



## Contribution of small ruminants to food security for Ethiopian smallholder farmers



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### ARTICLE INFO

#### Keywords:

Gender  
Small ruminants  
Food security  
Preference  
Ethiopia

### ABSTRACT

This study investigates how and to what extent arguments related to food security influence preference of livestock species for women and men. Data was collected in four regions of Ethiopia through 92 focus group discussions (FGD) in communities where small ruminant production is common. Using a gender sensitive study designs, 23 FGDs were held separately with men, women and youth (male and female), and through a household survey involving 217 male and 212 women. Qualitative analysis was conducted to extract reasons given to explain the importance of livestock. Reasons related to food security were mapped to the four dimensions underpinning food security—accessibility, availability, nutritional value and stability. All FGDs considered sheep the most important livestock species, followed by cattle, with women allocating higher scores to sheep than men. All four dimensions of food security came up in statements explaining the importance of species but with variations across species. Interestingly, food security related arguments were most prevalent for goats followed by poultry. Of reasons given by women concerning the importance of goats, 78 % were related to food security with all four dimensions represented, and 52 % for poultry with two dimensions (availability and nutritional value). Answers from men especially had a stronger focus on economic reasons directly linked to income generation. Nevertheless, 64 % of men's arguments for goats were related to food security. For sheep however, women only scored higher for arguments related to availability. When investigating purpose of small ruminant production at household level through a household survey, the importance of small ruminants for food security were confirmed; however, gender differences were less apparent. Being able to sell animals at short notice was the main reason for keeping small ruminants for both women and men followed by meat and milk for home consumption. Women's argument for prioritizing selling were accessibility. For men, key arguments for selling were related to availability. For meat and milk their nutritional value was an important argument. Comparing agroecologies, accessibility (selling) was ranked top in highland areas and nutritional value (milk) was most important in lowland areas. In conclusion, this study provides much needed evidence on how small ruminants contribute to different dimensions of food security and are promising entry points targeting women to improve food and nutritional security by providing adequate animal source foods in a household.

### 1. Introduction

Livestock are an important component of small holder farmer livelihoods in Ethiopia. Not only are they an important source of cash income, they also provide draught power, milk, meat, manure and hides and skins. Livestock thus play an important role in ensuring food security and alleviating poverty (Ehui et al., 2002). Small ruminants are generally considered a key asset for smallholders playing significant

economic and cultural roles and reared in different agroecological systems in Ethiopia as studies showed in Alaba and Dale districts of Southern Nations Nationalities and Peoples Region (Assefa, 2008; Ketema, 2007).

Small ruminants make an important contribution to household food and economic security. The annual estimate of sheep and goat consumption in Ethiopia is 1,078,000 and 1,128,000, respectively (Hirpa and Abebe, 2008). Slaughter is mostly done around holidays and other

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<https://doi.org/10.1016/j.smallrumres.2020.106064>

Received 22 February 2019; Received in revised form 8 January 2020; Accepted 31 January 2020

Available online 05 February 2020

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occasional celebrations. Consumption of goat milk is more common than sheep milk and believed to have medicinal properties. Children are the most frequent consumers, as well as sick and aged people (Fikru and Gebeyew, 2015).

Food security has been defined as all people, at all time, having physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (Clay, 2002). Household food security is the application of this concept to the family level, with individuals within households as the focus of concern. Dimensions of food security are availability, accessibility, utilization/nutritional value and stability (John et al., 2013).

Food insecurity and malnutrition are major challenges in Ethiopia. The five African countries with the most number of people in a state of hunger or malnutrition are Ethiopia (32.1 million), Tanzania (15.7 million), Nigeria (12.1 million), Kenya (11 million), and Uganda (10.7 million) (Africa food security and hunger, 2014). About 10 % of Ethiopia's citizens remain chronically food insecure and this figure rises to more than 15 % during drought years. Emergency food assistance was required for 2.7 million people and thousands of children require treatment for malnutrition in 2014 (Endalew et al., 2015). In 2017, 8.5 million people were food insecure, with 3.6 million children and pregnant and lactating women suffering from malnutrition (HRD, 2017).

Animal source foods in appropriate amounts are a valuable source of complete, high quality and easily digestible protein and contain iron, zinc, calcium, vitamin A and vitamin B12. Consumption of animal source foods with optimal protein quality was found to promote growth and protect stunting, preventing chronic malnutrition in toddlers and children (Darapheak et al., 2013; Neumann et al., 2003). Milk and meat intake improves anthropometric indices and cognitive functions in undernourished children and reduce the prevalence of biochemical and functional nutritional deficiencies, reducing morbidity and mortality (Dror and Allen, 2011).

For men and women in developing countries, small ruminants are important assets and sources of income. Women are more likely to be owners of small ruminants while men tend to own large livestock. A study in Peru found that women are in charge of sheep, while cattle were the domain of men. When livestock relates to the production domain of men, such as oxen in crop production, or other income generating activity, male control takes place (Valdivia, 2001). For the landless, small ruminants are the main source of income in surviving poverty and goats are often considered more profitable than sheep because they are more tolerant to harsh environments (Alary et al., 2015).

Poultry production requires comparably small investments and is accessible to vulnerable groups of society, provides households with income and are acceptable foods in many cultures (Wong et al., 2017). In addition, eggs improve maternal and child nutrition as their nutritional value supports early growth and development (Iannotti et al., 2014).

Small ruminants have become steadily more important in the livestock production of rural households. This is due to farmers recognizing that small ruminants provide alternative opportunities to increase their incomes. A comparative economic analysis of smallholder cattle and small ruminant production systems showed that in terms of efficiency of resource use, cattle and small ruminant production are almost equally efficient. Hence, if there is limited capital for production, rearing small ruminants is reasonable for many smallholder farmers, as was shown in Botswana (Panin, 2000). Another study in Uganda found that, in addition to meeting household needs, goats, sheep and chickens were important for income for buying cereals, getting treatment for sick family members or paying school fees; while cows and pigs were reared mostly for generating income (Ampaire, 2011).

Women invest the income from sale of livestock and livestock products into household consumption needs, as well as the education of their children (Valdivia, 2001). Thus, when women control income

from small ruminants it benefits their families, a necessary condition to negotiate the transition to a food secure society. Similarly, another study found that income from sales under the control of women is used for their households or local communities and that women use their income to increase the quantity and variety of foods purchased, for medical care, and schooling of their children (Meinzen-Dick et al., 2012).

When focusing on food security, gender is key to impacting household food security through small ruminant production. There is, however, limited literature focusing on women's contribution in improving food insecurity for their household through small ruminant production. Therefore, this study aimed to investigate gendered preferences between livestock species and the underlying reasons, explore differences between agroecologies and assess how food security arguments impact livestock species preferences.

