

# Prevalence of household food insecurity and associated factors in drought-prone pastoralist communities in Borana, Oromia, Ethiopia

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## Abstract

**Background:** Food security is a central component of the development agenda in pastoralist communities, especially among those who reside in drought-prone areas.

**Objective:** This study measured the prevalence of household food insecurity and associated factors among pastoralist communities of Borana, Ethiopia.

**Methods and materials:** A community-based cross-sectional study was conducted between July and August 2015 in two pastoralist communities in Borana Zone, Oromia, Ethiopia. Data were collected from 1,058 randomly sampled households through an interviewer-administered structured questionnaire. The data were analysed using SPSS version 21.0.

**Results:** The mean household food insecurity score was 18.21 (value range: 0.00–27.00). Overall, 82.33% of the households were severely food insecure, with 14.56% moderately food insecure. Ownership of private farming land, reliance on crop farming as the main economic activity ( $\beta=1.47$ ,  $p=0.016$ ), and one-way walk time to water sources ( $\beta=0.01$ ,  $p=0.001$ ) were significantly associated with household food insecurity ( $p<0.05$ ). Likewise, increased family size ( $\beta=0.49$ ,  $p=0.001$ ) and lack of education ( $\beta=1.41$ ,  $p=0.025$ ) were significantly associated with food insecurity. In contrast, dependence on small business (petty trade and shop) as the main economic activity ( $\beta=5.14$ ,  $p=0.001$ ); ownership of milking cow ( $\beta=-0.25$ ,  $p=0.001$ ), bull/heifer ( $\beta=-0.16$ ,  $p=0.002$ ), goat ( $\beta=-0.14$ ,  $p=0.001$ ) or pullet ( $\beta=-1.17$ ,  $p=0.001$ ); ownership of various assets, such as forage ( $\beta=-2.50$ ,  $p=0.009$ ); and participation in village-level saving schemes ( $\beta=-1.41$ ,  $p=0.044$ ) were all significantly associated with reduced household food insecurity.

**Conclusions:** Household food insecurity was widespread in the pastoralist communities of Borana, Ethiopia, affecting a high number of households in all domains: food anxiety, food quality, and quantity of food at the household level. As there were factors that were linked to food insecurity in the study pastoralists, evidence-based innovative interventions via a combination of measures in a medium-to-long-term development plan are vital for sustained household food security. [*Ethiop. J. Health Dev.* 2021; 35(1):38-49]

**Keywords:** Pastoralist, resilience, food resiliency, food insecurity, Borana, Ethiopia

## Background

After decades of substantial progress towards a steady decline in hunger (the proportion of undernourished people in developing regions fell by half between 2000 to 2015, for example), hunger across the globe has slowly been on the rise since 2015, making hunger a daily challenge for a significant number of the world's population (1). In 2018, about 821 million people globally suffered from hunger (1). This means that unacceptably large numbers of people still do not get the food they need so that they can lead active and healthy lives. Between 2014 and 2016, about 795 million people were undernourished, of whom 98.1% were living in developing regions (2). Even though remarkable progress has been made to meet the hunger-related Millennium Development Goal (MDG) target in many countries, progress towards eradicating hunger remains far short of the target in Africa, particularly in sub-Saharan Africa (SSA) (3). With 239 million food-insecure people, SSA carries the second highest burden of people who suffer from hunger. Despite remarkable

efforts, food insecurity and undernutrition remain top priorities for Ethiopia to address (2). Ethiopia is one of the four countries in SSA with the highest prevalence of underweight children (4), and evidence has shown that children in food-insecure households are more likely to be stunted, become underweight, and wasted (5-8).

Increasingly frequent extreme weather events and natural disasters hamper efforts to enhance food security in many countries, including Ethiopia. Consequently, a large number of the Ethiopian population, specifically those segments of the population who reside in arid and semi-arid lands, face chronic food insecurity and often rely on the Productive Safety Net Programme (PSNP) for survival and protection against acute food insecurity (9,10). Recurrent drought is one of the determinants of food insecurity in Ethiopia, especially in pastoralist areas (4), making Ethiopia one of the largest aid recipients across the globe (11). Other potential drivers of household food insecurity in pastoralist communities include poor access to the livestock market, lack of

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infrastructure, limited access to grain markets, and the lack of water sources and animal foods (12). Pastoralist communities entirely depend on good weather conditions, especially rainwater. In these communities, any level of drought is potentially dangerous, leading to food crises and insecurity. Accordingly, their livelihood in general and their food security, in particular, are closely related to the availability of, and access to, resources needed for livestock, mainly water, grazing lands, and forage (13-16).

In Ethiopia, pastoralist and agro-pastoralist communities represent 12% of the total population. They herd their livestock in arid and semi-arid lowland areas of the country, which are vulnerable to extreme rainfall variability and drought. Ethiopian pastoralists account for 22% of the country's cattle population, contribute 12-16% to Ethiopia's Gross Domestic Product (GDP), and 30-35% to agricultural GDP (17-19). In addition, the pastoral and agro-pastoral lowland grazing system contributes 35% of red meat and 56% of milk to the livestock sector GDP (12). Moreover, most of the exports of live animals are supplied from pastoral areas in Ethiopia (20). Yet, despite the significant contributions of pastoralism to local and national economies, levels of poverty and vulnerability remain unacceptably high among pastoral populations (21,22). On top of recurrent drought, these pastoral communities often experience recurrent conflicts and violence, thereby undermining entire households' livelihood, including food security (23,24). Despite the persistent impact of drought, combined with localized conflicts and violence, and the overuse of resources, pastoralist communities have their coping mechanisms and strategies to adapt to food insecurity at the household level. As noted by earlier studies, the ownership of various assets increases access to resources for animal forage, pastures, access to physical infrastructure, and social services, thereby providing some level of contribution to household food security (25,26). Some earlier reports indicate that pastoralists have tried various coping mechanisms and livelihood strategies – such as small-scale business activities, crop farming, holding financial and non-financial assets, and social networks and social support – to maintain household food security and wellbeing (25-27). Qualitative evidence from the same pastoralist communities also reveals that social networks play an important role in enhancing households' food security (28). In times of stress and shock emanating from drought, better social networks among members of the community can facilitate access to food and support for affected households and communities (29-32). One study indicates that social networks do not account for any variance in households' food security (33). Little is known about specific variables that play a role in improving households' food security in pastoralist communities affected by drought. Thus, in a context where food insecurity is a national challenge, it is important to examine pastoralists' livelihood strategies that would have the potential to enhance households' food security.

Pastoralists have unique characteristics, experience and most are vulnerable to food insecurity. Therefore, this

study aimed to assess the prevalence of household food insecurity and associated factors among Borana pastoralist communities. The study was conducted as a follow-up to a qualitative investigation that explored resilience dimensions, coping, and adaptive strategies in pastoralist communities (28). Principally, the present inquiry performed a statistical test to assess the prevalence of household food insecurity and the different factors associated with it among pastoralist communities in Borana, Ethiopia.

