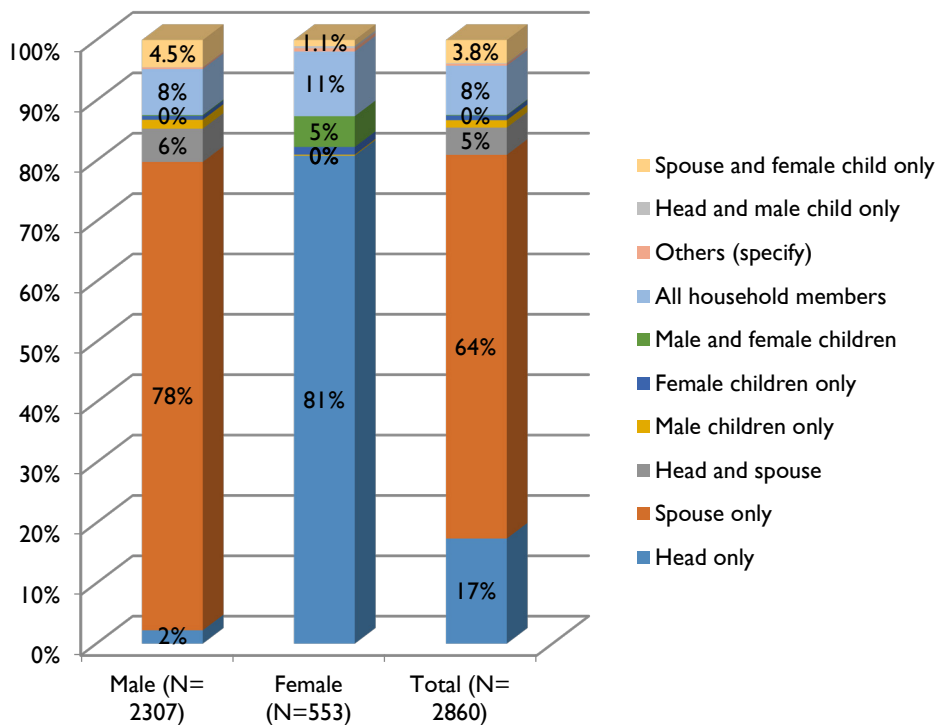


Figure 5 reports the division of responsibilities in poultry management in male- and female-headed households. In majority (64%) of both household groups, women (as heads or spouses) were responsible for poultry management. Women managed poultry in 81% and 78% of the female- and male-headed households, respectively. Men were involved in poultry management only in about 2% of the male-headed households. The rest of the family members (female or children) participated in poultry management only in a very small number of the households under the study. Thus, poultry management is largely the responsibility of women in female-headed, as well as in male-headed, households.

Figure 5: Gender roles in poultry management in male- and female-headed households.



This study has found that poultry has an exceptional reach among the female-headed households when compared to larger livestock such as cattle, sheep and goats. Researches undertaken on village poultry in developing countries have justified the association between poultry and the poor (including female headed) households in different ways.

Firstly, village poultry can be produced by the very poor who may be landless or marginal landowners (Saleque and Mustafa 1996; Dessie and Ogle 2001). For instance, poultry keeping in Bangladesh was negatively related with the size of land holding (Dolberg 2003). Secondly, unlike other livestock such as cattle, village poultry are natural scavengers requiring minimal feed inputs without demanding much additional cost from the poor (Alders and Pym 2009; Kryger et al. 2010). Ekin et al (2010) predicted that households who have lower income per capita are more likely to be poultry keepers. This was attributed to the reason that poultry keeping is considered as a livelihoods activity attractive to the poor due to its high return rate compared to its low input investment requirements. Thirdly, village poultry can be managed by children and women as part of household activities, unlike other agricultural activities and wage employment options (Tan 2013).

Finally, the reproductive efficiency is also an advantage to the poor. The relatively short maturity age of poultry requires little capital investment. Resource-constrained households can produce poultry and get quick returns with low investment. Apart from creating access to quality protein, households can generate supplementary income from sale of birds and eggs to buy foodstuffs, purchase market goods and send children to school. For these reasons, researchers have considered poultry as a first step in a metaphorical livestock ladder where the poorest start with poultry before moving on to acquire larger livestock assets such as dairy cattle (Dolberg 2001; Aklilu 2008; Udo et al. 2011).

3.2 Production performance

Flock dynamics

Flock inflows

Flock dynamics can be expressed in terms of the flow of birds into and out of the flock. Table 5 reports the relative importance of different causes that contributed to the inflow of poultry flock. Hatching is the largest source of the flock replacement or maintenance for local and improved breeds. More than three quarters of the birds entering the flock comes from hatching. Next to hatching, households relied on purchasing for restocking. Purchasing is a source of slightly more than one-fifth of the flock inflow of local breed. The contribution of local birds obtained as gifts for incoming flock is minimal (less than 1%).

Table 5: Causes of inflows of flock in poultry-keeping male- and female-headed households

Sex of household head	Breeds	Number of households	Percentage contributions (mean and SDs) of different causes to inflow of flocks		
			Hatching	Purchasing	Gift-ins
Female	Local	242	77.25(40.38)	22.08(40.17)	0.67(6.66)
	Improved	36	48.40(49.77)	45.81(49.60)	2.86(16.90)
Male	Local	943	80.92(38.07)	18.32(37.40)	0.57(6.98)
	Improved	136	47.58(49.42)	51.71(49.45)	0.00

For improved breeds, hatching (48%) and purchasing (46–52%) made similar contributions to flock entries. As compared to the improved flock, incoming improved flock received relatively more contributions from hatching but less from purchasing in both male- and female-headed households.

The study disaggregated the number of birds purchased per household by purpose of purchasing. Hatching (41%), meat production (26%) and egg production (15%) were the three most important priority purposes local birds were

purchased for. The largest share (93%) of the purchased improved birds was for hatching and egg production for direct offtake. The contribution of meat production as a purpose for purchasing was very low (only 1%) implying that these breeds are being distributed through the extension system are of egg type. The other less ranking reasons that motivated farmers to purchase local and improved birds were saving-in-kind, increasing social prestige and reselling later.

The types and levels of importance of purposes for purchasing local and improved breeds do not seem to show different patterns in male- and female-headed households.

Flock outflows

Table 6 reports the flow of birds out of the flocks at household level during the study period. Death accounted for up to 51-56% of the outflow of local and improved flocks. The study included information on the types and level of effects of causes to the death of birds. Households reported that disease caused more than 70% of the mortality of the birds. Predators and accidents accounted for, respectively, about 15% and 9% of the flock losses caused by death. Poisoning (caused by e.g. chemicals and snake bites) contributed to nearly 4% of the death of the birds. There are unclear differences between local and improved breeds and between male- and female-headed households in the contribution of mortality to bird outflows.

Table 6: Causes of outflows of flocks in poultry-keeping male- and female-headed households

Sex of household head	Breed	Number of households	Means and SDs of percentage contribution of different causes to outflow of flocks				
			Slaughter	Death	Sale	Gift-out	Theft
Female	local	454	14.63 (25.72)	56.19 (38.91)	26.55 (33.90)	0.49 (4.12)	2.12 (12.65)
	Improved	103	13.52(26.96)	52.56 (44.75)	32.15 (39.85)	0.57 (4.09)	1.20 (6.33)
Male	local	1728	20.07(29.14)	51.02 (39.21)	27.94 (34.73)	0.52 (5.20)	0.39 (3.85)
	Improved	306	14.50 (27.30)	56.56 (43.24)	26.04 (38.19)	0.82 (6.54)	2.08 (13.00)

Many researches carried out in different developing countries have recognized that NCD is the major cause of mortality in village poultry (Smith 1992; Tadelle and Ogle 2001; Mapiye and Sibanda 2005; Dinesh et al. 2011; Teng 2011; Okeno et al. 2011; Sodjinou 2011). Mortality due to the highly infectious NCD is reported to have at times almost reached a 100%, for example, in some African countries like Tanzania, Ethiopia and the Gambia (Kitalyi 1998). Studies on village poultry in other countries show that predation reduced income from poultry by 36% (Maijer 1987).

Although prevention of the disease is possible through vaccination, its effective implementation poses challenges. Among the major challenge for control of this disease are the costs of vaccine and vaccinating and refrigeration to maintain the vaccine. The fact that vaccinations have to be repeated at regular intervals (Udo 1997) needs continuous supply of vaccine.

Additionally, parasites also affect village poultry. In Kenya, about 90% of village chickens examined for internal parasites were infested with helminthes (Ondwasy et al. 1999). The problem of pests such as lice, chicken mites, fowl tick and stick tight fleas is prevalent in village chickens (Siamba et al. 1999). One of the most important reasons that households do not want to expend effort and money on improved husbandry and housing of village poultry is the risk that the birds can be wiped out by diseases (Mulabachi et al. 1999).

As indicated above, predation is the second cause of mortality next to diseases. In free range systems in Ethiopia and other countries, poultry are barely provided with proper housing. Dessie (1996) reported that in rural areas of Ethiopia, most households did not have purposeful housing for poultry except few planks of wood inside the family residence where the birds can roost during the night. In Kenya, households kept their poultry housed only at night in kitchens or main houses (Okitoi 1999). During the daytimes, the birds are released to the open environment which makes them susceptible to predation.

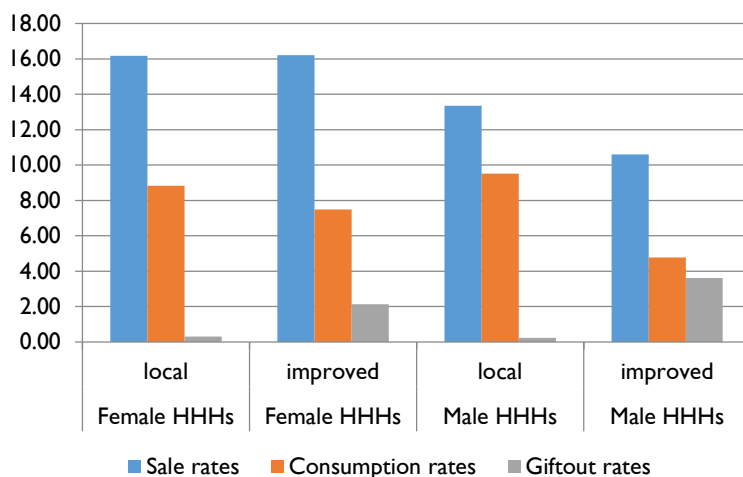
Sale is the second most important contributor (26-28%) of birds moving out of the flocks. Slaughtering caused 13-20% of the flock outflow. On average, households used nearly 95% of the slaughtered birds for home consumption. The sale of slaughtered (processed) birds was not a common practice (less than 2%) of households. Sickesses and accidents contributed minimally as causes for slaughter of birds. As for inflows, the contribution of gifts to outflow of flocks is small. Giving out birds as a gift is uncommon (less than 1%).