## 2. Methodology

### 2.1. Study site

The study was conducted in 23 kebeles (municipalities—the smallest administrative units in Ethiopia, across 14 woredas (districts) in four regions. Five woredas were in the Amhara region and the rest nine distributed equally in Oromia, SNNP and Tigray regions. The sites represent important areas of small ruminant production, based on their importance for the livelihood in different agroecologies of Ethiopia (Table 1).

The agroecologies include the highlands 2300–3200 masl, which usually are areas where crops such as barley, wheat, and pulses are grown and livestock such as cattle, equines and sheep are kept. All major rain-fed crops can be grown in most parts of this belt, particularly teff and maize. The midland belt 1500–2300 masl usually has sufficient rainfall for mixed crop-livestock farming, allowing at least one cropping season per year. The lowlands 500–1500 masl are characterized by moisture limitations for major crops. Sorghum is a dominant crop in the lowland belt and teff and maize are grown there if rainfall permits. Livestock farming such as goat, cattle and camels are common in the lowlands.

### 2.2. Study design

Qualitative data was collected through 92 focus group discussions and a cross-sectional household survey involving 429 households was conducted to complement qualitative findings with quantitative data (Table 2).

### 2.3. Focus group discussions

Gender disaggregated data on livestock production, importance, preference, arguments and reasons given in relation to food security were collected in four regions of Ethiopia through separate focus group discussions (FGDs) for men, women, young males and young females held in each of the 23 study sites, resulting in 92 FGDs in total. Each FGD had 6–8 participants.

Respondent in the FGDs were selected using purposive sampling strategy to include men, women (married or widowed) and youth who are actively involved in small ruminant production with their own small ruminant herd. To identify the relative order of importance of livestock species which indicates the preference of respondents, participatory tools were used, including simple ranking and proportional piling. The FGD participants allocated 100 bean counters across the species they mentioned in their flock to indicate their relative importance and gave reasons to explain their importance. During FGDs, arguments and reasons for scoring were noted and transcribed for content qualitative analysis (Krippendorff, 2004). Statements clearly relating to food security were mapped to the four dimensions

**Table 1**  
Selected woredas and production systems for the study.

Region	Zone	District (woreda)	Kebele (site)	Agroecology	Altitude (masl)	Rainfall (mm)	Average temperature (°C)
Amhara	North Shewa	Menz Gera	07 (Yedilfere)	Highland	3097	1261	12
		Menz Mama Mider	06 (Delfanna)	Highland	3097	1261	12
	Wag Himra	Ziquala	Bilaqu	Lowland	1486	732	22
		Abergelle	Sazaba	Lowland	–	–	–
	North Shewa	Basona Werana	Goshe bado	Highland	2419	948	16
Oromia	Borena	Yabello	Gudo beret	Highland	3142	1118	12
			Elewaya	Lowland	1181	493	22
	Wellega Zone	Horro	Derito	Midland	1588	625	20
			Lakku iggu	Highland	2678	1621	13
	Bale	Sinana	Gitilo Dole	Highland	2640	1604	14
			Selka Bakaye	Highland	2486	1017	14
			Ilu sambitu	Highland	2372	1039	15
SNNP	Kembata Timbaro	Doyogena	Ancha Sadicho	Highland	2616	1314	14
			Hawara Arara	Highland	2499	1275	15
	Kefa	Menjwo	Boka	Highland	2464	1910	15
			Shuta	Highland	2316	1871	15
	Hadiya	Lemmu	Jawe	Midland	2152	1136	17
Tigray	Eastern Tigray	Atsbi Wonberta	Upper Gana	Midland	2151	1086	17
			Golgol Naele	Highland	–	608	15
	Central Tigray	Tanqua Abergelle	Habes	Highland	2559	588	16
			Hibiret	Lowland	1442	653	22
	Southern Tigray	Endemehoni	Embahasti	Highland	2884	746	14
		Tsebet	Highland	3184	796	13	

underpinning food security as defined by (John et al., 2013) and were handled as follows: 1) availability = the amount of food that is present in a household through subsistence production or bought from the local markets; 2) accessibility = the household has enough resources to obtain food in sufficient quantity, quality and diversity for a nutritious diet; 3) stability = available, accessible and nutritional foods remain constant during the year and in the long-term; and 4) utilization/nutritional value = safe and nutritious food which meets the household's dietary needs. The scores of the proportional piling were summarized for comparison between respondent groups.

#### 2.4. Household survey

As a follow up to the focus group discussions (FGDs), in 2016 a household survey involving 429 households was conducted in which 217 men and 212 women were interviewed to investigate the purposes of small ruminant production at household level. The interviews were important to get the different perceptions on the importance of small ruminants for women and men. The survey captured information about key importance factors for keeping livestock species as identified in FGDs. It also assessed the involvement of household members in small ruminant production for food security.

Respondent selection for the household survey was done using systematic random sampling from a list obtained from the respective kebele administration offices. In each target kebele 15 men-headed households and 4 women-headed households who were actively involved in small ruminant production and have their own small ruminant herd were selected from the list. If less than four women-headed households were present in a kebele, all of them were included in the sample. When the number was more than four, the random sampling

procedure was followed.

In the household survey, simple ranking was used to identify the most important purposes of keeping small ruminants. The questions on the purposes were asked and the respondents described the purposes. The responses were recorded under the following categories: household meat consumption, milk consumption, sale of animals, insurance against crop failure, cultural/religious ceremonies, exchange for cattle, savings, prestige, wool production, feces as compost/fertilizer and others.

#### 2.5. Data analysis

The data collected were entered in Epi Info software version 7, exported into Microsoft Excel 2013 spreadsheet and analyzed using SPSS version 24.

Computed descriptive statistics included frequency and percentage of themes mentioned in statements to understand the importance of small ruminants for food security for women and men.

For the FGD data, the level of agreement of importance of livestock species based on scores of informant groups (men, women, young men and young women) was assessed using Kendall's coefficient of concordance (W) (Siegel and Castellan, 1988). Consequently, evidence of agreement was categorized according to published guidelines on the interpretation of W and the P values; agreement was termed "weak" for  $W < 0.26$ ,  $P > 0.05$ ; "moderate" for W ranging from 0.26 to 0.38,  $P < 0.05$ , and "strong" for  $W > 0.38$ ,  $P < 0.01$ .

For the household data on the purposes of keeping small ruminants, multinomial logistic regression analysis was performed (McCullagh and Nelder, 1989; Abeyasekera, 2001). The agroecological zones and gender were considered as nominal independent variables in the model.

**Table 2**  
Key research questions and type of data collected.

Key research question	Tools used	Type of data collected
Are there gendered preferences between livestock species and what are the reasons?	FGD, participatory tools, including simple ranking and proportional piling	Importance of livestock species and reasons or arguments on importance
Are there differences between agroecologies?	FGD, participatory tools, including simple ranking and proportional piling	Importance/preference of livestock species in three different agroecologies
Are food security arguments a reason for their preference?	FGD, household survey and simple ranking	Rankings of purposes for raising sheep and goats in relation to the four food security dimensions

Categories of reasons for the ranking (purpose of keeping small ruminants) were considered as dependent variables.