### Methods and materials

**Study setting:** The data were collected between July and August 2015 as part of a larger community-based cross-sectional study aimed at determining factors that influence resilience towards the effects of recurrent drought in two drought-affected districts (i.e. Arero and Dhas) in Borana Zone, Oromia National Regional State, Ethiopia. The zone is situated between 3°36' to 6°38' north latitude and 3°43' to 39°30' east longitude, with an altitude of between 1,000m and 1,500m above sea level. Of the zone landmass, 70% is semi-arid lowland (34,35). More than 85% of the population of the study districts are pastoralists. The two districts are the most vulnerable in the zone to drought and human-made shocks, such as conflicts. Between 2000 and 2005 alone, four episodes of conflict were documented in the two districts, with increasing frequency in recent years (34).

**Population and sample:** The data were collected from heads of households in four villages, locally called *ganda* (the lowest administrative unit). However, when the household head was not available at the time of the visit, the spouse was interviewed. The sample size was determined using the single population proportion formula,  $n = (Z 1-\alpha/2)^2 p (1-p)/d^2$ , based on the following assumptions: 95% CI, a proportion of 50% (variable of interest), and 3% margin of error. Considering a 10% non-response rate, the final sample size was 1,174 households. In each study district, two *gandas* were selected purposively, taking into account the risk and frequency of droughts (34,35). Accordingly, Geleba and Wachille (in Arero district) and Erdar and Gorille (in Dhas district) were included in the survey. The sample size was allocated to the selected four *gandas*, proportional to the total number of households in each. Within each selected *ganda*, the desired households were randomly selected from the sampling frame taken from the *ganda* registry. The data collectors approached selected households through the guidance of local informants. In each selected household, either the husband or wife was interviewed. If the husband was present, he was considered for an interview; however, if the husband was not at home at the time of the visit, the wife was interviewed. In the absence of both (after two visits), a relatively older member of the household who could provide information was considered for an interview.

**Measurements:** The survey questionnaires were adopted from various sources (36-39) and adapted to the local context. The survey questionnaire contained different parts and items. Respondents' characteristics – such as age, sex marital status, religion, education, family size – and households' main economic activities were assessed. The tool consisted of items designed to

measure households' distance to main facilities, such as the market, health facility, and water sources. Distance from the market, health facility, and the water source was quantified as 'one-way walk time' based on the self-reported measures of respondents. The survey tool also assessed households' ownership of various livestock types, and ownership of various assets and resources, such as hayfields, private agricultural and farming land, animal forage, as well as access to and participation in microfinance services.

**Household food insecurity measures:** Household food insecurity was the outcome variable in the present analysis and it was assessed using the standard Household Food Insecurity Access Prevalence (HFIAP) questionnaire (36). The HFIAP questionnaire consists of nine occurrence questions (yes/no) that represent a generally increasing level of severity of food insecurity (access) and nine frequency-of-occurrence questions that are asked as a follow-up to each occurrence question to determine how often the condition occurred during the last four weeks. The frequency of occurrence of the event was rated as 'rarely' (1), 'sometimes' (2), and 'often' (3). The HFIAS occurrence questions assess three different domains of food insecurity: anxiety and uncertainty about the household food supply; insufficient quality; and insufficient food intake and its physical consequences (36). The overall HFIAS score was calculated for each household by summing up responses to each frequency-of-occurrence question; the range of possible scores was 0-27. The higher the score, the more food insecurity the household experienced, and vice versa. Categories of food insecurity were defined as food secure (1), mildly food insecure (2), moderately food insecure (3), and severely food insecure (4), as per the standard computation method (36).

**Independent variables:** Independent variables included attributes and characteristics, such as background characteristics of the respondents, ownership of various livestock types, household economic activities, household assets, and access to water and facilities. The community network was assessed using 19 items on a three-point scale, ranging from: agree (2), uncertain (1), and disagree (0). The tool addresses how people view or experience the various aspects of social support and exchanges at the time of problems or difficulties. In addition, it shows perceptions towards indigenous social support institutions and external support, including food aid. The questionnaire was prepared in English and translated into the community's language (Afan Oromo), then back-translated to English to check for consistency and appropriateness. The Afan Oromo version was pre-tested on 5% of the sample size in a similar setting and used for actual data collection.

**Data collection method:** Data were collected using an interviewer-administered questionnaire. The interviewers held at least a first degree in public health or a related field and were trained in administering the questionnaire. Local guides assisted the interviewers in identifying the selected *gandas* and households. Data collection was supervised by the investigators.

**Statistical analysis:** Data were double entered in EpiData version 3.1 and then exported to SPSS version 21 for analysis. A principal component analysis (PCA) with varimax rotation was conducted to uncover dimensions underlying food insecurity and social network scales. Mean household food insecurity scores were computed and used in the linear regression analysis. The independent variables were entered into the regression model in blocks. In the first block, associations between background characteristics and household food insecurity were assessed. The second block examined the relationship between household food insecurity and social networks. The effect of ownership of various livestock types on household food insecurity was assessed in the third block; the fourth regression block evaluated the effects of ownership of various assets on households' food insecurity. The last regression model was built from all variables that were significant in the preceding regression models after age, sex, and villages were kept constant. In all analyses, a  $p$ -value  $< 0.05$  was considered as a cut-off point for statistical significance.

## Results

**Background characteristics of respondents:** One thousand and fifty-eight respondents participated, giving a response rate of 90.12%. The mean age of the respondents was 38.93±17.44 years. The majority (63.52%) of the survey respondents were females, and the vast majority (85.16%) had no formal education.

**Prevalence of household food insecurity:** The analysis indicated that the mean household food insecurity score was 18.21 (SD=7.36, min=0.00, max=27.00). There was no significant difference in the mean food insecurity score by district (Arero 18.26 vs Dhas 19.20) ( $p>0.05$ ) (data not shown). Table 1 shows participants' responses to each food insecurity measure item.

Table 1 shows that 84.88% of the households were worried that their household would not have enough food, of which 59.45% experienced this often. Likewise, the majority of the households were obliged to eat poor quality food due to a lack of resources (items: 2-5). Similarly, the vast majority of the households were forced to eat an insufficient quantity of food due to a shortage of food in their household.