Generally, households sold up to twice as many local birds as they slaughtered. This is confirmed by the several studies in Ethiopia which found out that generally households prioritized sales above consumption of poultry (Dessie and Ogle 2001; Tadelle et al. 2003; Aklilu 2008). Selling poultry helped households to generate small but immediate income in order to cover emergency expenditures (Tadelle and Ogle 2001; Mtileni et al. 2012), preventing the sale of larger livestock which are assets with higher value.

Another aspect of the flock dynamics was the relative number of birds moving into and out of flocks. The ratio of inflow to outflow across the study areas was about 0.56 for local and 0.51 for improved breeds. The ratio indicated that the outflow was higher than the inflow implying the flock decreased during the reference period. Flock dynamics is season-dependent. As data were collected during or right after the main rainy season, this might have an impact on the flock available, mortality, reproduction and offtake. In village poultry, flock size varies with seasons due to fluctuating availability of feed and mortality (Okitoi 1999; Dessie 1996). This was attributed to the effect of restriction of birds from moving to crop fields. For easing the restriction, farmers reduce their flock size. Inadequate feeding also contributes to decreased flock size. During a rainy season, village poultry-keeping households decrease flock sizes but they raise them in the rest of the year (Mulabachi et al. 1999). In village poultry production, the number of cocks, growers and chicks fluctuate over seasons but that of hens remains almost constant (Okitoi 1999). The incidence of diseases and increase in predation losses in wet seasons to which the young birds, chicks and growers, are most susceptible (Chiligati et al. 1995) could be the causes of the variability in the number of young birds. Mortality from predation is higher in rainy season because the relatively denser vegetation in the villages during the wet seasons harbours predators (Dessie 1999).

Male- and female-headed households slightly differ in the level of importance they attach to sales and consumptions of poultry. Figure 6 presents the patterns of sale and consumption rates of birds in male- and female-headed households. Female-headed households were more inclined towards sale than to consumption of birds. Male-headed households, which in many cases have better access to resources (wealth), may be less pressurized to sell poultry and thus prioritize for consuming them. In North Ethiopia, a significantly higher proportion of female-headed households kept only poultry compared with male-headed ones (Aklilu et al. 2008). The same study reported that households in Tigray with livestock preferred to consume rather than sell their poultry but for the poor with few livestock, consuming their own poultry products was considered as unaffordable. Another study in Ethiopia has also found out a significantly positive correlation between family income and the consumption of poultry products (Dessie et al. 2003).

Figure 6: Bird offtake rates in male- and female-headed households.



Research findings from other countries in Africa indicate similar patterns regarding the relationship between household wealth and income from poultry. In Nigeria, Kenya and Ghana, the share of income obtained from poultry decreases with income quintiles (Ekin *et al* 2010). This implied that poorer households rely more on poultry to provide some of their livelihoods than their better off counterparts. Apart from wealth, market access affects households' decision to consume or to sell poultry. Households in remote (less market accessible) areas prioritized consumption over sales of poultry products (Dessie *et al.* 2003; Aklilu *et al.* 2007; Tung and Costales 2007).

Egg dynamics

Egg production

Table 7 reports egg production performance of local and improved breeds in different regions of the study. Across the regions, the general average number of eggs per year per layer for the local breeds is low (56). Depending on the regions, annual egg production per local hen ranged from about 46 to 64 where the minimum is from Amhara and the maximum from Tigray and Oromia regions. This study is rather exploratory and further investigation might be needed to understand the cause of the regional variation in egg production performance.

Table 7: Egg production performance of local and improved breeds in different regions

Region	Breed	Observations	Number of eggs per year per layer		Number of eggs per laying cycle per layer	
			Mean	Std. deviation	Mean	Std. deviation
Tigray	Local	594	63.87	20.26	13.13	3.16
	Improved	167	165.64	67.25	98.05	84.43
Amhara	Local	920	46.34	21.13	12.56	2.66
	Improved	120	161.68	71.83	87.01	92.10
Oromia	Local	554	63.43	25.36	13.97	4.04
	Improved	57	171.74	74.62	75.88	81.83
SNNPR	Local	308	58.11	25.86	12.04	3.17
	Improved	11	132.73	74.03	43.18	44.49
Total	Local	2376	56.23	24.01	12.97	3.28
	Improved	355	164.26	70.24	89.06	86.27

This finding of low egg production performance is almost in agreement with the reports of many researches undertaken on village poultry production systems. Examples among the various reported figures on numbers of eggs produced per year per hen include 45 (Amine *et al.* 1992), 50 (Sonaiya 1992), about 50 (Owango *et al.* 1999), 36 (Chiligati *et al.* 1995), 34 (Dessie 1996), and 60 (Kitalyi 1998).

The main reasons for the low egg production include poor feed availability, disease and low genetic potential. In Ethiopia, deficiencies of protein and energy are critical especially in rainy and dry seasons, respectively (Dessie 1996). The relatively higher availability of invertebrates in the environment in the wet season (Savory 1989) implies better protein supply as compared to the dry season. Energy supply increases in the dry season due to the availability of cereals particularly in the harvesting period. Therefore, the lack of combined availability of these nutrients (unbalanced diet) throughout the year decreases egg production performance.

The low genetic potential of local breeds is one of the key causes for the low egg production performance. One of the genetic traits that reduce egg production of local chickens is broodiness. The time during which a female bird incubates her eggs and rears her young is called the broody period (Rose 1997). During the period of broodiness, a natural behaviour is exhibited by all local chickens; birds interrupt egg laying (Alemu 1995). While it is a naturally efficient system to use hens to incubate eggs and hatch chicks in the village, the time is spent at the expense of egg production.

The time lost when the hen incubates her eggs and broods small chicks represents a considerable loss of egg production (Dessie 1996). It is estimated that the reproductive cycle of village chickens consists of a 10 day laying phase, a 21-day incubation phase and finally a 56-day brooding phase (Smith 1990). Sonaiya (1992) reported a longer rearing period for chicks, about 85 days. Dessie (1996) observed that the mother hen broods her young chicks for a period of 45–56 days. Owango et al. (1999) found an inter-brooding interval of 30 days and broodiness frequency of three times per year. A good local hen spends nearly half of her life sitting on the eggs and brooding her chicks even under regular housing and supplementation (Siamba et al. 1999). Thus, the shortening or break of broodiness period is considered as one of the critical genetic interventions for improving egg production performance.

In this study, the improved breeds produced almost three times higher number of eggs per layer per year than the local breeds. The overall average number of clutches (laying cycles) is about four and the size of a clutch being nearly 13 eggs. The number of eggs in a clutch is 7–8 times larger in improved breeds than in local breeds. The finding that the use of improved breed increases egg production as compared to local breeds is in agreement with many other studies undertaken on village poultry production in the tropics (Amine et al. 1992; Hoyer 1992). This is because improved breeds exhibit short or no broody period, have higher feed intake and feed conversion efficiency, although they thrive less with lower quality feeds.

Egg use patterns

The use of eggs for different purposes in male- and female-headed households is given in Table 8. It can be observed that the primary purpose of households in producing eggs is selling and that the second is home consumption.

Table 8: Egg use patterns in male- and female-headed households

Sex of household head	Number of households	Means and (SDs) % of eggs used for different purposes				
		consumed at home	Eggs spoiled	Used for hatching	Eggs given out	Eggs sold
Female	106	28.15(27.49)	0.99(3.12)	3.92(8.00)	0.30(1.53)	66.64(29.49)
Male	375	33.42(30.24)	1.46(4.62)	4.84(12.96)	0.25(1.60)	60.02(31.81)
Total	481	32.26(29.71)	1.36(4.34)	4.64(12.04)	0.26(1.58)	61.48(31.40)

Hatching is the third function. Eggs sale rates are slightly higher and consumption rates are lower in female-headed households than in the male-headed counterparts. Egg gift-out and spoilage rates were found to be rather small.

The number of eggs sold per household was twice higher than those consumed. This shows households value immediate cash income ahead of consumption. This is similar to the relative importance households attached to bird sales whose justification was given above. On the other hand, other studies (Dessie et al. 2003; Dessie and Ogle 2001) reported hatching as the highest purpose of egg production in central highlands of Ethiopia. There are reports which indicate the way households prioritize the use of eggs can differ between seasons in village poultry production. For example, in Kenya, households increased egg offtake and decreased the number of eggs set for hatching in times when risks of feed shortage and disease incidence are expected (Ondwasy and Okitoi 1999). Village poultry keepers decrease practices of incubation and hatching during wet seasons (Okitoi 1999).

3.3 Use of inputs

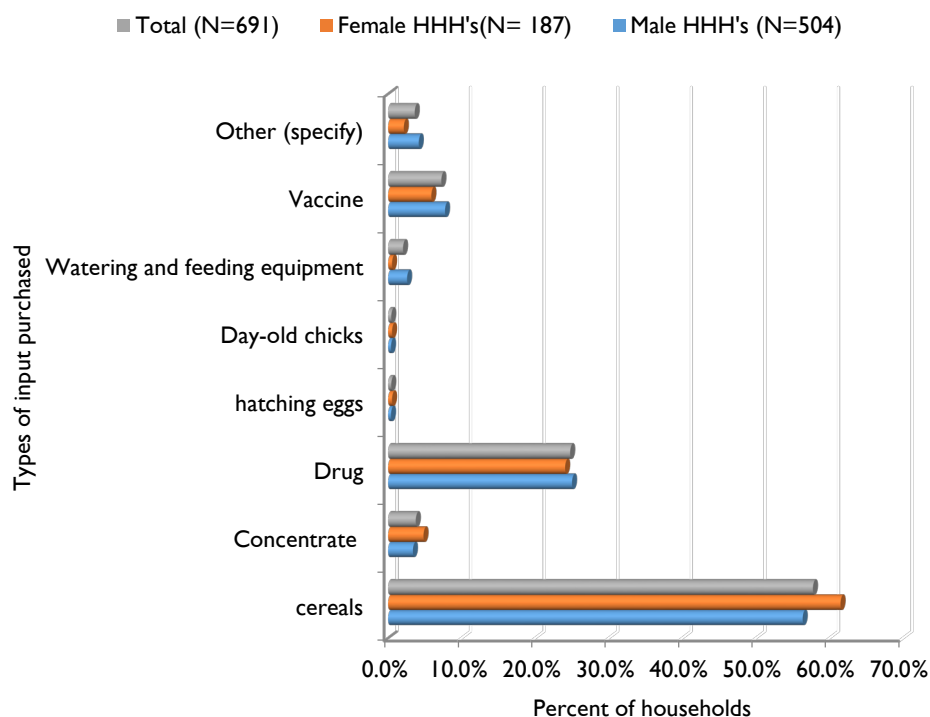
Table 9 presents the status of use of purchased inputs for village poultry production in male- and female-headed households. About 20% of the households reported that they purchased and used at least one type of input for poultry production. The types of inputs purchased by households included cereals, commercial feeds, drugs, vaccines, hatching eggs, day old chicks, watering and feeding equipment.