The likelihood ratio chi-square test was used to assess if the model predicts significantly better, or more accurately, than the null model. A p-value of less than 0.05 was considered to suggest model fit in the likelihood ratio test. The goodness-of-fit was also assessed through the Pearson chi-square tests, with p-values greater than 0.05 signifying better fit (Tabatchnick and Fidell, 2007).

In the model (Dohoo et al., 2003), for an outcome variable that has J categories, the probability of membership in each of the outcome categories was computed by simultaneously fitting J-1 separate logistic models (with one category serving as the baseline or reference category). Consequently, for the dependent variable with 4 levels (leaving the first level as the baseline category), we estimated 3 sets of coefficients ( $\beta(2)$ ,  $\beta(3)$ ) corresponding to the remaining outcome categories. Because  $\beta(1) = 0$ , the predicted probability that an observation is in category 1 was:

$$P(y = 1) = 1 / (1 + \exp(x\beta^{(2)}) + \exp(x\beta^{(3)}) + \exp(x\beta^{(4)}))$$

while the probability of being in category 2 was:

$$P(y = 2) = \exp(x\beta^{(2)}) / (1 + \exp(x\beta^{(2)}) + \exp(x\beta^{(3)}) + \exp(x\beta^{(4)}))$$

and similar for categories 3.

### 3. Results

#### 3.1. Focus group discussion

##### 3.1.1. Importance of livestock species by gender

In the FGDs, participants scored livestock species according to their importance using proportional piling. Combining data of all FGDs, sheep was ranked the most important livestock species, followed by cattle. Looking at the different gender groups, cattle were considered the most important livestock species by men in both categories, closely followed by sheep. Women in both categories allocating higher scores for sheep followed by cattle. For both men and women, the level of

importance for goats, equine and poultry was similar (Fig. 1).

Sheep were the most important livestock species in the highlands and goats in the lowlands. In the midlands, cattle were most important for women, men and youth men. (Table 3).

##### 3.1.2. Importance of small ruminants from food security perspectives

The meaning of statements given about the importance of livestock were mapped to the four dimensions underpinning food security: accessibility, availability, stability and utilization/nutritional value (Table 4). Interestingly, food security related arguments were most prevalent for goats followed by poultry (Fig. 2). Of reasons given by women for importance of goats, 78 % related to food security with all four dimensions represented; and for poultry 52 % with high scores in two dimensions (availability and utilization/nutritional value). For cattle and sheep, food security dimensions were less apparent (40 %). When it comes to availability, women argued that small ruminants have a short gestation period, fill gaps of food shortages in the household and they can be sold at short notice during emergencies. In addition, stability was an important argument for goats in some areas as they are an important source of milk for children throughout the year, most importantly during drought seasons when cattle are unable to provide milk and goats withstand the drought surviving on low-value feeds.

The availability dimension of food security was reflected in statements like:

‘Goats are cattle gifted for the poor.’ (From women FGD in the lowlands, 2015)

‘Sheep are fast growing cabbage in the homestead.’ (From women FGD in the highlands, 2015)

Men and women had various reasons for their species preferences. Women groups scored sheep highly because of their nutritional value (39 %). Their accessibility given short reproductive cycles and high reproductive rates (67 % for sheep, 39 % for goat) was also considered important as it ensures sufficient food resources. Ease of management and the possibility to sell locally for income generation to cover the

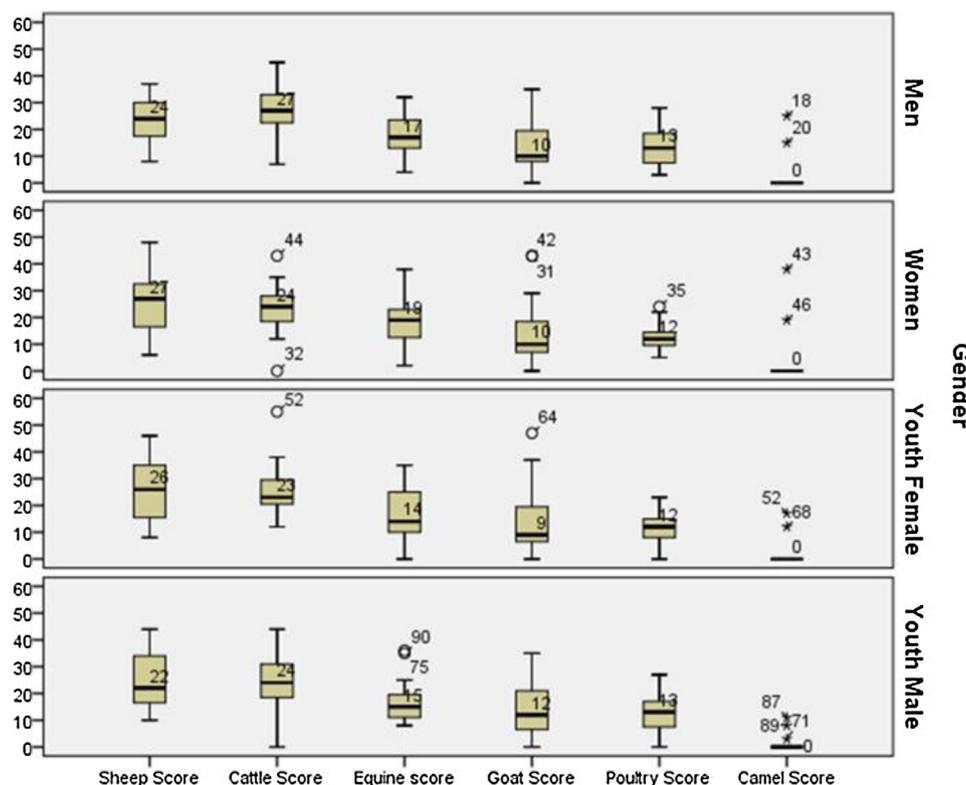


Fig. 1. Preferences of livestock species by gender groups.