Table 1: Response to household food insecurity, Borana, August 2015

During the last four weeks, how often...	Not at all (%)	Rarely (%)	Sometimes (%)	Often (%)
	you worry that your household would not have enough food?	15.12	3.59	21.83
you or any household member not able to eat the kinds of foods you prefer because of a lack of resources?	9.17	5.58	27.60	57.66
you or any household member had to eat a limited variety of foods due to lack of resources?	8.41	4.91	35.63	51.04
you or any household member had to eat some foods that you really did not want to eat because of lack of resources to obtain other types of food?	19.19	6.43	27.60	46.79
you or any household member had to eat a smaller meal than you felt you needed because there was not enough food?	10.68	6.24	28.36	54.73
you or any household member had to eat fewer meals in a day because there was not enough food?	11.34	6.62	28.83	53.21
there was no food of any kind to eat in your household because of a lack of resources to get food?	24.39	10.78	31.76	33.08
you or any household member slept at night hungry because there was not enough food?	28.73	13.33	33.84	24.10
you or any household member passed the whole day and night without eating anything because there was not enough food?	43.48	20.70	19.47	16.35

Figure 1 depicts the household food insecurity prevalence among the study population. Overall, 82.33% of the households were severely food insecure and 14.56% were moderately food insecure. The

proportions of households with severe food insecurity were similar across study villages, but slightly higher in Wachille (89.22%) and lower in Erdar (75.79%). The proportion of food-secure households was almost nil.

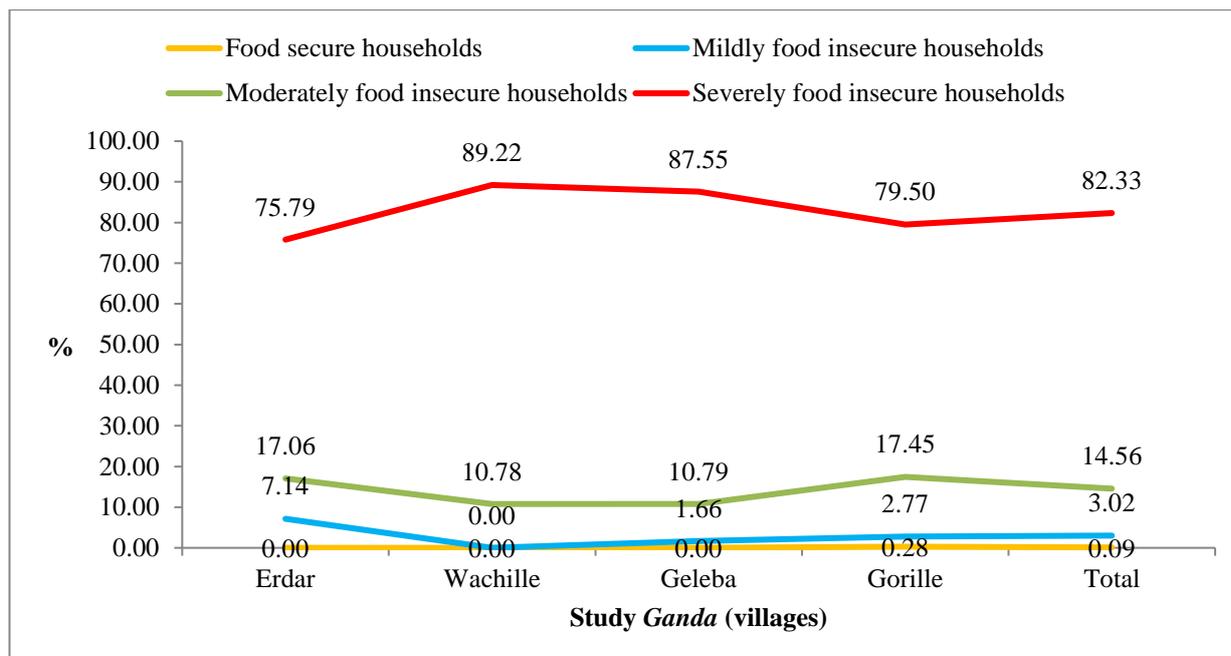


Figure 1: Prevalence of household food insecurity among the study population, Borana, August 2015

**Background characteristics associated with household food insecurity:** As Table 2 shows, family size, sex, age, households' main economic activity, education, and religion were significantly associated with household food insecurity. A unit increase in family size (i.e. plus one person) increased food insecurity, on average, by 0.43 points (95% CI: 0.24-0.62,  $p=0.001$ ). Likewise, the food insecurity score was lower on average by 5.07

points among households whose main livelihood was small-scale business activities. Conversely, the food insecurity score was higher on average by 2.83 points among households that relied on agricultural crop farming as a leading economic activity. On the other hand, the food insecurity score was higher on average by 1.93 points (95% CI: 0.62-3.24) among respondents with no formal education.

Table 2: **Background factors associated with household food insecurity, Borana, August 2015**

Variables	B	P-value	95% CI	
Family size	0.43	0.001	0.24	0.62
Sex (Female, * male)	1.09	0.023	0.15	2.03
Age of respondent	0.06	0.001	0.03	0.08
Main economic activity of household				
Livestock*				
Jobless	1.32	0.158	-0.51	3.14
Business	-5.07	0.001	-7.14	-3.00
Farming	2.83	0.016	0.53	5.12
Others	0.61	0.521	-1.25	2.47
Education of respondents (Formal education, * No education)	1.93	0.004	0.62	3.24
Marital status (Others, Married*)	-0.01	0.986	-1.16	1.14
Religion				
Wakeffeta*				
Muslim	-1.19	0.038	-2.32	-0.07
Protestant	-0.72	0.242	-1.92	0.48
Other religion	3.94	0.032	0.33	7.55

\*Reference category

**Association between community networks and household food insecurity:** PCA revealed that social networks as coping strategies had three underlying components. The three components jointly explained 66.00% of the total variance. The first component was related to social support or resource sharing at the time of difficulty and it explained the majority of the variance (45.10%). The second factor was related to the indigenous social support institution, *Busa gonofa*, which explained 12.50% of the variance. The last factor was related to the influence or role of an external system, such as governance or food aid, on the community network and social support system.

The three components of social networks were regressed against the overall household food insecurity score. Consequently, social support that involves the exchange of resources, mainly food-related items, was inversely associated with household food insecurity – increased

social support was associated with a reduced household food insecurity score of 0.60 points on average (95% CI: -1.00, 1.41,  $p=0.009$ ). Likewise, the indigenous social support institution, *Busa gonofa*, was significantly associated with a decreased food insecurity score ( $\beta=-0.60$ , 95% CI: -1.00, -0.12,  $p=0.011$ ). External support, such as food aid and the influence of modern governance, did not show a significant association with households' food security ( $p=0.505$ ).

**Association of ownership of various livestock types with food insecurity:** Table 3 shows the association between ownership of various livestock categories and household food insecurity. In this analysis, only ownership of milking cow ( $\beta=-0.27$ ,  $p=0.001$ ), goat ( $\beta=-0.12$ ,  $p=0.002$ ), bull/heifer ( $\beta=-0.17$ ,  $p=0.003$ ) and pullet ( $\beta=-0.85$ ,  $p=0.032$ ) were significantly associated with improved household food security.