Table 9: Use of purchased input for poultry production in male- (N= 2442) and female- (N= 537) headed households

Sex of head	Households that used purchased input	
	Number of households	% of households
Female	118	22.0
Male	488	20.0
Total	606	20.3

The practice of purchase was different with different types of inputs (Figure 7). Of those households that purchased inputs, on average, about 58% reported they purchased cereals. Approximately 4% of these households purchased commercial feeds. A case study in these households could be useful to better understand the drivers and constraints of commercial feeds by village poultry keepers for possible scaling up. Next to feeds, drugs were the most widely purchased inputs by nearly 25% of the households. The purchase of vaccines was also reported by 7% of the households. A very small portion of the households purchased feeding and watering equipment (2%), hatching eggs (<1%) and day old chicks (<1%).

Figure 7: Percentage of households that used inputs by types purchased.



Feeds

As indicated on Table 9, the households' use of purchased input including feed for poultry production was very limited. The majority (88%) of the households used scavenging feed resources. Typical scavenging feed resources for village poultry are mainly constituted by household food wastes, forage seeds, and agricultural by products which are influenced by the density of households in the area, season and crops grown (Sonaiya and Swan 2004). The ability of birds (especially the local ones) to convert low quality energy feed to animal protein (Kitalyi 1998) is considered as an advantage. In commercial poultry production systems, feed cost constitutes 70% to the total cost (Huque et al. 1999). Thus, the use of scavenging system decreases the financial cost of village poultry.

However, according to Alders and Pym (2009), scavenging feeds provide only about 60-70% of nutrient requirements of a bird. Thus, although scavenging has advantages, the lack of feed supplementation is a major limiting factor. The performance of egg production under the scavenging system was found to be about 40% of that of commercial systems because of inadequate feed nutrition (Huque et al. 1999). Thus, if the production performance is to

be enhanced, feed supplementation is needed. However, the economic viability of extra costs of poultry feed supplementation have to be carefully analysed through research using situation (location) specific data.

Health control

As indicated in previous sections, flock mortality is very high in Ethiopia. Many studies have reported that mortality is high in village poultry also elsewhere. For example, among the various field reports of general mortality rates the following data were found: 66% (NPDP 1979), 62 % (Maijer 1987), 70% (Sonaiya 1992), and 80% (Siamba et al. 1999). In village poultry, diseases cause mortality of half of the flock or more on average (Maijer 1987; Permin and Detmer 2007). As previously indicated, mortality contributed to up to 56% of outflow of flocks in the study areas. Despite the high mortality, only 6% of the households used vaccines and drugs for poultry health control. The types of vaccines and target diseases have yet to be examined in future researches. Often, the first measure proposed to improve village poultry is vaccination before implementing other interventions such as improving the scavenging feed resources (Bell 2009). However, modern vaccinations are difficult to apply for village poultry production as these require cold storage facilities and precise administration by a trained veterinarian (Udo 1997).

Genetic improvement

Many village poultry development programs in the developing world involved genetic improvement. In this respect, the introduction of exotic breeds or cross-breeding has been the most common approach (Kitalyi 1998). Bessei (1987) reviewed the methods that have been used to develop rural poultry as cockerel exchange, pullet exchange, distribution of hatchable eggs, and distribution of day old chicks. In this study, a very small portion of the households (1–2%) used hatching eggs and day old chicks for genetic improvement of local breeds. However, as discussed earlier, 19% of the households in this study reported that they had both local and improved breeds and that approximately 9% of them kept only improved breeds. These households must be acquiring improved breeds through other methods (e.g. cockerels and pullets) than in the form of day old chicks and hatching eggs. Cockerel exchange has been the most common approach for improving breeds in Ethiopia (Alemu 1995). The underlying principle is that the off springs of the improved cocks are expected to have a higher productive potential than the indigenous chicken due to hybrid vigour. As presented in previous sections, households reported that the egg production performance of improved breeds was upto three times higher than those of local breeds. Apart from their biological performance, a careful analysis of their economic performance (profitability) should be carried out.

Some papers have asserted that the impact of the introduction of improved breeds requires critical analysis. In the context of scavenging system, the hardiness and performance of improved breeds as compared to local breeds has to be investigated (Alders and Pym 2009). Although commercial improved breeds have higher potential on commercial farms, their performance at backyard environment has been low (Huque et al. 1999). Studies have reported that the local breeds have a robust adaptability to the backyard environment in terms of predator avoidance, disease resistance and other survival instincts (Permin and Detmer 2007; Alders and Pym 2009). These traits enable the local breeds to thrive well in free or semi-scavenging systems.

Studies have found out that crossbreeds perform better under semi-intensive system than in free ranging systems (Islam and Jabbar 2005; Huque et al. 1999). In order to improve village poultry production, first feed supplementation and then disease control interventions have to be implemented before cross-breeding (Dessie et al. 2003; Bell 2009). Thus, the introduction of improved breeds will not guarantee higher production, unless the rest of the production system (e.g. health and feeding) is improved.

The introduction of exotic breeds or crossbreeding should not be promoted as the only option for genetic improvement of village poultry in Ethiopia. There are variations within the local population (e.g. in egg production) that warrant potential improvement in the local population through selection programs. Farmers also do not practice selective breeding as shown by the low percentage (2.7%) of culling for low productivity (Fig. 8). Furthermore, research on genetic variation could be initiated or strengthened to introduce selective breeding to increase production performance.

Housing

Village poultry are free in the range in the day but the provision of night shelter protects flocks from predators and increases their chances of survival. Local materials can be used to construct poultry housing. In this study, only a small portion of the households (<2%) purchased equipment for housing implying they are using home materials for the same. Village poultry housing can be built at low cost but its quality depends on whether it has features for optimal production including space for litters and perches, ventilation, light and protection (Sonaiya and Swan 2004). Effective housing should also be suitable for taking bio-security measures. The design of the house should allow easy regular cleaning, avoid contact with other animals or humans, and enable to put sick birds under quarantine (Alders and Pym 2009). Housing is especially needed for chicks because of their highest susceptibility to disease infections and predators.

Shelter is especially important for young chicks as they are the most vulnerable to predators and are highly susceptible to disease infections. According to Sodjinou (2011), young chicks have to be housed separately as they have been found to be more affected by disease vectors and insects in hen houses than older poultry.

Finally, as indicated above, the use of purchased inputs for poultry production is a rare practice of households. This observation is shared by studies conducted in Ethiopia and elsewhere (Dessie et al. 2003; Aklilu 2007; Guèye 2000; Kitalyi 1998; Sonaiya 2000). Some papers (Jensen and Dolberg 2003; FAO 2014) consider the low-input-low output village as an advantage to the poor households as they have easy access to production and can continue maintain small flock at low cost.

On the other hand, the problem of low production performance of village poultry, explained in terms of high flock mortality combined with low egg production rate per hen implies that there is an opportunity for improvement using inputs (home-grown or purchased).

Where resources and technical knowledge allow, some households use even purchased inputs to improve poultry performance. In this study, only few households used purchased inputs. However, additional detailed study is needed to understand the drivers, opportunities, enablers or barriers for use of purchased inputs by village poultry keepers. The comprehension of socio-economic context of households is needed if increased use of external inputs is to lead to positive outcomes in small holder livestock development such as village poultry (Udo et al. 2011; Asem-Bansah et al. 2012). This implies the importance of understanding households' objectives for poultry, the resource constraints they face and the interactions between their decisions and the external environment in which households operate. The use of improved techniques (inputs) is aimed at increasing production and economic performance of village poultry which is dependent on the socio-economic characteristics of households (Dessie and Ogle 2001; Sodjinou 2011). In North Ethiopia, household wealth was associated with the use of improved breeds, supplementary feed and poultry housing (Aklilu 2008). In Vietnam, low household income was also linked to lower feed supplementation and gross margins from poultry (Tung 2012). In Kenya, feeding and housing practices of village poultry-keeping households were found to differ significantly between agro-ecological zones (Okeno et al. 2011). The same paper also found out that households in semi-arid areas had experience in cattle vaccination, and the use of poultry vaccination was therefore more common in these regions.

According to Sodjinou (2011), significant differences were observed between the North and South regions in Benin in the use of poultry housing and supplementary feed because of differences in availability of housing construction materials and agro-ecological resources, respectively. The use of supplementary feeds (purchased or home grown) depends on seasonal fluctuations in feed supply and nutritional composition, which has to be considered in designing feeding interventions (Muchadeyi et al. 2004; Teng 2011; Mtileni et al. 2012). Thus, the decision on whether or not to use purchased inputs for poultry production is dependent on multiple factors. If village poultry is to be transformed from the traditional subsistent production systems into market-oriented profitable enterprises, the availability and increased use of technologies or inputs will be critical.

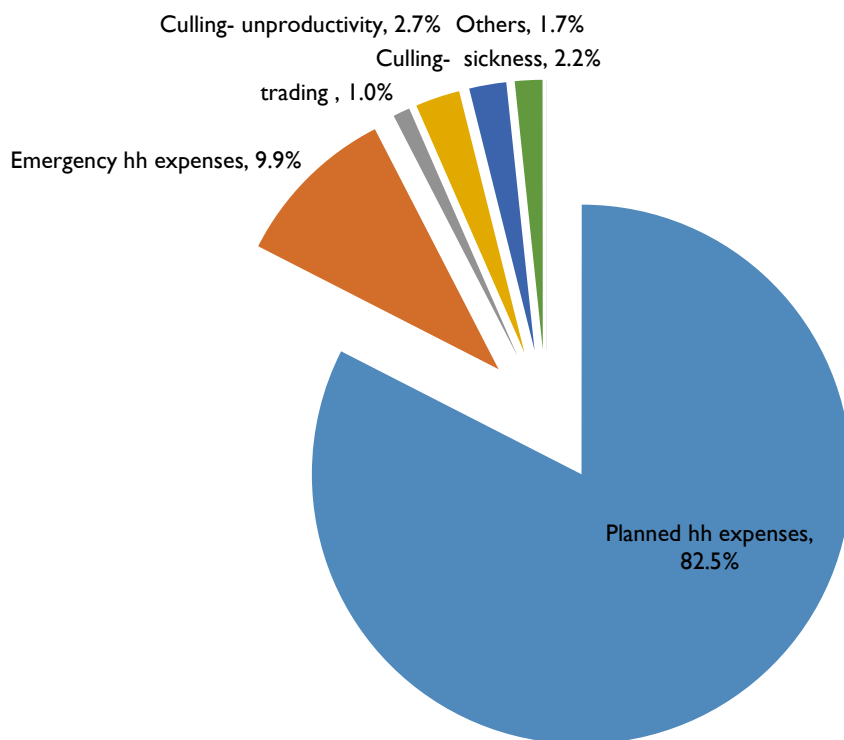
3.4 Poultry marketing

Bird marketing

Motives for selling birds

Figure 8 reports the reasons for selling birds. For majority of the households (83%), covering planned household expense was the most important reason for selling birds. Emergency household expenses (9.9%), culling due to lack of productivity (2.7%), culling due to sickness (2.2%) and poultry trading as business (1%) were the other purposes of bird sales.

Figure 8: Reasons for selling birds.