**Table 3**  
Importance of livestock species in three agroecologies of Ethiopia.

Agroecology	Gender	N <sup>b</sup>	Mean rank score						Kendall's W <sup>a</sup>	Chi-Square	Df	P Value
			Cattle	Goat	Sheep	Equine	Camel	Poultry				
Highland	Men	16	5.09	2.69	5.31	3.88	1.06	2.97	0.740	59.164	5	0.000
	Young male	16	5.00	2.78	5.34	3.75	1.09	3.03	0.704	56.349	5	0.000
	Women	16	4.59	2.38	5.50	4.09	1.09	3.34	0.731	58.463	5	0.000
	Young female	16	4.91	2.47	5.44	3.78	1.16	3.25	0.721	57.645	5	0.000
Lowland	Men	5	4.80	5.40	3.80	2.60	2.20	2.20	0.547	13.686	5	0.018
	Young male	5	3.00	6.00	4.40	3.20	1.70	3.30	0.363	12.716	5	0.026
	Women	5	4.60	5.60	3.40	2.80	2.60	2.00	0.387	13.531	5	0.019
	Young female	5	4.60	5.60	3.80	3.00	2.20	1.80	0.407	14.259	5	0.014
Midland	Men	2	6.00	2.50	2.50	5.00	1.00	4.00	0.971	9.714	5	0.084
	Young male	2	6.00	2.00	3.00	4.50	1.00	4.50	0.971	9.714	5	0.084
	Women	2	6.00	2.50	3.00	5.00	1.00	3.50	0.914	9.143	5	0.103
	Young female	2	4.50	2.57	3.25	6.00	1.25	3.25	0.765	7.647	5	0.177

a. Kendall's coefficient of concordance.

b. Number of focus group discussions (FGD).

**Table 4**  
Food security arguments for importance of small ruminant.

Food security dimension	Arguments given by the farmers
Availability	The fast and high reproduction ability of small ruminants means that animals are produced in sufficient quantity and quality to ensure nutritious food for the household. Ample production allows small ruminants to be used as insurance and savings.
Access	Small ruminants are readily available to sell or exchange and purchase the necessary amount of food for the household, e.g. teff, maize, corn, wheat
Stability	Small ruminants, being drought, disease and cold resistant, are constantly available and accessible for the household throughout the year.
Utilization/Nutrition	Nutritional/medicinal value of milk and meat, especially for children and sick people, and safely produced/prepared animal products or purchased food for household consumption to fulfil dietary needs.

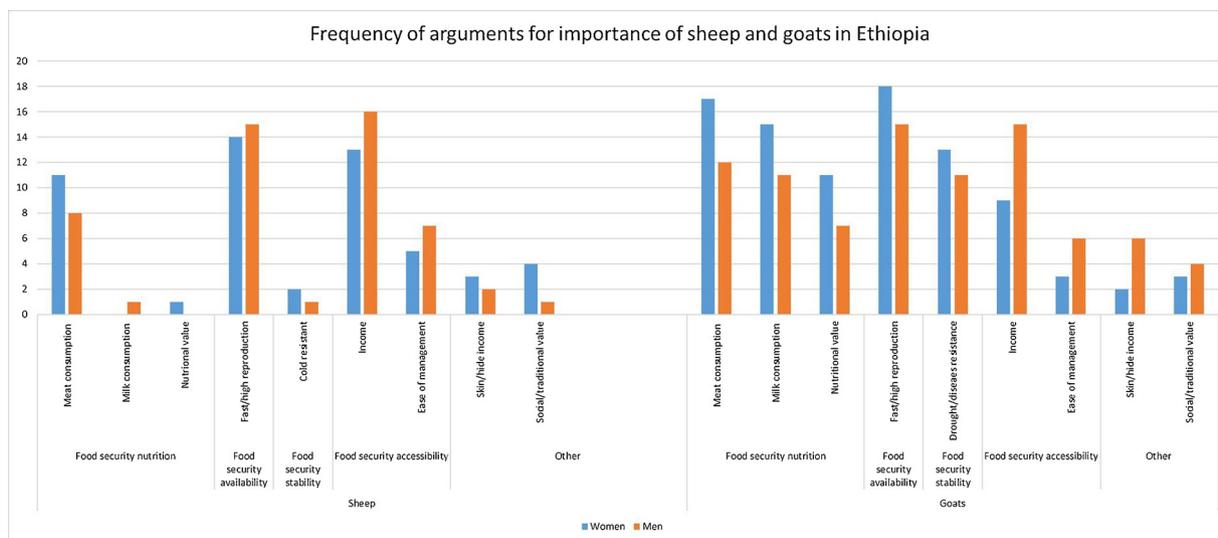


Fig. 2. Frequency of arguments for importance sheep and goats given during focus group discussions by gender 6.

needs of the family like sending children to school, purchasing food, health care and clothing were reasons given linked to accessibility. In addition, women preferred goats over cattle because of their milk for home consumption (33 %) and its nutritional and medicinal value (24 %), especially for children and the sick (Table 5).

The accessibility dimension of food security was reflected in statements like:

‘Sheep are like *Injera*, ready to be eaten.’ (From women FGD in the highlands, 2015)

Answers from men had a stronger focus on economic reasons and were directly linked to income generation. They reported that the majority of the income from small ruminants comes from sale of goats and sheep. The income generated from goats and sheep is used to

purchase cattle. Nevertheless, 64 % of arguments for goats, 43 % for sheep and 38 % for cattle by men also related to food security. For goats and sheep, all four food security dimensions were more often mentioned by women compared to men.

‘Sheep are like money in a pocket.’ (From men FGD in the highlands, 2015)

With all four dimensions represented, food security related arguments were most prevalent for goats (Table 5).

### 3.1.3. Gender and animal source foods consumption

This study found that consumption of animal source foods is common due to ownership of livestock which makes animal source foods available and/or income made from sales allows households to

**Table 5**  
Food security related arguments given during focus group discussions.

LS species	Component	Arguments given for importance	% of respondents related to food security	
			Women freq (%) (N = 46)	Men freq (%) (N = 46)
Sheep	Availability	Fast and high reproduction: ample production allows use as insurance and saving	(31) 67 %	(27) 59 %
	Access	Ease of management: readily available to sell or exchange and purchase the necessary amount of food	Ease of management (14) 30 % and income (32) 69 %	Ease of management (7) 15 % and income (28) 61 %
	Stability	Cold resistance	(2) 4 %	(5) 11 %
Cattle	Nutrition/ utilization	Nutritional/medicinal value: meat for household consumption	Meat (18) 39 %, milk (1) 2 %	Meat (20) 43 %, milk (1) 2 % and nutrition (2) 4 %
	Availability	Ease of management: readily available to sell or exchange and purchase the necessary amount of food	Income (27) 59 %	Income (27) 59 %
	Access	Nutritional value: meat and milk for home consumption	Meat (19) 41 %, milk (37) 80 % and nutrition (2) 4 %	Meat (18) 39 %, milk (33) 72 %
Goat	Stability	Ease of management: readily available to sell or exchange and purchase the necessary amount of food	(18) 39 %	(15) 33 %
	Utilization	Fast and high reproduction: readily available to sell or exchange and purchase the necessary amount of food	Ease of management (3) 7 % and income (9) 20 %	Ease of management (6) 13 % and income (15) 33 %
	Access	Ease of management: readily available to sell or exchange and purchase the necessary amount of food	(13) 28 %	(11) 24 %
Chicken	Stability	Drought/disease resistance	Meat (17) 37 %, milk (15) 33 % and nutrition (11) 24 %	Meat (12) 26 %, milk (11) 24 % and nutrition (7) 15 %
	Utilization	Nutritional/medicinal value: milk/meat for home consumption	(11) 24 %	(10) 22 %
	Access	Fast and high reproduction: ample production allows use as insurance and saving	Ease of management (4) 9 % and income (36) 78 %	Ease of management (13) 28 % and income (39) 85 %
	Stability	Ease of management: readily available to sell or exchange and purchase the necessary amount of food	Meat (23) 50 %, eggs (21) 46 % and nutrition (2) 4 %	Meat (12) 26 %, eggs (15) 33 % and nutrition (5) 11 %
	Utilization	Nutritional value: meat and eggs for household consumption		

**Table 6**

Men and women farmers/pastoralist perceptions on the importance of animal source food consumption and level of agreement between respondent groups in Ethiopia.