Table 3: **Association between ownership of various livestock types and household food insecurity, Borana, August 2015**

Livestock types owned	B	P-value	95.0% CI	
Oxen	-0.48	0.060	-0.98	0.02
Milking cow	-0.27	0.001	-0.43	-0.11
Calf	0.09	0.346	-0.09	0.27
Bull/heifer	-0.17	0.003	-0.28	-0.06
Goat	-0.12	0.002	-0.19	-0.04
Sheep	-0.04	0.466	-0.15	0.07
Camel	-0.01	0.962	-0.19	0.18
Mule	0.72	0.076	-0.078	1.51
Donkey	-0.04	0.886	-0.52	0.45
Horse	0.09	0.861	-0.86	1.03
Laying hens	0.01	0.985	-0.30	0.31
Non-laying hens	-0.18	0.461	-0.65	0.29
Chicken	-0.07	0.684	-0.40	0.26
Pullet	-0.85	0.032	-1.63	-0.07
Beehives	0.02	0.466	-0.03	0.07

**Association between ownership of various assets and households' food insecurity:** In the third block of the regression model (Table 4), six of the 11 attribute variables were significantly associated with decreased household food insecurity. Consequently, having bank savings account decreased households' food insecurity score by an average of 5.15 points (95% CI: -8.74, -1.56,  $p=0.005$ ). Correspondingly, participation in a village-level saving and loan group decreased household food insecurity score on average by 2.74 points (95% CI: -

4.26, -1.21,  $p=0.001$ ). On the other hand, access to forage/animal food ( $\beta=-3.59$ , 95% CI: -5.71, -1.48,  $p=0.001$ ) and hayfields ( $\beta=-0.77$ , 95% CI: -1.81, 0.27,  $p=0.049$ ) significantly contributed to decreased household food insecurity in the study community. In this analysis, having access to private farming land was associated with increased household food insecurity on average by 3.70 points (95% CI: 1.49, 5.92,  $p=0.001$ ). However, participation in crop production contributed to decreased household food insecurity.

**Table 4: Association between ownership of various assets and household food insecurity, Borana, August 2015**

Assets/attributes	B	P-value	95.0% CI	
Hayfield	-0.77	0.049	-1.81	0.27
Crop field/agricultural land	-1.19	0.129	-2.73	0.35
Forage	-3.59	0.001	-5.71	-1.48
Farming land	3.70	0.001	1.49	5.92
Household cultivated any crop	-1.64	0.004	-2.77	-0.51
Any food aid in the last two years	0.71	0.169	-0.30	1.72
Microfinance saving and loan account	-0.56	0.499	-2.17	1.06
Any member of the household has a village-level saving and loan account	-2.74	0.001	-4.26	-1.21
Has bank account	-5.15	0.005	-8.74	-1.56
Has a plot of land	-0.03	0.975	-2.17	2.09
Has a house in town	-1.71	0.017	-3.11	-0.31

**Association between access to facilities and household food insecurity:** The analysis revealed that self-reported walk time to the nearest health facility and the water source was linked with increased food insecurity (Table 5). The household food insecurity score increased with increasing walk time (in a minute) to the health facility and water source. For instance, a unit (1 minute) increase in walk time to a water source on average

increased the food insecurity score by 1.60 points (95% CI: 1.00-2.21,  $p=0.001$ ). Similarly, a unit increase in walking time to the nearest health facility increased the food insecurity score by an average of 0.01 points (95% CI: 0.01-0.02,  $p=0.007$ ). However, waiting time to collect water and distance from the market did not show a significant association with food insecurity ( $p>0.05$ ).

**Table 5: Association between access to water and facilities with household food insecurity, Borana, August 2015**

Variables	$\beta$	p-value	95% CI for $\beta$	
Time to get to the closest market	-0.01	0.366	-0.01	0.02
One-way walk time to the nearest health facility	0.01	0.007	0.01	0.02
One-way walk time to the nearest water source	1.60	0.001	1.00	2.21
Waiting time to collect water	-0.01	0.777	-0.01	0.01

**Predictors of household food insecurity:** In the final regression model, which was built from significant variables ( $p<0.05$ ) in the preceding models after controlling for age and sex, 11 variables remained significant predictors of the food insecurity score (Table 6). However, in the final regression model, none of the

dimensions of social networks showed a significant association with household food insecurity. Also, the religion of the respondent, ownership of pullet, having a house in town, having a bank account, and farming as the main economic activity of heads of household did not show an association with household food insecurity.

**Table 6: Regression results of independent predictors of household food insecurity in pastoralist communities, Borana, Ethiopia**

Variables	B	p-value	95.0% CI	
Sex	1.15	0.008	0.30	2.01
Age	0.05	0.000	0.03	0.08
One-way walk time to nearest health facility	0.01	0.050	0.00	0.01
One-way walk time water source	0.01	0.001	0.01	0.02
Has forage	-2.50	0.009	-4.39	-0.62
Has farming land	1.47	0.016	0.27	2.67
Household cultivated any crop in the last season	-1.61	0.002	-2.62	-0.60
Family size	0.49	0.000	0.31	0.67
Business	-5.14	0.000	-7.08	-3.20
Crop farming	1.19	0.277	-0.96	3.34
Muslim	-0.15	0.776	-1.19	0.89
Other religions	2.79	0.101	-0.55	6.12
Education	1.41	0.025	0.18	2.65
Household has village-level saving and loan account	-1.41	0.044	-2.78	-0.04
Has house in town	0.62	0.350	-0.68	1.92
Household has bank account	-2.22	0.185	-5.51	1.06
Milking cow	-0.25	0.001	-0.35	-0.15
Goat	-0.14	0.001	-0.20	-0.08
Pullet	-1.17	0.001	-1.86	-0.48
Bull/heifer	-0.16	0.002	-0.26	-0.06
<i>Busa gonofa</i>	0.12	0.560	-0.28	0.52
External aid	-0.05	0.795	-0.45	0.34

### Discussion

This study assessed the prevalence of household food insecurity and associated factors in pastoralist communities of Borana Zone, Oromia, Ethiopia. The study documented that a very large number of households were living in a state of anxiety and uncertainty about their food supply, and forced to eat insufficient food in terms of quantity, quality, variety, and preference. Certainly, food insecurity has been a critically enduring challenge among pastoralists in the Horn of Africa (15), and the present evidence also demonstrates that many households in the study area do not have both physical and economic access to sufficient food to meet their dietary needs for productive and healthy life (40). The prevalence of food-insecure households in the study area was very high compared to previous studies in similar contexts (41-43). This study was conducted during the dry season, which increases pastoralist households' vulnerability to food shortages. Correspondingly, the present study identified background characteristics – community networks, ownership of various livestock types and assets, access to water and facilities – that are significantly associated with an increased risk of household food insecurity. Subsequently, larger family size tended to increase the risk of household food insecurity. This is a logical finding and also consistent with both theoretical and empirical evidence, in that as family size increases, demand for food increases (44,45). This suggests the need to prioritize large households for immediate food security interventions. Indeed, efforts to reduce family size and population growth through the promotion of family planning methods, as part of an effort to ensure food security in pastoralist areas, need to be strengthened.