Market places

The market outlets of birds in different regions are presented in Table 10. Generally, district capitals are the largest market places where, on average, about 43% of the birds were sold. Market places in other PAs and in own PA are important outlets which, respectively, make up about 28% and 20% of the total birds sold. A smaller share of the birds sold were channelled to zonal capital (6%) and at farm gate (3%) and at regional capital (<1%). The order of importance of different market places for selling birds for each region seems to be almost consistent. However, the portion of birds sold in a given market place varies with regions. For example, farm gate selling was highest in Oromia (7%) and lowest in Amhara (1%). While bird sale at zonal capital market was about 12% in Tigray, it is none in SNNPR. However, the use of regional markets for selling birds is nearly uniformly low (<1%) in all regions.

Table 10: Use of purchased inputs for poultry production in male (N= 2442) and female (N= 537) headed households

Region	N	Means (SDs) of percentage of birds sold in different market places					
		Farm gate	Market in PA	Market in other PA	Market at district capital	Market at zonal capital	Market at regional capital
Tigray	280	2.32 (14.79)	14.23 (35.00)	27.32 (44.54)	43.42 (49.65)	11.74 (32.25)	0.71 (8.42)
Amhara	302	0.73 (8.20)	23.34 (42.27)	34.85 (47.58)	36.44 (48.09)	3.64 (18.77)	0.99 (9.93)
Oromia	241	6.62 (24.58)	18.71 (39.04)	24.15 (42.81)	47.20 (49.95)	3.32 (17.95)	0.00
SNNPR	76	3.95 (19.60)	27.63 (45.01)	18.42 (39.02)	48.67 (49.98)	0.00	0.66 (5.74)
Total	900	3.08 (17.01)	19.62 (39.69)	28.25 (44.94)	42.53 (49.38)	5.78 (23.35)	0.61 (7.62)

Buyers of birds

The types and relative importance of buyers of birds is given in Table 11. The general average across regions shows that urban consumers were the largest buyers who purchased about 43% of the total birds sold. The next important buyers were retailers (22%), assemblers (18%), and wholesalers (9%) and farmers (8%). Households sold only a very small portion of birds (<1%) to processors and cooperatives which indicates that these actually hardly exist in the study areas. However the order of buyers within a region was different for different regions. For instance, while urban consumers are the largest buyers in Tigray, retailers took the lowest position in SNNPR.

Table 11: Types of buyers of poultry in different regions

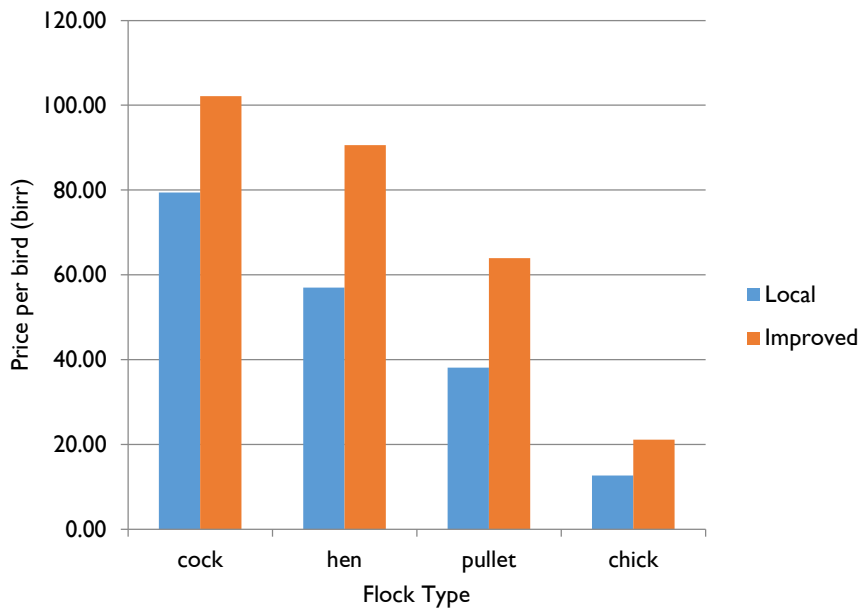
Region	N	Means (SDs) of percentage of birds purchased by different buyers						
		Farmers	Assemblers	Wholesalers	Retailers	Processors	Urban consumers	Cooperatives
Tigray	281	8.06 (26.66)	19.14(38.62)	4.98 (21.38)	4.27 (20.26)	0.09 (1.49)	63.17 (47.63)	0.00 (0.00)
Amhara	302	10.43 (29.13)	8.91(25.66)	6.09 (23.79)	35.22 (46.53)	1.16 (10.33)	38.20 (46.04)	0.00
Oromia	241	6.04 (23.07)	31.54(46.34)	13.49 (34.08)	19.07 (39.02)	0.73 (7.36)	28.73 (45.03)	0.41 (6.44)
SNNPR	76	3.55 (17.10)	3.95(19.60)	15.79 (36.71)	42.00 (47.79)	0.66 (5.74)	33.29 (45.71)	0.00
Total	900	7.93 (26.01)	17.74(37.20)	8.54 (27.77)	21.78 (40.52)	0.67 (7.33)	43.04 (48.26)	0.11 (3.33)

For Oromia, assemblers are the highest buyers and urban consumers were the next most important ones. The share of bird sales to retailers and wholesalers was largest in SNNPR and smallest in Tigray. Further studies are required to explain the intra and inter regional difference in the importance of different buyers.

Prices of poultry

As an element of poultry marketing, we explored the prices of local and improved breeds in the study areas (Figure 9). Depending on the flock types, the prices were ETB 10-78 for local breeds and ETB 20-102 for improved breeds. Of all flock categories, cocks fetched the highest prices for both breeds. Considering the adult flock, the price of cocks was almost 35% and 13%, higher than local and improved hens, respectively. Improved breeds were more expensive than local breeds by 31% (cocks), 55% (hens), 65% (pullets) and 200% (chicks).

Figure 9: Price per bird (ETB) of local and improved breeds (2012).



Gender roles in poultry selling and income control

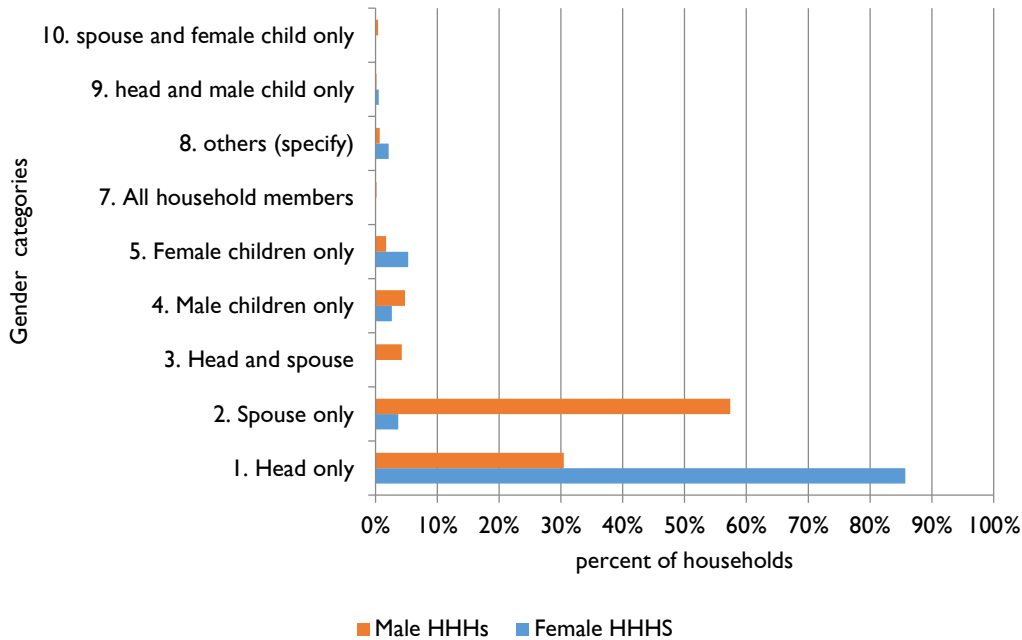
In order to understand the relative benefits of poultry sales to male- and female-headed households, financial values (in ETB) of total sales of local and improved birds was analysed (Figure 10). Generally, the revenue per family from bird sales was rather small. Female-headed households generated more than twice more income per family member from bird sales than male-headed households. Female-headed households tended to sell a higher portion of their birds and they had less family size as compared to male-headed households.

Figure 10: Values (ETB) of sales of local and improved breeds per family member in male (N= 2237) and female (N= 543) households during September 2012–August 2013 in Ethiopia.



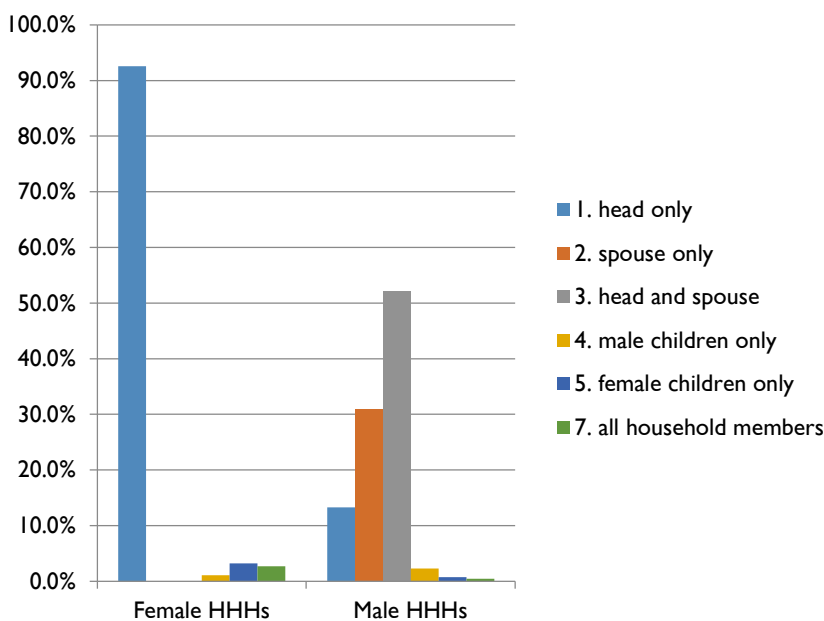
The division of responsibilities among gender categories for poultry selling was examined (Figure. 11). In majority of the female-headed households, women heads were responsible for a large portion (86%) of the birds that were sold. In male-headed households, 57% and 31% of the birds were, respectively, sold by women (as spouses) and men (as heads). In both household groups, the responsibility for selling of the rest of the birds was shared by other family members such as female and male children.

Figure 11: Gender roles in selling birds in male- and female-headed households.



The distribution of responsibilities among gender categories in control of income from bird sales were also explored (Figure 12). On average, women controlled more than 90% of the income from bird sales in female-headed households. In male-headed households, the heads (men) alone and the spouses (women) alone respectively controlled 13% and 30% of the income from bird sales. More than half of the income from bird sales was jointly controlled by the head and spouses in male-headed households. The other household members (children and others) had little role regarding decisions in use of income from poultry.