Gender	N <sup>b</sup>	Mean rank score							Kendall's W <sup>a</sup>	Chi-Square	Df	P Value	
		Beef	Dairy (milk/milk products)	Goat meat	Goat milk	Sheep meat	Sheep milk	Chicken meat					Chicken Eggs
Men	46	4.74	6.04	4.22	4.13	4.91	3.26	4.48	4.22	0.209	67.143	7	0.000
Women	46	4.51	6.08	4.34	4.16	4.42	2.95	4.68	4.86	0.236	76.089	7	0.000

a. Kendall's coefficient of concordance.

b. Number of focus group discussions (FGD).

purchase what is needed. Consumption of cow milk and milk products, goat milk and meat and chicken meat and eggs had higher scores for women than men respondents ( $W = 0.236$ ,  $P = 0.000$ ). In contrast, men assigned higher scores to consumption of beef, sheep milk and meat with weak agreement ( $W = 0.209$ ,  $P = 0.000$ ) (Table 6).

### 3.2. Household survey

#### 3.2.1. Purpose of keeping small ruminants in relation to food security

Data from the household survey showed that 97.8 % of households owned one or more livestock species including sheep, cattle, goat, equine and poultry. The number of small ruminants owned by the majority of respondents ranged from 1 to 25, which farmers considered a small flock size. Men and women farmers mentioned that the main reason to keep small ruminants is for regular cash income through sales of animals, nutritional value through household consumption of meat and milk, manure production, savings and insurance against emergencies, social purposes (cultural ceremonies) and exchange for cattle. They also saw livestock as assets and the number of animals or herds owned indicates one's level of wealth. The income generated from livestock sale was used to pay school fees, buy clothes, cover medical expense, purchase food and animals to rear.

In the household survey, differences between rankings given by men and women on purposes of keeping small ruminants were less apparent. Considering food security, accessibility was mentioned as first purpose by both female and male respondents (73.4 %). They sell small ruminants (72.9 % of households) locally to generate income to address livelihood needs of families (sending children to school, purchase food, health care and clothing). Nutritional value (meat and milk consumption) was mentioned by 69 % of the respondents as another purpose for keeping small ruminants (51.1 % and 17.9 %, respectively) (Table 7).

When comparing agroecologies, respondents in the highlands ranked animal sales as the most important purpose for keeping small ruminants (74.1 %), reflecting the accessibility dimension of food security. The 2nd ranked reason in the highlands was meat and milk

consumption (69.4 % of respondents), which reflects availability. In the lowlands, milk consumption (96 %) was most important, an argument linked to the nutritional value dimension of food security (Table 8).

In the multinomial logistic regression analysis, the food security arguments for prioritizing small ruminants were compared to each other (each considered as a reference category in turn) in a series of analyses to determine the statistical significance of the differences for ranking by sex and agroecologies. Women and the lowland agroecology were considered as the reference category. For the first ranked food security arguments, the respondents in midlands, compared to the lowlands, were more likely to give arguments related to accessibility than availability. The respondents in the highland ( $OR = 5.393$ ) and midlands ( $OR = 3.427$ ), compared to lowland respondents, were more likely to rank accessibility higher than nutritional value. There was no significant gender difference (Table 9).

## 4. Discussion

Small ruminants are one of the most preferred livestock species towards improving smallholder livelihoods as they provide milk, meat, wool, manure and income. Our study confirmed the findings of others who investigated advantages of small ruminant keeping. Sheep and goats are considered as convenient in terms of financial asset as they can be sold or exchanged to fulfil immediate cash requirements; meet basic needs such as foods, medicines and school fees; are easy to raise with little space and minimum feed requirements; and are symbols of wealth and social wellbeing. This is in agreement with Dossa et al. (2008) who argue that the main motivation of the majority of small ruminant keepers is to obtain extra income from sales which is used to buy staple foods and clothes, pay school fees for children and finance farm or subsidiary activities. In addition, their ability to resist drought and disease, generate income quickly and reproduce fast ensures enough food resources. Study by Tulicha (2013) found that small ruminants withstand drought on low-value feeds which is an important milk and meat source for children while cattle are unable to provide milk.

**Table 7**

Food security pillars versus gender.

FS pillars	1 <sup>st</sup> rank freq. (%)			2 <sup>nd</sup> rank freq. (%)			3 <sup>rd</sup> rank freq. (%)		
	M	F	Total (n = 429)	M	F	Total (n = 429)	M	F	Total (n = 429)
<b>Access</b>	153 (48.6)	162 (51.4)	315 (73.43)	25 (41)	36 (59)	61 (14.2)	49 (51.6)	46 (48.4)	95 (22.7)
Selling	152 (48.6)	161 (51.4)	313 (72.9)	23 (48.9)	24 (51.1)	47 (10.9)	28 (59.6)	19 (40.3)	47 (11.2)
Exchange	1 (50)	1 (50)	2 (0.5)	2 (14.3)	12 (85.7)	14 (3.3)	21 (43.8)	27 (56.3)	48 (11.5)
<b>Availability</b>	10 (76.9)	3 (23.1)	13 (3)	17 (31.5)	37 (68.5)	54 (12.59)	44 (44.9)	54 (55.1)	98 (23.4)
Insurance	5 (83.3)	1 (16.7)	6 (1.4)	10 (27)	27 (73)	37 (8.6)	15 (38.5)	24 (61.5)	39 (9.3)
Saving	5 (71.4)	2 (28.6)	7 (1.6)	7 (41.2)	10 (58.8)	17 (3.9)	29 (49.2)	30 (50.9)	59 (14.1)
<b>Nutritional value</b>	47 (54)	40 (46)	87 (20.3)	168 (56.8)	128 (43.2)	296 (69)	104 (54.7)	86 (45.3)	190 (45.4)
Meat consumption	39 (62.9)	23 (37.1)	62 (14.5)	114 (52.1)	105 (47.9)	219 (51.1)	42 (51.8)	39 (48.2)	81 (19.3)
Milk consumption	8 (32)	17 (68)	25 (5.8)	54 (70.1)	23 (29.9)	77 (17.9)	39 (33.9)	20 (66.1)	59 (14.1)
<b>Others</b>	7 (50)	7 (50)	14 (3.3)	7 (38.9)	11 (61.1)	18 (4.2)	16 (44.4)	20 (55.6)	36 (8.59)
Manure for fertilizer	5 (62.5)	3 (37.5)	8 (1.9)	2 (33.3)	4 (66.7)	6 (1.4)	23 (46)	27 (54)	50 (11.9)
Wool production	0	0	0	0	3 (100)	3 (0.7)	8 (44.4)	10 (55.6)	18 (4.3)
Prestige	0	0	0	0	0	0	1 (50)	1 (50)	2 (0.5)
Cultural ceremonies	2 (33.3)	4 (66.7)	6 (1.4)	5 (55.6)	4 (44.4)	9 (2.1)	7 (43.8)	9 (56.3)	16 (3.8)