Consistent with earlier evidence (44,46-50), this study shows that less educated households are more likely to experience food insecurity. This suggests that educated families and individuals earn higher incomes, which means more resources to buy food, better access to nutritious foods, and more options to cope with price shocks and food shortages (46-49).

The study indicates that households' participation in diverse income-generating activities, such as small-scale business and petty trade, reduces the risk of food insecurity, suggesting that self-employment in small-scale businesses plays a constructive role in improving food security at the household level. Earlier evidence also reports similar findings (44). Interestingly, no evidence supports the view that household participation in agricultural crop farming as the main economic activity or livelihood strategy significantly reduces household food insecurity. However, households that were practicing crop farming as a supplementary strategy to their main source of livelihood were less affected by food insecurity. Qualitative findings in the same community also document that households that depend on crop farming alone are more prone to food shortages (19). This finding has paramount policy implications, since pastoralists' dependence on growing crops may not be sufficient to improve their food security; rather, promoting pastoralists' participation in various small business or income-generating activities is fundamental to improve food security and family well-being. Nevertheless, promoting agricultural crop farming practices in pastoralist communities, where a lack of rain and scarcity of water are persistent phenomena, can increase the risk of food insecurity. This means that a fundamental shift from pastoralist-led

livelihoods to agricultural practice may exacerbate food insecurity. Thus, rather than attempting to shift livelihoods, it is important to diversify the economic activities of pastoralists to improve their resilience in relation to food security. Some earlier studies from other countries indicate that land ownership and participation in diversified livelihood strategies significantly reduce the risk of food insecurity at the household level (43,51,52). A qualitative study in the same community also revealed that livelihood diversification through participation in agricultural practices was viewed by the communities as a vital strategy to improve their resilience capacity (28). However, the promotion of crop farming in such an arid and fragile environment needs to be implemented with caution, and close support is crucial for pastoralists, especially in providing information on weather conditions and climate factors that can have a negative impact on the productivity of crop farming.

This study found that social networks did not have a significant positive effect on household food security. Nevertheless, a qualitative study in the same community evidenced that the Borana pastoralist communities have strong traditional institutions, such as *Busa gonofa*, that play a vital role during periods of stress and shock (28). In these communities, however, social networks and support schemes have declined in recent years and are no longer effective in supporting communities as a coping strategy (28), and many factors, such as increased demand for such support, have deteriorated the community's capacity to contribute to social support schemes. An unwillingness among community members to join social networks, the influence of external aids and interventions, and the negative impact of formal government structures have also contributed to the weakened social networks in these pastoralist communities (28).

Food security interventions need to revitalize, promote, and work with these indigenous social institutions for maximum impact. In this study, food aid and external support did not show an association with household food security. Indeed, the food aid program may not be effective in ensuring sustained food security, especially if its distribution is not properly controlled and managed to ensure its reach to needy households. Previous studies also note that there is no significant association between household food insecurity and the receipt of food aid, due to the lack of a proper screening system for determining eligibility into food aid programs at both the *district* and household levels (53).

This study indicated a self-reported one-way walk time to water sources and health facilities associated with increased food insecurity. It is difficult to assume a direct link between distance to health facilities, water sources, and household food insecurity. Maybe, traveling a long distance or many hours to health facilities affected the time devoted to food production and preparations at the household level. Also, distance to health facilities may affect people's health status, which in turn impacts food security (54). The proximity of water is vital for food security and associated with improved health outcomes, and a lack of it can be a

major cause of famine and malnutrition, especially in areas where people depend on local agriculture or livestock for food (47-49). One study investigated whether time spent walking to the main water source was a significant determinant of health outcomes for under-5 children (55). In many settings, the responsibility of water collection rests on women, and as the distance to the water source increases, it may increase women's workload which in turn negatively affects women's role in livestock raising and food security activities (27).

Unlike some earlier studies (15,28,52,56), distance to market did not have a significant impact on food security. Rural and pastoralist communities are usually affected by a lack of well-developed infrastructure services, including market access, which could impact negatively their health and food access (28,57). It is believed that market facilities can contribute to food security by increasing the income of pastoralists from sales and, hence, enhance their ability to purchase foodstuffs in times of need (58).

In this study, ownership of milking cow, bull/heifer, goat, or pullet was associated with improved household food security. Ownership of other types of livestock did not show an association with food security at the household level. Certainly, this is a logical finding, given that milk and milk products are the major sources of food for households in pastoralist communities. However, studies from the agro-pastoralist community indicate that ownership of oxen shows a significant association with food insecurity (52). On the other hand, cash can be generated regularly from direct sales of milk and milk products to purchase food, which could help households to diversify their dietary consumption (59,60).

Perhaps, organizations that engage in food security programs need to strengthen efforts towards improving household milk production through improved breeding of milking cows, forage production, and proper milk handling and utilization. Concerning this finding, this study also evidenced that access to animal foods, such as forage, plays a crucial role in ensuring household food security in Borana pastoralist communities. This is a consistent finding since increased access to animal food improves animal products, which in turn contributes to the household food supply. Accessing forage and other types of animal foods is a challenge and serious concern for pastoralists, and it is important to emphasize ways of ensuring their access to livestock foods, mainly forage supply.

Additionally, ownership of goats contributed to improved household food security. A household may buy a goat and feed it food purchased from the market, or consume goat meat at the household level. Evidence has shown that goat rearing plays an important role in food security and income generation in SSA (61). Given that goats are an ideal livestock type in arid and semi-arid areas, where a shortage of rain persists throughout the year, the present study encourages the need to increase goat production as a means of improving household food security. Of course, it is also essential to

equip pastoralists with at least basic skills (unless they have them already) and supply them with improved goat breeds for better results. Moreover, ownership of young hens (pullets) and bulls/heifers was associated with improved household food security. One report indicates that small livestock can act as a cash buffer in pastoralist and agro-pastoralist communities, thereby mitigating the risk of food insecurity during serious food shortages (62). Hence, ownership of hens might help the communities to cope up with food shortages and also enhance food diversity. Income gains from chicken sales may also enable households to purchase a greater variety of food (59). This implies that agricultural sectors and food security programs should promote poultry production in pastoralist communities, focusing especially on commercial hens.