Figure 12: Control of income from bird sales in male- and female-headed households.

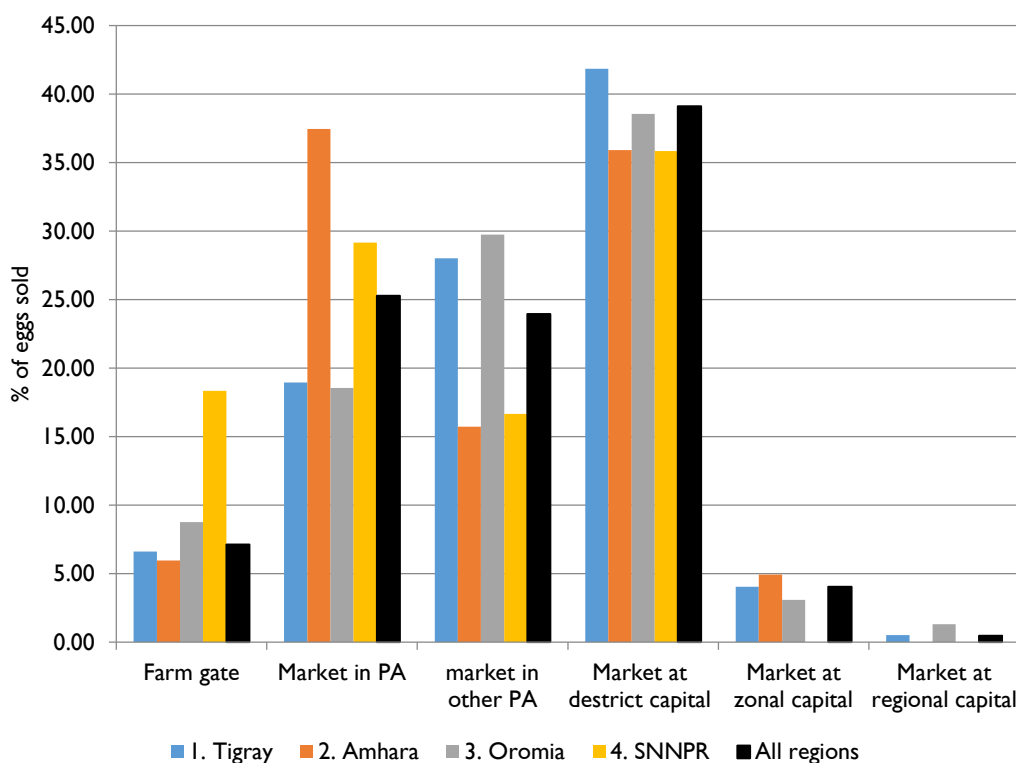


Egg marketing

Market places

The market outlets for selling eggs in different regions are given in Figure 13. The average for all regions shows that the largest portion of eggs was sold at market places in district capitals (39%), in PAs (25%) and other PAs (24%). Zonal and regional capitals accounted for a very small share of the eggs sales. Egg sale at farm gate is higher for SNNPR than other regions.

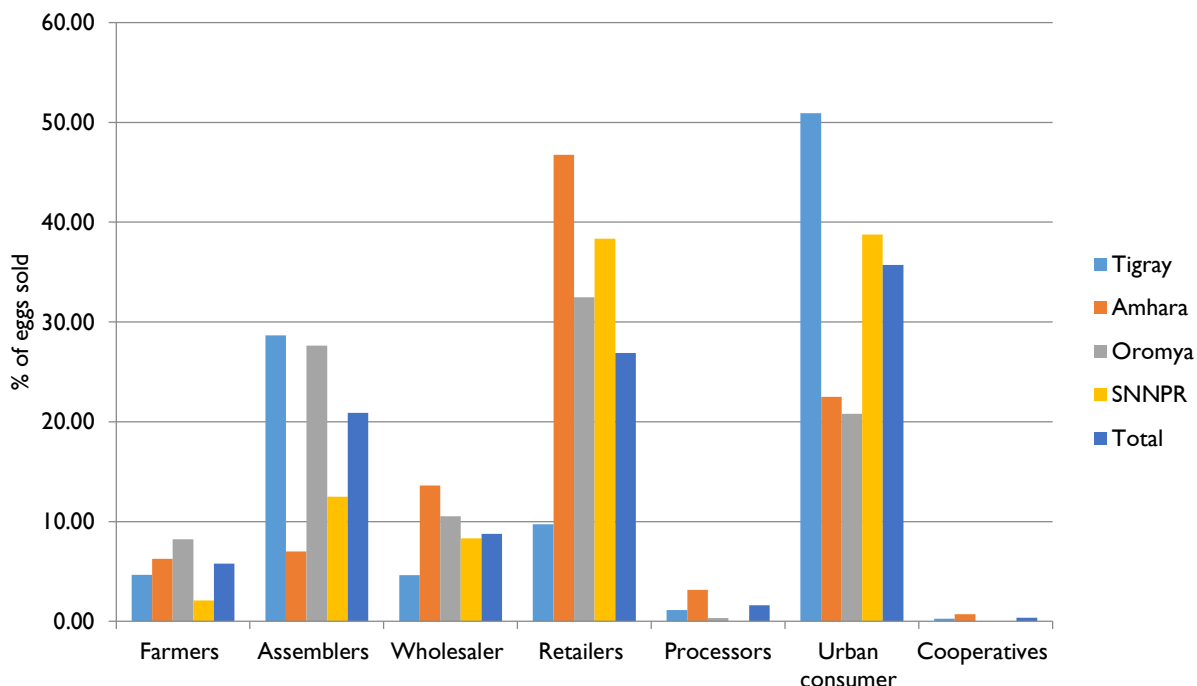
Figure 13: Market places of eggs in different regions.



Buyers

The portion of eggs sold to different buyers for different regions is presented in Figure 14. Overall, the highest share of eggs was sold to urban consumers (36%) followed by retailers (27%) and assemblers (21%). Processors and cooperatives were the types of buyers eggs are hardly sold to. The percentage of eggs sold destined to different buyers varies with regions. For Amhara region, retailers were the largest buyers (48%). Urban consumers bought the largest part of eggs sold in Tigray (51%) and SNNPR (39%). Thus, the pattern of channelling eggs sold to different buyers was not uniform across regions.

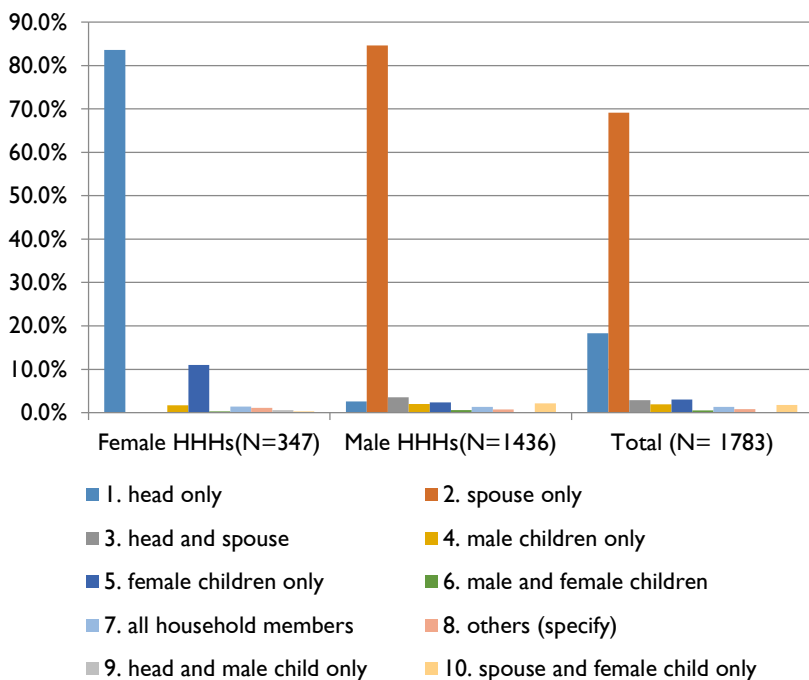
Figure 14: Types and importance of buyers of eggs in different regions.



Gender roles in selling and income control

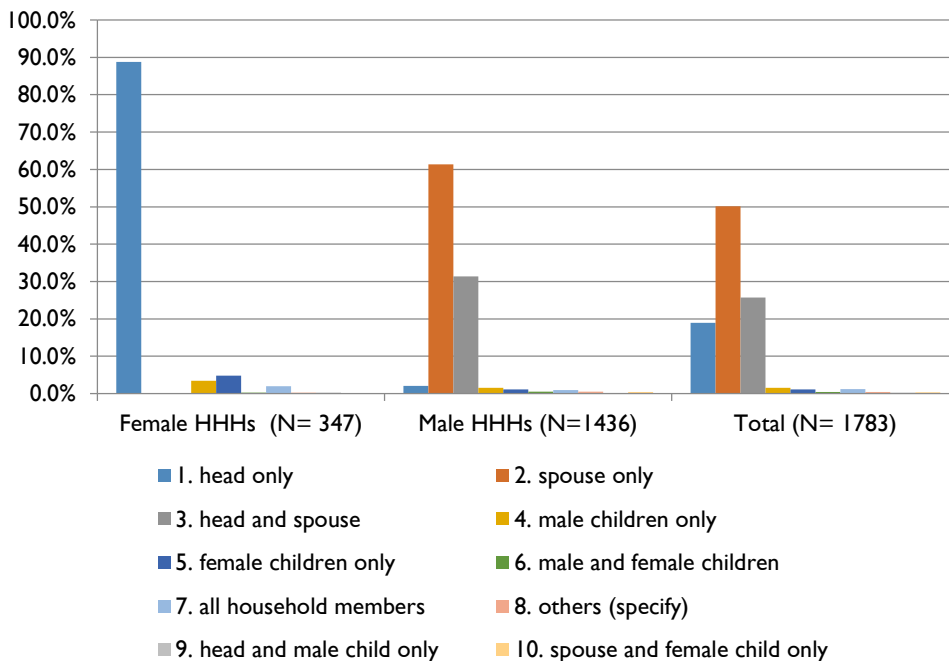
As for birds, selling eggs was largely the responsibility of women in general in both male- and female-headed households (Figure 15). Women sold about 85% of the eggs in both household groups. The contribution of men in male-headed households was only 3% of the eggs sold. Female children sold about 10% and 4% of the eggs, respectively, in female- and male-headed households.

Figure 15: Gender responsibilities in selling eggs in male- and female-headed households.



The role of gender in control of income from egg sales is given in Figure 16. Nearly 90% of the income from egg sale was controlled by women in female-headed households. This figure was 60% in male-headed households in which the head and the spouse jointly controlled the income generated from selling eggs. Male and female children had less role (<10%) in that respect.

Figure 16: Gender responsibilities in control of income from eggs.