**Table 8**  
Food security pillars versus agroecology.

FS pillars	1 <sup>st</sup> rank freq. (%)				2 <sup>nd</sup> rank freq. (%)				3 <sup>rd</sup> rank freq. (%)			
	Highland (n = 284)	Midland (N = 36)	Lowland (N = 109)	Total (n = 429)	Highland (n = 284)	Midland (N = 36)	Lowland (N = 109)	Total (n = 429)	Highland (n = 284)	Midland (N = 36)	Lowland (N = 109)	Total (n = 429)
Access	233 (74)	29 (9.2)	53 (16.8)	315 (73.43)	35 (57.4)	7 (11.5)	19 (31.1)	61 (14.2)	81 (82.6)	8 (8.2)	9 (9.2)	95 (22.7)
Selling	232 (74.1)	28 (9)	53 (17)	313 (72.9)	21 (41.7)	7 (14.9)	19 (40.4)	47 (10.9)	26 (55.3)	1 (2.1)	20 (42.6)	47 (11.2)
Exchange	1 (50)	1 (50)	0	2 (0.5)	14 (100)	0	0	14 (3.3)	34 (70.8)	14 (29.2)	0	48 (11.5)
Availability	8 (61.5)	0	5 (38.5)	13 (3)	49 (90.7)	1 (1.9)	4 (7.4)	54 (12.59)	60 (63.2)	15 (15.8)	20 (21.1)	98 (23.4)
Insurance	6 (100)	0	0	6 (1.4)	36 (97.3)	1 (2.7)	0	37 (8.6)	36 (92.3)	0	3 (7.7)	39 (9.3)
Saving	2 (28.6)	0	5 (71.4)	7 (1.6)	13 (76.5)	0	4 (23.5)	17 (3.9)	45 (76.3)	0	6 (10.2)	59 (14.1)
Nutritional value	36 (41.4)	7 (8.1)	44 (50.6)	87 (20.3)	187 (63.2)	27 (9.1)	82 (27.7)	296 (69)	109 (57.4)	9 (4.7)	72 (37.9)	190 (45.4)
Meat consumption	35 (56.5)	7 (11.3)	20 (32.3)	62 (14.5)	152 (69.4)	25 (11.4)	42 (19.2)	219 (51.1)	41 (50.6)	2 (2.5)	38 (47)	81 (19.3)
Milk consumption	1 (4)	0	24 (96)	25 (5.8)	35 (45.5)	2 (2.6)	40 (52)	77 (17.9)	28 (40.7)	7 (11.9)	28 (47.5)	59 (14.1)
Others	7 (50)	0	7 (50)	14 (3.3)	13 (72.2)	1 (5.6)	4 (22.2)	18 (4.2)	24 (77.8)	4 (11.1)	4 (11.1)	36 (8.59)
Cultural ceremonies	6 (100)	0	0	6 (1.4)	6 (66.7)	1 (11.1)	2 (22.2)	9 (2.1)	8 (50)	4 (25)	4 (25)	16 (3.8)
Manure for fertilizer	1 (0.4)	0	7 (6.4)	8 (1.9)	4 (66.7)	0	2 (33.3)	6 (1.4)	44 (88)	0	6 (12)	50 (11.9)
Wool production	0	0	0	0	3 (100)	0	0	3 (0.7)	18 (100)	0	0	18 (4.3)
Prestige	0	0	0	0	0	0	0	0	2 (100)	0	0	2 (0.5)

Regarding the choice of women to own small ruminants, our results seem to differ with the findings of [Njuki et al. \(2013\)](#) who stated that women do not choose to own small ruminants, but that culture and tradition restricts their choices of livestock. Our study indicates that women prefer to own small ruminants due to the food security benefits. However, there is the undeniable fact that cultural gender norms restrict women from owning large ruminants, but as we understood from the discussions, women also choose to have small ruminants for their different advantages.

The various reasons given that can be mapped to food security show that small ruminants play a significant role in providing food and nutritional security by providing animal source foods directly or from sales indirectly. [Herrero et al. \(2013\)](#) documented that livestock contributes to food security through direct access to animal source foods and providing cash income from sales, which can be used to purchase food, especially during times of food deficit. Also in the findings of [Oluwatayo and Oluwatayo \(2012\)](#), small ruminant production has significant impact on households in combatting food insecurity by being sources of food, increasing consumption of animal products and by products and generating income for purchasing food and other things.

The reasons given by women for preferring small ruminants is clearly linked to the four food security dimensions: their accessibility to be sold or exchanged to fulfil immediate cash requirements, nutritional value to meet basic food needs through consumption of meat and milk, production availability with short reproductive cycles and high reproductive rates to ensure sufficient food resources for the family, and resistance to extreme weather conditions which makes them a stable asset for the household. Similarly, in Kenya, women have higher preference for small livestock due to their importance in fulfilling household needs ([Waithanji et al., 2015](#)).

In addition, the difference in preference of livestock species in the different gender groups might also be because of women's easier access to small ruminants, that they're allowed ownership of them, have control over and benefit from the animals and their products without permission from their spouses in some cases. [Galiè et al. \(2015\)](#) argued in their study that ownership has different and ambiguous meanings in different areas. From the discussions in Ethiopia, they concluded that if the household member contributed in the management, directly benefited from the livestock and consumed the products, they claim ownership of the animals.