Evidence indicates that household assets have a positive impact on a household's food security. Households with higher or better assets experience less food insecurity (25). For example, in this study, households who had houses in urban areas were less likely to experience food insecurity, suggesting that asset diversification can be one of the viable options in strengthening households' food security. This is supported by earlier findings in the same community, where some pastoralist households were building houses in town and renting them to generate more income (63).

Another important characteristic that appeared to have an impact on food security was the household's access to financial services and village-level saving groups. The evidence indicates that saving money in banks and small groups helps the community to cope with food insecurity. Earlier studies in the same community also note that access to microfinance, savings, and loan services is crucial to strengthening community resilience, including food access (23,24,63). There is abundant evidence that shows that pastoralist-oriented microfinance services lead to food availability and access, thereby minimizing food insecurity (64-66). Specifically, village-level informal financial institutions that rely on networks and informal financial mechanisms play an important role in strengthening households' food security (52,67,68), especially when women are targeted (69,70).

The current study highlights relevant evidence that could have important policy implications and practical significance that call for an urgent response to household food insecurity crises in such fragile settings. Nevertheless, the study has at least one limitation – the study villages (*gandas*) were purposively selected, and they are not necessarily representative of other *gandas* in the region as a whole, and therefore the findings of the study may not be applicable to all pastoralist settings in the region.

### Conclusions

The present study assessed the prevalence of food insecurity and associated factors based on households' experiences in drought-vulnerable pastoralist communities of Borana Zone, Oromia, Ethiopia. The results of the study indicate that household food insecurity is a widespread phenomenon in the study

communities. The households' experiences were very severe in all aspects of food insecurity, including uncertainty/anxiety over food supplies, and insufficiency of foods in terms of both quantity and quality. Household participation in crop farming as a major livelihood strategy does not help households to improve their food security; rather, it is found to be a positive coping strategy when it is practiced as a supplementary means of livelihood strategy. Moreover, engagement in small-scale business activities, including as a main economic activity, significantly helps households to become food secure.

Distance to water sources and health facilities, a lack of education, and a large family size negatively impact household food security. Even though pastoralists keep various livestock types, only milking cows, bulls/heifers, goats, and pullets positively contribute to enhanced household food security in the present context. Moreover, some assets, such as animal forage and access to financial services, enhance household food security. Interventions aimed at enhancing household food security in pastoralist communities depend on context-specific evidence for effective and sustainable impacts. Moreover, this also exemplifies the need to go beyond the traditional approach to sector-wide efforts to improve household food security in vulnerable pastoralist communities.

### Conflict of interests

The authors declare that they have no competing interests.

### Authors' contributions

ZB, AA, WK, and KWM conceived and designed the study, and were involved in data analysis, interpretation, and report writing. ZB drafted the manuscript. AA, AT, NB and KWM reviewed the manuscript for intellectual content. ZB revised the manuscript and all authors read and approved the final version of the manuscript.

### References

1. United Nations. Food. 2015. [www.un.org/en/sections/issues-depth/food/index.html](http://www.un.org/en/sections/issues-depth/food/index.html)
2. FAO Regional Office for Africa. Africa's food security prospects brighter than ever before. 2015. [www.fao.org/africa/news/detail-news/en/c/297741/](http://www.fao.org/africa/news/detail-news/en/c/297741/)
3. FAO/WFP/IFAD. The state of food insecurity in the world. 2015. [www.fao.org/3/a-i4646e.pdf](http://www.fao.org/3/a-i4646e.pdf)
4. Fanzo J. The nutrition challenge in sub-Saharan Africa. 2012. [www.undp.org/content/dam/rba/docs/Working%20Papers/Nutrition%20Challenge.pdf](http://www.undp.org/content/dam/rba/docs/Working%20Papers/Nutrition%20Challenge.pdf)
5. Berra WG. Household food insecurity predicts childhood undernutrition: A cross-sectional study in West Oromia (Ethiopia). *Journal of Environmental and Public Health*. 2020: e5871980.
6. Mulu E, Mengistie B. Household food insecurity and its association with nutritional status of under five children in Sekela District, western Ethiopia: A comparative