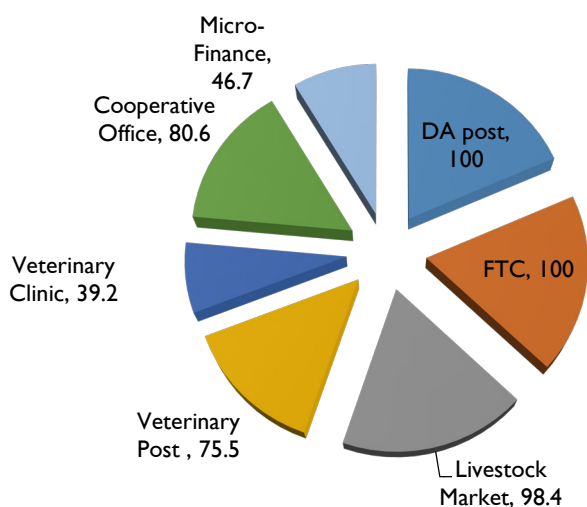
3.5 Institutions, infrastructure and extension services

Access to institutions and infrastructure

Availability of infrastructure and institutions in PAs

Households provided information on the key institutions and infrastructure available in their own peasant associations (PAs). Figure 17 presents the share of households in the study that reported the presence of these facilities in their respective PAs. All the households reported that they had development agent (DA) posts and farmers training centers (FTCs) in their PAs. Almost in every PA of the study households, there was a livestock market. Approximately 76% and 81% of the households reported that their PAs had veterinary posts and cooperative offices respectively. However, the portion of households that had microfinance office and veterinary clinic in their PAs were 48% and 39%, respectively.

Figure 17: Percentage of households that reported they had institutions in their PAs.



Distance of institutions from households

The accessibility of infrastructure and institutions was assessed in terms of average walking distance (Table 12). Of all the facilities, DA posts, FTCs and cooperative offices were most easily accessible to the households who, on average, could reach them within 30-40 minutes of walking. However, the average household had to walk up to three hours (8-9 kms) to find a livestock market, veterinary clinic and microfinance office.

Table 12: Average distance of infrastructure and institutions from households

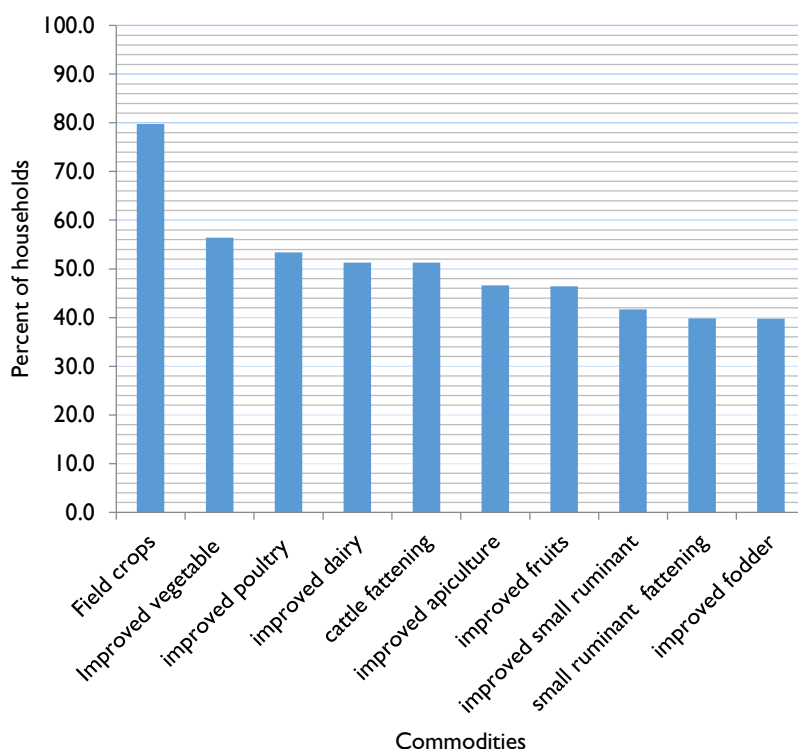
Facility	One way distance from home (kms)	One way walking distance from home (minutes)
DA post	2.97	30.96
FTC	3.02	31.75
Livestock market	8.51	90.29
Veterinary post	5.11	52.9
Veterinary clinic	8.14	84.82
Cooperative office	3.85	41.28
Micro-finance	7.94	84.25

Access to agricultural extension service

The availability of extension service for improved poultry was examined in terms of households' access to information, credit, linkage support and training. To assess accessibility of information, the share of households that contacted DAs seeking advice for improved poultry production was explored in relation to other commodities (Figure 18). It can be observed that improved poultry production was the third commodity (next to improved field crops and vegetables) for which households sought advice from development agents. About 48% of the female-headed households and 55% of the male-headed households contacted development agents for information (advice) to improve poultry production.

Information support

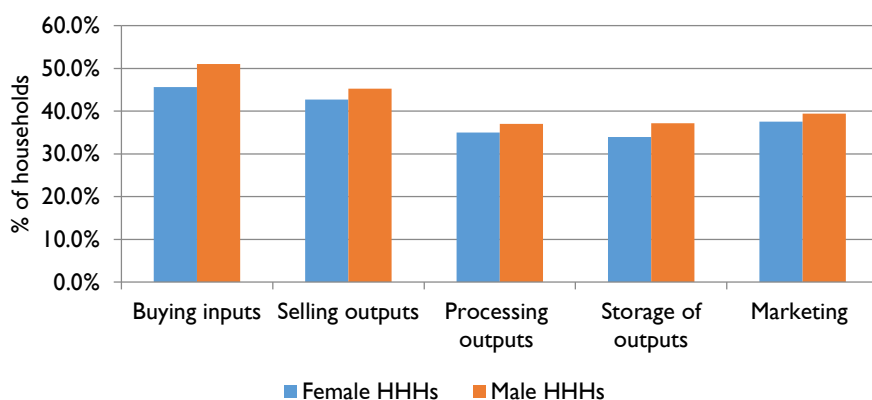
Figure 18: Percentage of poultry-keeper households (N=2979)* that contacted development agents for advice on improved production of different commodities.



Household heads made up to 82% of the family members that contacted development agents for advice on improved poultry production. Women were the family members that contacted development in about 96% and 89% of female- and male-headed household, respectively. Men alone contacted development agents only in 4% of the male-headed households. Children had hardly any contact with DAs for advice on improved poultry production.

The types of extension information provided to poultry-keeping households that contacted development agents are presented on Figure 19. These types of information were related to buying inputs, selling outputs, processing outputs, storage outputs and marketing. Half of the households reported that they acquired information on buying inputs. A less portion of the households (30–40%) reported they obtained information on the other aforementioned types of information.

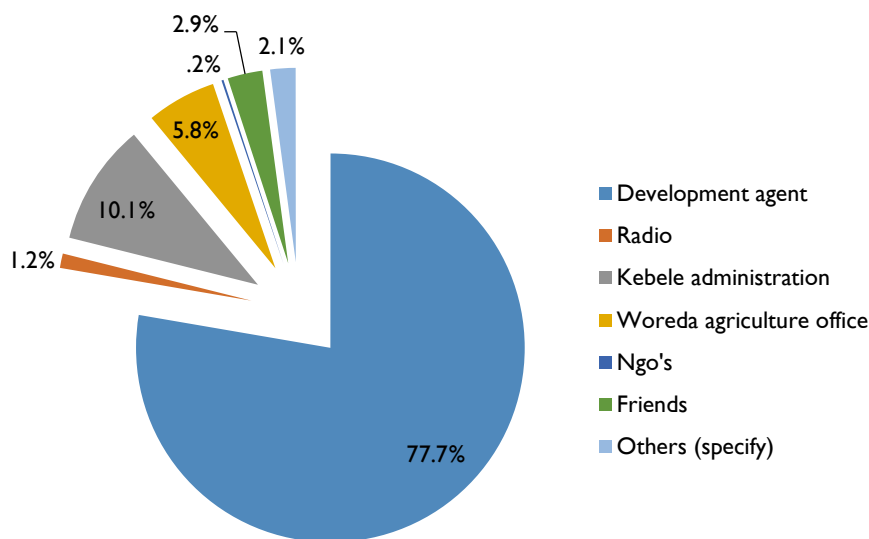
Figure 19: Access to different types of extension information of male (N=2396) and female (583) headed households for poultry.



Sources of information

Households obtained market information from different sources (Figure 20). About 78% of the households reported that they received market information from development agents. Next to development agents, kebele administration and woreda office of agriculture were the second and third ranking sources of poultry market information to about 10% and 6% of the households. The remaining small portion of the households (10%) got the information from other sources including friends, NGOs and the radio.

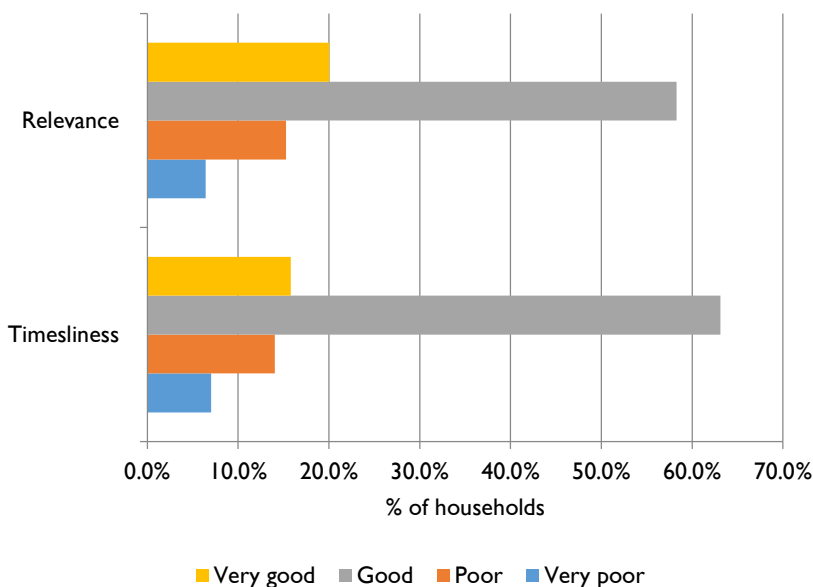
Figure 20: Percentage of households that accessed poultry market information from different sources.



Relevance and timeliness of information

Households rated the quality of information they received in terms of relevance and timeliness (Figure 21). Majority of the households qualified the relevance (58%) and timeliness (64%) of information as good. More than 20% of the households opined that the information obtained from extension was 'poorly' (6.4%) or 'very poorly' (15.3%) relevant with similar pattern of opinions for timeliness.