Consumption of animal source foods depends on the household management. Our study found that consumption of animal source foods was common in the study areas, showing that these foods are available and accessible, or households are in a position to purchase what is needed. Women respondents gave higher rank for cow milk/milk products, goat milk and meat and chicken meat and eggs. Goat and chicken products are commonly used mainly for children, the sick, elderly and pregnant family members. This indicates that women are more concerned about the immediate food needs and securing food in the family, which improves the nutritional status of the household. Men in contrast ranked beef higher; raw meat (beef) is culturally consumed mainly by men in Ethiopia, which may explain the ranking. Previous studies suggested investment in small ruminants targeting women is a feasible way to improve child and family nutrition given the important role of gender in determining household nutritional status ([Iannotti et al., 2013](#)). Women of the developing world contribute significantly to three dimensions of food security: food production, economic access to available food and nutritional security. This shows that women that generate small ruminant income benefit their families and negotiate the transition to a food secure society ([Quisumbing, 1998](#)).

The household survey corroborated results found in the focus group discussion on purpose of keeping small ruminants and the links to food security. Findings in the highland sites, where respondents ranked income from sales as the primary purpose for keeping small ruminants (which contributes to accessibility aspect of food security) were in line

**Table 9**  
Multinomial logistic regression coefficients and odds ratios for the 1<sup>st</sup> ranked purpose of small ruminant keeping.

FS pillars		Availability <sup>§</sup>		Nutritional value <sup>§</sup>		Others <sup>§</sup>	
		B	e <sup>β</sup> (OR)	B	e <sup>β</sup>	B	e <sup>β</sup> (OR)
Availability	Women			-1.025	.359	-1.197	.302
	Highland			.657	1.928	.453	1.573
	Midland			-18.577	NE	.416	1.515
Accessibility	Women	1.264	3.538	.238	1.269	.067	1.069
	Highland	1.029	2.797	1.685	5.393**	1.482	4.401**
	Midland	18.808	NE**	1.232	3.427*	18.224	NE*
Others	Women			.172	1.187		
	Highland			.203	1.225		
	Midland			-18.992	NE		

NE = Non estimable.

\*\* The parameters  $\beta$  were significant at 0.001 level; \* at 0.01.

<sup>§</sup> considered as reference category.

with [Beyene et al. \(2018\)](#), who argued that the main reason for keeping small ruminants was to generate cash income for households through the sale of live animals to meet immediate household financial obligations.

In lowlands we found milk consumption as the key purpose (contributing to nutritional value), whereas [Beyene et al. \(2018\)](#) found the priority for keeping small ruminants in lowlands related to insurance (linked to the availability dimension of food security).

Our findings indicate that accessibility was more important than availability according to food security arguments by respondents in the midlands compared to the lowlands. Similar findings were noted in highland and a mid-altitude agroecologies ([Legesse et al., 2008](#); [Etalesma and Abera, 2018](#)) where sheep and goat were primarily sold to generate cash needed for specific purposes such as buying farm inputs.

Similarly, the respondents in the highlands and midlands were more likely to rank accessibility higher than nutritional value as a purpose for keeping small ruminants. A study conducted in dry lowlands (agropastoral) reported that pastoralists raise sheep and goats for meat and milk (goat), which relates to the nutritional value dimension of food security ([Gizaw et al., 2010](#)).

## 5. Conclusion

This study provides further evidence on the role small ruminants play in ensuring food security for smallholder farmers. Small ruminants and poultry production have potential to improve food security by increasing animal source food production and nutritional intake through consumption of meat, milk and eggs, especially for women farmers. We found a preference among women toward the use of small ruminants as animal source foods. Women have a decisive role to play in the improvement of food and nutrition security by deriving income from sales of animals and their products and ensuring the household has adequate supply of animal source food. To encourage the contribution of small ruminants at national level, research should be done on the multiple advantages of the animals, the opportunities and constraints within households and their socioeconomic contributions. Also, useful would be generating more insights into how decision-making power in households affects choice of livestock species and perceived importance and preference of different species. Considering gender roles in household management and cultural norms will help increase women's ownership of small ruminants, market participation and income management, which in turn will facilitate to increase food security at the household level.

## Declaration of Competing Interest

The authors declared that there are no conflicts of interest with respect to the research, authorship, and/or publication of this article.

## Acknowledgment

The authors would like to thank the International Livestock Research Institute (ILRI) Animal and Human Health program staff for their support and contributions. We also thank our partners at regional research centers, universities and agricultural offices in the project sites, whose collaboration and facilitation has been essential to accomplish the present study. This study was supported by the IFAD SmART project, Africa RISING project and the CGIAR Research Program on Livestock. We thank donors and organizations which globally support work of the CGIAR through their contributions to the CGIAR Trust Fund.

## References

- Abeyasekera, S., 2001. Analysis Approaches in Participatory Work Involving Ranks or Scores. DFID Theme Paper (Revised). Statistical Services Centre, University of Reading, UK Retrieved from <http://www.reading.ac.uk/ssc/> (Accessed May 2018).
- Africa Food Security and Hunger, A, 2014. Undernourishment Multiple Indicator: Time Lag for Verifiable Comparable Information Across Countries 12 to 18 Months. Retrieved from <https://allafrica.com/download/resource/main/main/idadcs/00080509:c4065c285335e1a6173fa8bcceda7b41.pdf> (Accessed August 2019).
- Alary, V., Aboul-Naga, A., El Shafie, M., Abdelkrim, N., Hamdon, H., Metawi, H.A., 2015. Roles of small ruminants in rural livelihood improvement—Comparative analysis in Egypt. *Rev. Elev. Med. Vet. Pays Trop.* 68, 79–85.
- Ampaire, A., 2011. Farmers' experiences with rearing pigs, goats and chickens to improve household nutrition and income in Kamuli, Uganda. *Liflod Work* 68, 1–13. <https://doi.org/10.31274/etd-180810-1075>. (Accessed August 2019).
- Assefa, E., 2008. Assessment of Production and Marketing System of Goats in Dale District, Sidama Zone. MSc Thesis (Animal Production). Hawassa University 170 p. <https://hdl.handle.net/10568/697> (Accessed August 2019).
- Beyene, A., Alilo, A., Mola, M., 2018. Assessment of sheep and goat (small ruminants) production system in Esera District, of Dawro Zone, Southern Ethiopia. *J. Adv. Dairy Res.* 6, 2.
- Clay, E., 2002. Food security: concepts and measurement. *Trade Reforms and Food Security: Conceptualizing the Linkages.* pp. 25–34.
- Darapheak, C., Takano, T., Kizuki, M., Nakamura, K., Seino, K., 2013. Consumption of animal source foods and dietary diversity reduce stunting in children in Cambodia. *Int. Arch. Med.* 6, 29.
- Dohoo, I.R., Martin, W., Stryhn, H., 2003. *Veterinary Epidemiologic Research (No. V413 DOHV)*. AVC Incorporated, Charlottetown, Canada.
- Dossa, L.H., Rischkowsky, B., Birner, R., Wollny, C., 2008. Socio-economic determinants of keeping goats and sheep by rural people in southern Benin. *Agric. Human Values* 25, 581.
- Dror, D.K., Allen, L.H., 2011. The importance of milk and other animal-source foods for children in low-income countries. *Food Nutr. Bull.* 32, 227–243.
- Ehui, S., Benin, S., Williams, T., Meijer, S., 2002. Food Security in Sub-Saharan Africa to 2020, Socio-economics and Policy Research Working Paper 49. International Livestock Research Institute, Nairobi.
- Endalew, B., Muche, M., Tadesse, S., 2015. Assessment of food security situation in Ethiopia: a Review. *Asian. J. Agric. Res.* 9, 55–68.
- Etalesma, S., Abera, A., 2018. Small ruminant production and constraints in Misha Woreda, Hadiya Zone, Southern Ethiopia. *Int. J. Livest. Prod.* 9, 192–197.
- Fikru, S., Gebeyew, K., 2015. Sheep and goat production systems in Degehabur Zone, Eastern Ethiopia: challenge and opportunities. *Adv. Dairy Res.* 1–9.
- Galiè, A., Mulema, A., Benard, M.A.M., Onzere, S.N., Colverson, K.E., 2015. Exploring gender perceptions of resource ownership and their implications for food security among rural livestock owners in Tanzania, Ethiopia, and Nicaragua. *Agric. Food*