- cross-sectional study. *BMC Nutr.* 2017;3(1):35.
7. Betebo B, Ejajo T, Alemseged F, Massa D. Household food insecurity and its association with nutritional status of children 6-59 months of age in East Badawacho District, south Ethiopia. *J Environ Public Health.* 2017;6373595.
  8. Ali D, Saha KK, Nguyen PH, Diressie MT, Ruel MT, Menon P, *et al.* Household food insecurity is associated with higher child undernutrition in Bangladesh, Ethiopia, and Vietnam, but the effect is not mediated by child dietary diversity. *J Nutr.* 2013;143(12):2015-21.
  9. Berhanu W. Recurrent shocks, poverty traps and the degradation of pastoralists' social capital in southern Ethiopia. *Afr J Agric Resour Econ.* 2011;6(1):1-15.
  10. Berhanu W. Recurrent shocks, poverty traps and the degradation of pastoralists' social capital in southern Ethiopia. *Afr J Agric Resour Econ.* 2011;6(1):1-15.
  11. World Food Programme. Food tracker. [www.wfp.org/fais/](http://www.wfp.org/fais/)
  12. Shapiro B I, Gebru G, Desta S, Negassa A, Nigussie K, Aboset G, *et al.* Ethiopia livestock sector analysis. Addis Ababa, Ethiopia: International Livestock Research Institute (ILRI); 2017. [https://cgspace.cgiar.org/bitstream/handle/10568/92057/LSA\\_Ethiopia.pdf?sequence=3](https://cgspace.cgiar.org/bitstream/handle/10568/92057/LSA_Ethiopia.pdf?sequence=3)
  13. FAO. Pastoralism in the new millennium. Undated. [www.fao.org/docrep/005/Y2647E/y2647e02.htm](http://www.fao.org/docrep/005/Y2647E/y2647e02.htm)
  14. Tsegaye D, Vedeld P, Moe SR. Pastoralists and livelihoods: A case study from northern Afar, Ethiopia. *J Arid Environ.* 2013;91:138-46.
  15. Wakhungu J, Wesongah J, Tura G, Msalya G, Grace D, Unger F, *et al.* Pastoralism in Kenya and Tanzania: Challenges and opportunities in animal health and food security. Poster prepared for the 6th All Africa Conference on Animal Agriculture, Nairobi, Kenya, 27-30 October 2014. Nairobi, Kenya: ILRI. <https://cgspace.cgiar.org/handle/10568/51337>
  16. International Union for Conservation of Nature. Enhancing food security in pastoral areas through pastoralism and mobility IUCN. 2013. [www.iucn.org/content/enhancing-food-security-pastoral-areas-through-pastoralism-and-mobility](http://www.iucn.org/content/enhancing-food-security-pastoral-areas-through-pastoralism-and-mobility)
  17. Federal Ministry of Agriculture. Regional Pastoral Livelihoods Resilience Project (RPLRP): Resilience policy framework. Addis Ababa: MoA; 2013.
  18. National Oceanic and Atmospheric Administration (NOAA). Drought facts. 2002. [http://threeissues.sdsu.edu/three\\_issues\\_droughtfacts01.html](http://threeissues.sdsu.edu/three_issues_droughtfacts01.html)
  19. Ethiopian Population Center. Population Council country profile. Addis Ababa; EPC; 2013.
  20. Birch I. Economic growth in the lowlands of Ethiopia. 2018 <https://opendocs.ids.ac.uk/opendocs/handle/20500.12413/14220>
  21. Abdurehman E. Jostling for trade: The politics of livestock marketing on the Ethiopia - Somaliland border. 2014. [www.future-agricultures.org/publications/research-and-analysis/working-papers/1829-jostling-for-trade-the-politics-of-livestock-marketing-on-the-ethiopia-somaliland-border/file](http://www.future-agricultures.org/publications/research-and-analysis/working-papers/1829-jostling-for-trade-the-politics-of-livestock-marketing-on-the-ethiopia-somaliland-border/file)
  22. White L. Pastoralism in Ethiopia: New briefings and paper. *Future Agriculture*; 2014. [www.future-agricultures.org/themes/pastoralism/pastoralism-in-ethiopia-new-briefings-and-paper/](http://www.future-agricultures.org/themes/pastoralism/pastoralism-in-ethiopia-new-briefings-and-paper/)
  23. Debelo AR. Living with conflict: Borana's resilience in southern Ethiopia. *Afr Confl Peacebuilding Rev.* 2019;9(2):75-97.
  24. Odhiambo MO. Impact of conflict on pastoral communities' resilience in the Horn of Africa: Case studies from Ethiopia, Kenya and Uganda. 2012. [www.alnap.org/help-library/impact-of-conflict-on-pastoral-communities-resilience-in-the-horn-of-africa-case](http://www.alnap.org/help-library/impact-of-conflict-on-pastoral-communities-resilience-in-the-horn-of-africa-case)
  25. Wright H, Kristjanson P, Bhatta G. Understanding adaptive capacity: Sustainable livelihoods and food security in coastal Bangladesh. CCAFS Working Paper No. 32. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen, Denmark. 2012. <https://ccafs.cgiar.org/resources/publications/understanding-adaptive-capacity-sustainable-livelihoods-and-food>
  26. Common Market for Eastern and Southern Africa Comprehensive African Agriculture Development Programme (CAADP) Pillar III: Policy framework for food security in pastoralist areas. COMESA; 2009.
  27. Poppy GM, Chiotha S, Eigenbrod F, Harvey CA, Honzák M, Hudson MD, *et al.* Food security in a perfect storm: Using the ecosystem services framework to increase understanding. *Philos Trans R Soc B.* 2014;369:20120288.
  28. Birhanu Z, Ambelu A, Berhanu N, Tesfaye A, Woldemichael K. Understanding resilience dimensions and adaptive strategies to the impact of recurrent droughts in Borana Zone, Oromia Region, Ethiopia: A grounded theory approach. *Int J Environ Res Public Health.* 2017;14(2):118.
  29. Martin KS, Rogers BL, Cook JT, Joseph HM. Social capital is associated with decreased risk of hunger. *Soc Sci Med.* 1982;58(12):2645-54.
  30. Díaz HL, Drumm RD, Ramírez-Johnson J, Oidjarv H. Social capital, economic development and food security in Peru's mountain region. *Int Soc Work.* 2002;45(4):481-95.
  31. Dzanja J, Christie M, Fazey I, Hyde T. The role of social capital in rural household food security: The case study of Dowa and Lilongwe

- Districts in central Malawi. *J Agric Sci.* 2015;7(12):165.
32. Gallaher CM, Kerr JM, Njenga M, Karanja NK, WinklerPrins AMGA. Urban agriculture, social capital, and food security in the Kibera slums of Nairobi, Kenya. *Agric Hum Values.* 2013;30(3):389-404.
  33. Mayanja MN, Rubaire-Akiiki C, Greiner T, Morton JF. Characterising food insecurity in pastoral and agro-pastoral communities in Uganda using a consumption coping strategy index. *Pastoralism.* 2015;5(1):11.
  34. Odhiambo MO. Impact of conflict on pastoral communities' resilience in the Horn of Africa: Case studies from Ethiopia, Kenya and Uganda. 2012. [www.alnap.org/help-library/impact-of-conflict-on-pastoral-communities-resilience-in-the-horn-of-africa-case](http://www.alnap.org/help-library/impact-of-conflict-on-pastoral-communities-resilience-in-the-horn-of-africa-case)
  35. Angassa A, Oba G. Herder perceptions on impacts of range enclosures, crop farming, fire ban and bush encroachment on the rangelands of Borana, southern Ethiopia. *Hum Ecol.* 2008;36(2):201-15.
  36. Coates J, Swindale A, Bilinsky S. Household Food Insecurity Access Scale (HFIAS) for measurement of food access: Indicator guide. 2007. [www.fantaproject.org/monitoring-and-evaluation/household-food-insecurity-access-scale-hfias](http://www.fantaproject.org/monitoring-and-evaluation/household-food-insecurity-access-scale-hfias)
  37. Central Statistical Agency of Ethiopia. Ethiopia - Socioeconomic survey 2013-2014. 2013. <http://microdata.worldbank.org/index.php/catalog/2247>
  38. The World Bank. Measuring social capital: An integrated questionnaire (English). 2004. <http://documents.worldbank.org/curated/en/515261468740392133/Measuring-social-capital-an-integrated-questionnaire>
  39. Youngmann R, Zilber N, Workneh F, Giel R. Adapting the SRQ for Ethiopian populations: A culturally-sensitive psychiatric screening instrument. *Transcult Psychiatry.* 2008;45(4):566-89.
  40. United States Agency for International Development (USAID). Policy determination, Definition of food security. 1992. [http://pdf.usaid.gov/pdf\\_docs/Pnaav468.pdf](http://pdf.usaid.gov/pdf_docs/Pnaav468.pdf)
  41. Mayanja MN, Rubaire-Akiiki C, Greiner T, Morton JF. Characterising food insecurity in pastoral and agro-pastoral communities in Uganda using a consumption coping strategy index. *Pastoralism.* 2015;5(1):11.
  42. Indris Sirajea, and Adam Bekeleb. Assessment of food insecurity and coping mechanisms among pastoral households of Afar national regional state: The case of Chifra district, Ethiopia. 2013; *Ethiop. J. Agric. Sci.* 23:145-156. <https://www.ajol.info/index.php/ejas/article/view/142874>
  43. Asenso-Okyere K, Mekonnen DA, Ayalew D, Zerfu E. Determinants of food security in selected agro-pastoral communities of Somali and Oromia regions, Ethiopia. *Journal of Food Science and Engineering.* 2013;3:453-71.
  44. Aidoo R, Mensah JO, Tuffour T. Determinants of household food security in the Sekyere-Afram Plains District of Ghana. *European Scientific Journal, ESJ.* 2013;9(21). <http://eujournal.org/index.php/esj/article/view/1488>
  45. Olayemi A O. Effects of family size on household food security in Osun State, Nigeria. *Asian Journal of Agriculture and Rural Development.* 2012;2(2):136-41.
  46. Zimmerman, E., and S. H. Woolf. Understanding the relationship between education and health. Discussion Paper, Institute of Medicine, Washington, DC. 2014. <https://nam.edu/wpcontent/uploads/2015/06/BPH-UnderstandingTheRelationship1.pdf>
  47. FAO. Education for rural people and food security - A cross country analysis. 2007. [www.fao.org/docrep/010/a1434e/a1434e00.htm](http://www.fao.org/docrep/010/a1434e/a1434e00.htm)
  48. Mutisya M, Ngware MW, Kabiru CW, Kandala N. The effect of education on household food security in two informal urban settlements in Kenya: A longitudinal analysis. *Food Secur.* 2016;8(4):743-56.
  49. Muro PD, Burchi F. Education for rural people: A neglected key to food security. Report No.: 0078. Department of Economics - University Roma Tre; 2007. <https://ideas.repec.org/p/rtr/wpaper/0078.html>
  50. Ajao KO, Ojofeitimi EO, Adebayo AA, Fatusi AO, Afolabi OT. Influence of family size, household food security status, and child care practices on the nutritional status of under-five children in Ile-Ife, Nigeria. *Afr J Reprod Health.* 2010;14(4 Spec no.):117-26.
  51. Harris-Fry H, Azad K, Kuddus A, Shaha S, Nahar B, Hossen M, *et al.* Socio-economic determinants of household food security and women's dietary diversity in rural Bangladesh: A cross-sectional study. *J Health Popul Nutr.* 2015;33:2.
  52. Ahmed A.Hussein. Food insecurity and coping strategies of agropastoral households in Babile District of Somali Regional State, Ethiopia. MSC thesis, Haramaya University; 2015. <https://scholar.google.com/citations?user=rRwQ4VUAAA&hl=en>
  53. Clay DC, Molla D, Habtewold D. Food aid targeting in Ethiopia: A study of who needs it and who gets it. *Food Policy.* 1999;24(4):391-409.
  54. Sharkey JR, Johnson CM, Dean WR. Relationship of household food insecurity to health-related quality of life (HRQOL) in a large sample of rural and urban women. *Women Health.* 2011;51(5):442-60.
  55. Pickering AJ, Davis J. Freshwater availability and water fetching distance affect child health in sub-Saharan Africa. *Environ Sci Technol.* 2012;46(4):2391-7.