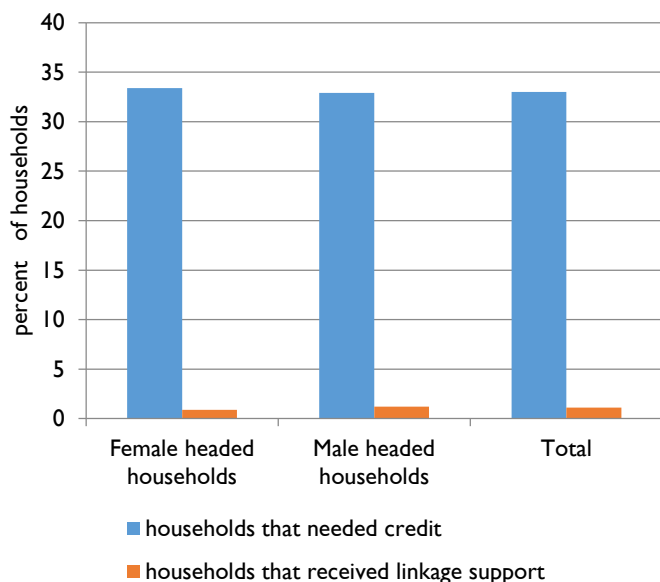
Figure 21: Response of poultry-keeper households (N= 1651) on the relevance and timeliness of information support provided from extension.



Access to credit

The accessibility of credits to households was assessed in relation to availability of linkage support, needs for and reception of credit. Of 2979 households that were in need of credit, only 33 (1.1%) reported that they received linkage support to access credit services for improved poultry production (Figure 22). But one-third of these households said they needed credit to improve their poultry. Of these households that received credits for improving various commodities, only <1% of them said they received the credit for the purpose of poultry.

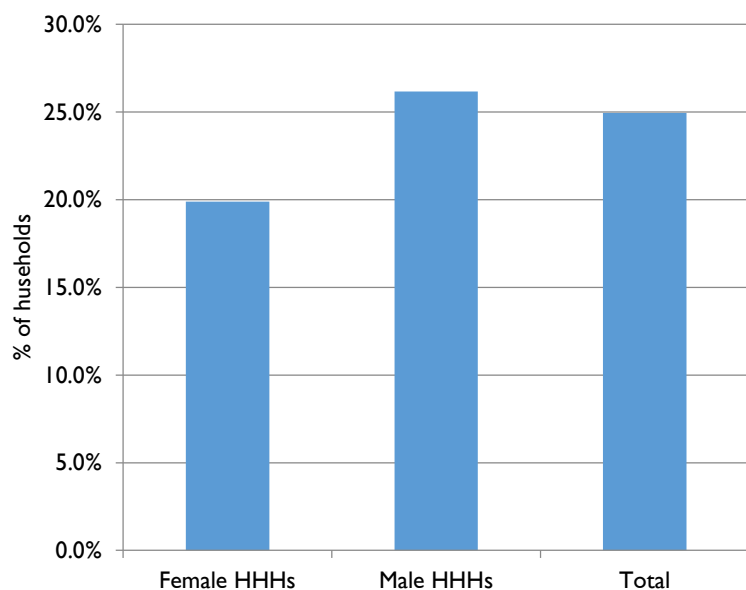
Figure 22: Availability of linkage support to facilitate credit services for male (2396) and female (583) headed households for poultry.



Training

Figure 23 presents the portion of households that received training on poultry production. Generally, one-fourth of the households reported that they participated in training on improved poultry. A slightly larger portion of male-headed households (27%) than the female headed counterparts (20%) seemed to have received the training. Of those that were trained, 33% of the female-headed households and 37% of the male headed ones said they applied the skills they acquired via training.

Figure 23: Percentage of male (N= 2396) and female (N= 583) headed households that received training on poultry production.



However, about two-third of the households did not apply skills acquired through training.

Table 13: Percentage of male- and female-headed households that mentioned reasons for not applying skills acquired from training

Reason	Sex of household head			Rank (total)
	Female (N= 78)	Male (N= 473)	Total (N= 743)	
Don't want to take risk	19.2	20.5	20.3	1
Lack of credit	17.9	18.2	18.2	2
Lack of flock	9.0	15.7	14.6	3
Other (specify)	12.8	8.6	9.3	4
The training was not enough	9.0	9.1	9.1	5
Lack of equipment	9.0	8.9	8.9	6
It doesn't work	9.0	6.1	6.6	7
Lack of man power	7.7	5.3	5.7	8
Lack of land	2.6	3.5	3.4	9
Shortage of time	2.6	3.3	3.2	10
Training was not timely	1.3	0.8	.8	11

Table 13 presents the reasons for not applying the skills developed from training for improving poultry production. Risk and lack of credit were the most important reasons that households mentioned for not using their skills to improve their poultry.

Households were asked to provide information on the areas of the training they received. The status of households' reception and application of training on poultry marketing is given in Table 14. A very small part of the households (13%) received training on marketing. About half of these households applied the skills developed from the training.

Table 14: Percentage of poultry keeper male- and female-headed households that mentioned reasons for not applying skills acquired via training for poultry production

Sex of household head	Households that received training on marketing?		Households that applied skills from the training?	
	N	%	N	%
Female	583	11.1	65	49.2
Male	2396	13.6	327	51.1
Total	2979	13.2	392	50.8

About 78% and 21% of the households reported that DAs and woreda offices of agriculture were, respectively, the most common providers of the training. Nearly 85% of the households said the family members that attended the training were household heads. Similarly only about 2% and 2.5% of these households were supported to create linkage, respectively, for poultry marketing and input provision.

4. Conclusions and recommendations

4.1 Conclusions

This paper aimed at developing a baseline understanding of producers, production performance, marketing, institutional and infrastructural environment and support services in order to identify potential areas of improvement for action research and poultry value chain system development.

Production

Generally, a majority (60%) of rural households in the study areas practiced village poultry. This is not unique to Ethiopia. The wide replication of village poultry is attributed to its low requirements for inputs and its multiple functions as a source of immediate income and food particularly to the poor. However, many households (40%) did not keep poultry. Household characteristics (e.g. region of households, age of household head, family size, education, production of other livestock) affected households' involvement in poultry keeping and their scale of production. The understanding of factors that determine the decision on whether or not to keep poultry (or to expand it or not) helps to identify and target households and sites for possible interventions. Knowledge of driving factors helps to target interested and focused village poultry keepers based on their livelihood objectives.

The study explored the types and levels of utilization of poultry for different purposes. Households utilized their poultry firstly for economic and secondly for nutritional purposes. The number of birds and eggs households sold was twice higher than that of the slaughtered (consumed). However, the use of birds for socio-cultural functions was less common. Only limited portion of the households reported they gave out live birds and eggs as gifts. This implies motive for village poultry production was largely for market to generate income.

The scale of poultry production of the households in the study is small. The flock dynamics explored in this study showed that the inflow of flock was lower than its outflow. This can be attributed to high mortality, low egg production, offtake and low restocking rates due to limited incubation and hatching as detailed in previous sections. The average flock size per household (10) is 40% lower than the figure (14) reported in a study conducted about ten years ago (Dessie 1996) which shows the mismatch between human and poultry population growth. This calls for the need to increase production and productivity to meet the growing needs for poultry meat and eggs.

The study assessed whether and how much households used inputs or better management techniques to overcome the constraints and improve their poultry production. A limited portion (20%) of the households reported that they purchased and used at least one type of inputs such as cereals, commercial feeds, drugs, vaccines, hatching eggs, day old chicks, watering and feeding equipment. It should not be considered that increased use of external inputs will result in better outcomes without adequate understanding of households' context.

The largest share (88%) of the households under the study said they used scavenging feeds. As discussed earlier, village poultry can meet only 60-70% of their nutrients requirements from scavenging feed resources. Moreover,

the availability of scavenging feed resources (e.g. household food wastes, forage seeds, and agricultural by-products) is dependent on density of households, seasons and crops grown. Thus, their availability is limited and cannot support large flocks. This implies that supplementation is needed. But whether and how much the birds have to be supplemented depends on economic efficiency which may spatially and temporally fluctuate due to the variability in prices of additional feed and poultry outputs.

This study, found that mortality contributed to 56% of outflow of flocks out of which 70% is caused by diseases. However, a very limited part of the households (6%) used vaccines and drugs. The identification of the types of vaccines and drugs used and the diseases that they prevent or treat needs additional professional investigation. The control of Newcastle disease is recommended as the most effective intervention in village poultry development. Continued high mortality of flocks may in the course of time decrease the interest of farmers to improved poultry practices as it involves high risk. The fact that village poultry producers have small flocks and are located in large geographical areas increases high transaction cost which is one of the barriers for accessibility of veterinary services. In this situation, small poultry keepers may not demand these animal health services. Thus, the provision of these services to individual poor poultry keepers is difficult and a collective approach might be more effective under the setting of smallholding.

Many households kept both local and improved breeds. Based on reports from the study households, the egg production per layer of improved breeds was upto three times higher than that of local breeds. It appears that households were obtaining the improved breeds in the form of cockerels or pullets as a very small portion of them (1–2%) reported to have acquired day old chicks or hatching eggs. A future study could be useful for understanding the efficiency of the chain entailing the production and distribution of cockerels, pullets, hatching eggs or day old chicks and ultimately for enhancing supply of sufficient and economically viable improved breeds to households that need them.

Marketing

The study examined poultry marketing in terms of, among others, prices, market places and supply chain actors. Averagely, the price of adult birds (cocks and hens) was ETB 58–80 per bird. This price was up to five times higher in 2012 than in 2006. This pattern of rising prices indicates the growing demand for poultry which is an opportunity for poor poultry producers to generate income. Improved breeds fetched higher prices than local ones in this study. Depending on flock types, improved breeds were more expensive than the local ones by 31–200%. This might be due to their high demand for breeding rather than for consumption as local birds are considered to be tastier and best for consumption and ritual sacrifice.

Market places for poultry and eggs included farm gates and other market places located at own PA, in other PA, at district, zonal and regional capitals. District capitals were found to be the largest market places where averagely about 43% of the birds were sold. Farm gates and regional capitals were the market outlets of least importance making up, respectively, 3% and <1% of the birds sold. The types and relative importance of market places for eggs showed similar pattern as for birds. The differences in prices of birds and eggs across these market places might be interesting to explore through research in the future. As discussed previously, market access influences the use of improved technology for village poultry production and thus is key incentive to boost production by increasing producer's share of benefits rather than that of intermediaries.

The poultry marketing chain in the study areas involved a number of actors such as farmers, assemblers, wholesalers, retailers, processors, urban consumers and cooperatives. Households sold majority of their birds (43%) and eggs (36%) directly to urban consumers. Assemblers, retailers and wholesalers together purchased about 50% and 56% of the total birds and eggs sold, respectively. Processors and cooperatives made rather a limited contribution (<1%) in the supply chain. In general, it can be said that the poultry supply chain is long. At least 50% of the birds and eggs sold flows from producers to consumers indirectly via a number of intermediaries. Long market chain is the characteristic of low market access areas which adds transaction costs to farmers by involvement of more middle-men. Thus, the contribution of poultry to income is related to market access. This implies that research and development

efforts on village poultry cannot have meaningful impact if they do not consider market. Future researches might investigate in-depth the possible variations in development of poultry marketing chains and explore prospects for their improvement.