- Secur. 4, 2.
- Gizaw, S., Tegegne, A., Gebremedhin, B., Hoekstra, D., 2010. Sheep and goat production and marketing systems in Ethiopia: characteristics and strategies for improvement. IPMS (Improving Productivity and Market Success) of Ethiopian Farmers Project Working Paper 23. ILRI, Nairobi (Kenya). 58 p. <https://hdl.handle.net/10568/2238> (Accessed September 2019).
- Herrero, M., Grace, D., Njuki, J., Johnson, N., Enahoro, D., Silvestri, S., Rufino, M.C., 2013. The roles of livestock in developing countries. *Animal* 7, 3–18.
- Hirpa, A., Abebe, G., 2008. Economic significance of sheep and goats. *Sheep and Goats Production Hand Book for Ethiopia*.
- HRD (Humanitarian Requirements Document), 2017. Ethiopia: 2017 Revised Humanitarian Requirements Snapshot. Retrieved from <https://reliefweb.int/report/ethiopia/ethiopia-2017-revised-humanitarian-requirements-snapshot-8-august-2017>. (Accessed June 2019).
- Iannotti, L., Muehlhoff, E., McMahon, D., 2013. Review of milk and dairy programmes affecting nutrition. *J. Dev. Eff.* 5, 82–115.
- Iannotti, L.L., Lutter, C.K., Bunn, D.A., Stewart, C.P., 2014. Eggs: the uncracked potential for improving maternal and young child nutrition among the world's poor. *Nutr. Rev.* 72, 355–368.
- John, K.M.K., Demi, S., PK, A.D., 2013. Analysis of food security status of farming households in the forest belt of the Central Region of Ghana. *Russ. J. Agric. Socio-Econ. Sci.* 13.
- Ketema, T.K., 2007. Production and Marketing Systems of Sheep and Goats in Alaba, southern Ethiopia. Unpublished M. Sc. Thesis Dissertation. Hawassa University, Ethiopia.
- Krippendorff, K., 2004. Content Analysis: An Introduction to Its Methodology, 2nd ed. Sage Publications, Thousand Oaks, CA.
- Legesse, G., Abebe, G., Siegmund-Schultze, M., Zarate, A.V., 2008. Small ruminant production in two mixed-farming systems of southern Ethiopia: status and prospects for improvement. *Exp. Agric.* 44, 399–412.
- McCullagh, P., Nelder, J.A., 1989. *Monographs on Applied Statistics and Probability: Generalized Linear Models*, 2nd ed. Chapman and Hall, London.
- Meinzen-Dick, R., Behrman, J., Menon, P., Quisumbing, A., 2012. Gender: a key dimension linking agricultural programs to improved nutrition and health. *Reshaping Agric. Nutr. Heal.* 135–144.
- Neumann, C.G., Bwibo, N.O., Murphy, S.P., Sigman, M., Whaley, S., Allen, L.H., Guthrie, D., Weiss, R.E., Demment, M.W., 2003. Animal source foods improve dietary quality, micronutrient status, growth and cognitive function in Kenyan school children: background, study design and baseline findings. *J. Nutr.* 133, 3941S–3949S.
- Njuki, J., Waithanji, E., Lyimo-Macha, J., Kariuki, J., Mburu, S., 2013. Women, Livestock Ownership and Markets: Bridging the Gender Gap in Eastern and Southern Africa. Routledge <https://doi.org/10.4324/9780203083604>. (Accessed August 2019).
- Oluwatayo, I.B., Oluwatayo, T.B., 2012. Small Ruminants as a Source of Financial Security: A Case Study of Women in Rural Southwest Nigeria. Working Paper 1. (Accessed August 2019). Institute for Money, Technology and Financial Inclusion (IMTFI). [http://www.imtfi.uci.edu/imtfi\\_2010\\_oluwatayo](http://www.imtfi.uci.edu/imtfi_2010_oluwatayo).
- Panin, A., 2000. A comparative economic analysis of smallholder cattle and small ruminant production systems in Botswana. *Trop. Anim. Health Prod.* 32, 189–196.
- Quisumbing, A., 1998. Women, livestock and family food security. In: Symposium on Human Nutrition and Livestock in the Developing World. Little Rock, AR, Heifer Project International. pp. 121–132.
- Siegel, S., Castellan, N.J., 1988. *Nonparametric Statistics for the Behavioral Sciences*, 2nd ed. McGraw-Hill, New York.
- Tabatchnick, B.G., Fidell, L.S., 2007. Using multivariate statistics. In: Pearson Education, Inc, Tashakkori, A., Teddlie, C. (Eds.), 2010. *Sage Handbook of Mixed Methods in Social & Behavioral Research*, 5th ed. Sage, Boston, pp. 481–498.
- Tulich, A.Y., 2013. The Impact of Small Ruminant Diseases on Food Availability and Accessibility of Pastoral Households in Ethiopia: the Case of Liben District in Oromiya Region. Doctoral Dissertation. Rural Dev. Food Secur. Van Hall Larenstein University of Applied Sciences, Wageningen University, Netherlands.
- Valdivia, C., 2001. Gender, livestock assets, resource management, and food security: lessons from the SR-CRSP. *Agric. Human Values* 18, 27–39.
- Waithanji, E., Njuki, J., Mburu, S., Kariuki, J., Njeru, F., 2015. A gendered analysis of goat ownership and marketing in Meru, Kenya. *Dev. Pract.* 25, 188–203.
- Wong, J.T., de Bruyn, J., Bagnol, B., Grieve, H., Li, M., Pym, R., Alders, R.G., 2017. Small-scale poultry and food security in resource-poor settings: a review. *Glob. Food Sec.* 15, 43–52.