56. Zakari S, Ying L, Song B. Factors influencing household food security in West Africa: The case of southern Niger. *Sustainability*. 2014;6(3):1191-202.
57. Tembo D, Simtowe F. The effects of market accessibility on household food security: Evidence from Malawi. Conference Paper - Conference on International Research on Food Security, Natural Resource Management and Rural Development; 2009.
58. Ravi Nandi, S. Nedumaran, P. Ravula. The interplay between food market access and farm household dietary diversity in low and middle income countries: A systematic review of literature. 2021; *Global Food Security* 28. 100484: 2211-912.  
<https://www.sciencedirect.com/science/article/pii/S2211912420301371>
59. Kariuki J, Njuki J, Mburu S, Waithanji E. Women, livestock ownership and food security. 2013.  
[https://cgspace.cgiar.org/bitstream/handle/10568/27919/Women\\_LivestockOwnershipFoodSec.pdf?sequence=1](https://cgspace.cgiar.org/bitstream/handle/10568/27919/Women_LivestockOwnershipFoodSec.pdf?sequence=1)
60. FAO. Milk and dairy products in human nutrition. 2013.  
[www.fao.org/docrep/018/i3396e/i3396e.pdf](http://www.fao.org/docrep/018/i3396e/i3396e.pdf)
61. Ngambi JW, Alabi OJ, Norris D. Role of goats in food security, poverty alleviation and prosperity with special reference to sub-Saharan Africa: A review. *Indian J Anim Res*. 2013;47(1):1-9.
62. Sansoucy R. Livestock - a driving force for food security and sustainable development. Undated.  
[www.fao.org/docrep/v8180t/v8180T07.htm](http://www.fao.org/docrep/v8180t/v8180T07.htm)
63. Birhanu Z, Ambelu A, Berhanu N, Tesfaye A, Woldemichael K. Understanding resilience dimensions and adaptive strategies to the impact of recurrent droughts in Borana Zone, Oromia Region, Ethiopia: A grounded theory approach. *Int J Environ Res Public Health*. 2017;14(2):118.
64. Parvin G. Role of microfinance institutions to enhance food security in the climate change context: gender based analysis of rural poor community of Bangladesh. 2012.  
<http://gobeshona.net/publication/role-microfinance-institutions-enhance-food-security-climate-change-context-gender-based-analysis-rural-poor-community-bangladesh/>
65. European Microfinance Platform. Enhancing food security and resilience to climate change: What role for microfinance? [www.emfp.eu/sites/default/files/resources/2015/11/UMM%20Bergamo%20Thematic%20paper%202015\\_web\\_0.pdf](http://www.emfp.eu/sites/default/files/resources/2015/11/UMM%20Bergamo%20Thematic%20paper%202015_web_0.pdf)
66. Berg CN. Impact of microfinance on food security, informal credit, and agricultural wages: The case of Bangladesh. PhD dissertation, The George Washington University; 2014.  
<http://pqdtopen.proquest.com/doc/1498121528.html?FMT=ABS>
67. Collins D, Morduch J, Rutherford S, Ruthven O. *Portfolios of the poor: How the world's poor live on \$2 a day*. Princeton: Princeton University Press; 2010.
68. Rutherford S. *The poor and their money*. Oxford: Oxford University Press; 2000.
69. Mullinax A. Village savings and loan associations and food security: Exploring linkages in Sierra Leone and Tanzania. 2011.  
[www.marketlinks.org/resources/village-savings-and-loan-associations-and-food-security-exploring-linkages-sierra-leone](http://www.marketlinks.org/resources/village-savings-and-loan-associations-and-food-security-exploring-linkages-sierra-leone)
70. Ksoll C, Lilleør HB, Lønborg JH, Rasmussen OD. Impact of village savings and loan associations: Evidence from a cluster randomized trial. *J Dev Econ*. 2016;120:70-85.