Gender and village poultry

The study has found evidence that there is special association between women and village poultry in terms of production and marketing. Female-headed households tended to focus more on poultry as compared to the male headed ones. While the share of poultry in total TLU per household was slightly higher in female-headed households, a smaller portion of them owned cattle (65%) than the male headed counterparts (91%). Female-headed households were more inclined towards sale than to consumption of birds. Women were responsible for selling birds in 86% and 57% of the female- and male-headed households, respectively. Women controlled more than 90% and 30% of the income from bird sales in this order in female- and male-headed households. They also generated relatively more income per family member from bird sales than male-headed households. This implies that women are the most suitable targets for technology introduction and scaling up in order to improve poultry. Finally, in order to increase the benefit of poultry development for, especially, poor female-headed households, the role of gender should be considered not only in terms of production but also in marketing and consumption.

Infrastructure and institutional support

It is known that infrastructure and institutional support is needed for agricultural development. This study explored whether households had the access to institutions and infrastructure for poultry production and marketing. DA posts, FTCs and livestock markets were available in peasant areas of almost all the study households. This implies that households (poultry keepers) can easily reach these facilities, in principle, for information, capacity building and marketing. For this reason, about half of the households (48–55%) were able to contact development for advice to improve their poultry production.

The proximity of the posts to the households helped women to access DAs. Women made up to 96% of family members that approached DAs for advice. Households reported that they obtained information especially on buying inputs and to a limited extent on selling and processing outputs. Development agents followed by kebele administrators and officers of agriculture were the major sources of (market) information for households implying that these actors are the key entry points for future research and development (e.g. capacity building) in poultry production and marketing although NGOs, friends, and media (e.g. radio) may also have important contribution.

Although the accessibility of these institutions to households is a strength, its value has to be assessed in terms of the contribution to improvement of household poultry production or marketing. For example, development agents created linkage support to only 2–2.5% of poultry marketing and input provision. Despite the availability of DAs and contacts with farmers, a very small portion of the households (1%) reported that they received linkage support to access credit services for improved poultry. Only a small portion of the households (13%) received training, for example, on marketing half of which did not apply the skills they acquired. One-third of the households said they needed credit to improve their poultry. Of these households that received credits for improving various commodities, only <1% of them said they received the credit for the purpose of poultry.

Finally, the capacity of the infrastructure and institutions has to be strengthened so that they can be able to better support households to improve their poultry production and marketing by more effectively providing support that facilitates access to input and output market information, linkage, credit and training. The government is placing extension agents to staff and capacitate farmer training centers. The expansion of infrastructure (road and communication network) in rural areas is an opportunity to increase the benefits households gain from poultry through improved poultry and marketing. However, it looks that poultry is given little attention as compared to other commodities, for example, in terms of access to credit and training. Research can play an important role in building

evidence on whether and how much access to institutions and infrastructure affect dynamics in, for instance, poultry production, technology use and marketing.

4.2 Recommendations

The ultimate goal of this study was to explore existing constraints, opportunities and then identify, prioritize and recommend technological, institutional and organizational interventions for action research to facilitate poultry value chain development. Thus, recommendations are given hereunder under those domains.

Technical/technological

Feeds

- Nutritional content analysis of scavenged feeds: Households in the study area are largely dependent on scavenging feed resources. Efforts should be made to explore additional feed resources as their availability fluctuates and only partially meets the nutrients requirements of village poultry. In order to provide strategic supplements, carrying capacity of scavenging feed resources (SFR) have to be estimated and their quality have to be assessed by measuring crop-gizzard content (Roberts and Gunaratne 1992). Analysis of crop and gizzard contents (CGC) of scavenging poultry helps to overcome lacking nutrients by strategic feed supplementation depending on the needs of different seasons and agro-ecological zones. Chemical analyses of CGC will determine the deficiency of nutrients. This will serve as an input for documenting a profile (e.g. database) of carrying capacity and quality of SFR for planning and implementing village poultry research and development.
- Local feed resource-based ration formulation: It has to be noted that the efficiency of supplementary feeding will vary with locations, seasons of the year and the availability of the supplementary feed resource base. It is unlikely that the use of commercial feed alone will be economically viable especially with local breeds. In order to minimize the cost of supplementary feeding, household wastes and crop residues might be used. Situation specific and profitable supplementary feeds have to be formulated for key agro-ecological clusters using cost efficient ingredients. Through research, feed formulas might be reviewed and adjusted to meet the needs of village poultry by incorporating local raw materials based on an assessment of nutritional shortages.
- Skill development and research support to improve quality of feed formulation: Village poultry keepers rear small flocks with different sex and age groups which require different quantities and quality of feeds. As they need a small amount of supplemental feed, it is easier to prepare the feed with locally available raw materials. These households have to be provided with training and technical support to prepare the supplementary feed. The extension agents should play an active role in training village poultry keepers on feeds, nutrition and feeding practices to improve quality of feed formulations. Research should monitor and analyse the impact of the use of various combinations of scavenging and formulated supplementary feeds on the biological and economic performance of poultry production in different agro-ecological and market zones.
- Creep feeding and artificial brooding of chicks: Chicks are the highest vulnerable flock categories to mortality due to lack of and low quality feed. The separation of chicks from their mother early (at three or four weeks), creep feeding of chicks and supplementary feeding of growing chicks might be an effective way to achieve higher productivity. Early weaning of chicks not only helps to increase body weight gain of chicks, but also to increase egg production of mothers due to decreased period of broodiness (Sarkar and Bell 2006; Sarkar and Golam 2009). Hay box brooders (Solomon 1999) might be used for feeding and watering chicks when separated from their mothers. On-farm studies can be carried out to explore whether and how early weaning, creep feeding and artificial (hay box) brooding increase flock and egg production performance as well as its profitability.

Breeding and reproduction

- Enhance production and distribution system of improved breeds: The study found out that many households kept improved breeds together with local ones. Egg production per layer per year was higher for improved breeds. It is expected the demand for improved breeds will increase in the future. Sustaining and increasing the supply of improved cockerels, pullets, hatching eggs or day old chicks to meet the growing demands is becoming a challenge. Research should be carried out to examine the technical and organizational efficiency of the production and distribution system of improved breeds to poultry keepers located in various areas of the country. These studies should aim at identifying the requirements for producing and disseminating the most economic and productive breeds and flock types (pullets, cockerels, day old chicks, hatching eggs). An organizational option for involvement of farmers in raising improved chicks and grower for breeding might also be explored to enable households to benefit from supply chain of breeding stocks. Apart from the use of improved breeds, the variations within the local poultry population has to be used as an opportunity for promoting selective breeding to enhance production performance.
- Hatchery technologies: It is known that multiplication of improved breeds is being done usually through government poultry hatcheries. Effective mechanisms should be sought to involve farmer cooperatives in the multiplication and distribution process by using mini-hatcheries like non-electrical hatcheries (e.g. rick husk incubators) or small electrically operated incubators in rural or peri-urban or urban areas. Researchers should search for, adapt or develop appropriate incubation technologies to poultry keepers. For example, there are reports (FAO 2012; FAO 2014) which showed that mini hatcheries that used non-electric incubators, known as the brick incubator, were successful in rural setting in Malawi. These studies also reported that women in Bangladesh effectively used a mini hatchery technology called 'Chinese Rice Husk Method' to hatch improved breeds. An initiative in Bangladesh and India has documented such and other good experiences for potential replication in other countries (www.sapplpp.org).

Health control

- Appropriate vaccines for NCD control: It was indicated above that Newcastle disease (ND) is a major cause of mortality in village poultry. Researchers and development practitioners recommended the control of ND as the most effective intervention that should be implemented before any other solution. Vaccines are available to prevent each of this disease. The use of thermotolerant NCD vaccine is recommended for poultry production in remote areas where cold chain facilities are not available (Alexander *et al.* 2004).
- Community participation in NCD control: The introduction, application and affordability of the thermostable vaccine in village poultry will also be practically relevant to explore through research. Farmers' awareness has to be raised on the importance of vaccinating their flocks. The delivery of the vaccination service might involve trained community vaccinators (and perhaps with cost recovery mechanisms). If vaccination proves to be productive and profitable, even the poor may in the course of time be willing and able to pay for the service. The role of women as vaccinators has been reported as a successful experience in Bangladesh (FAO 2012).

Institutional and organizational support

- Village poultry resource centers: The introduction of feed, health control and breeding technologies will not guarantee higher production and productivity unless they are coupled with improved capacity of farmers. The FTCs, available in almost every PA, have to be stimulated and strengthened to prioritize and offer training on poultry. FTCs should serve as village poultry resource centers along with supporting other commodities. These resource centers should be equipped with prototype technologies (e.g. incubation technologies; feed formulations; vaccines etc.) for experimentation and demonstration. International and national training manuals in village poultry should be available in the centers in local languages. Poultry specialists from research institutes, universities and agricultural technical and vocational education colleges have to capacitate extension agents and contribute to the development of village poultry resource center in high potential poultry production areas.
- Integration of production and marketing: In Ethiopia, village poultry keepers are involved almost in all stages of production. For efficient flow of products and services, it is recommended that poultry producers form groups to develop a complementary and integrated system among production and marketing actors (e.g. chick producers,

distributors, traders, processors, consumers, transporters). Bangladesh, India and other countries have widely implemented a value chain approach in village poultry production (Nielsen 1996; Saleque and Mustafa 1996). This might be initiated in selected potential areas and with highly interested target groups. Households that tend to expand their scale of operation and show transition into semi-intensive production systems could be priority targets to be part of the poultry value chain (FAO 2014). The producer groups may play an important role in knowledge and experience sharing and in establishing links with the microcredit institutions. Agricultural research and education and training institutions can contribute to the development of the value chain through capacity building and provision of technologies.

- Research for enhancing efficiency of multiple interventions: Fragmented interventions are unlikely to improve village poultry (Udo et al. 2006). Integrated implementation of interventions (e.g. use of improved breeds, supplementary feeding and vaccination) is needed for optimal production. Credit service could be part of the integrated approach. Research can play a relevant contribution by analysis of effect of various combinations of interventions (inputs) on production and economic performance with the aim of identifying alternative options.
- Marketing groups: For households in especially remote areas, the formation of marketing groups could be beneficial for negotiating higher prices and for linking more directly with traders and consumers, for households in the remote areas. Such marketing arrangements are expected to motivate farmers to increase their scale of poultry production and to purchase more inputs.
- Identifying and supporting target groups: Together with (prior to) technical efforts to increase production, research and development interventions have to consider the socio-economic context in which households operate. Research and development priorities have to be geared towards understanding the characteristics that stimulate or discourage households to produce poultry and identify and support relevant target groups. Gender, age, family size, education, region and market access of households may be relevant factors to consider in village poultry research and development initiatives.
- Benefitting from national and international networks and knowledge base: Finally, research and development of village poultry in Ethiopia has to benefit from an accumulated international knowledge and experiences on this commodity. The International Network Family Poultry Development, a huge network of scientists and development partners (FAO 2014), could serve as a source of relevant information, knowledge and experiences for developing village poultry in Ethiopia. The Danish Network for Poultry Production and Health and the Australian the International Rural Poultry Centre (IRPC) are important sources of innovations. The Bangladesh model and its replicates are a rich source of practical experiences in family poultry (SA PPLPP 2011). Such networks could be important partners in the effort to develop village poultry in Ethiopia.

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