Smallholders Beef Cattle Commercialization in Southwest Ethiopia

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Abstract

In this study, the beef cattle markets in Southwest Ethiopia are analyzed based on a survey of 172 producers. The first part emphasized the characterization and commercialization of the beef cattle market in the study area. The second part is dedicated to identifying the factors affecting households’ participation in the beef cattle market using the Heckman two-step selection model. In the findings, the beef cattle market is characterized by the dominance of few traders, asymmetric information, lack of contract enforcement, lack of transparency among market actors, and poorly developed market infrastructure. There is very low net commercial off-take rate of cattle for smallholder farmers in the study area. The result from the Heckman two-step selection model revealed that having positive stock of cattle, better access to extension service & feed, and a better level of literacy enhanced market participation and sales volume. On the contrary, market participation and sales volume were negatively affected by cattle keeper's age, non-livestock income, and poor road and health infrastructure. The study suggested that improving the market and health infrastructure, providing capacity building for producers, and improving access to feed could enhance the intensity of smallholder beef cattle market participation.

Introduction

Background

As the global population grows from 7 billion in 2010 to a projected 9.8 billion in 2050, and incomes grow across the developing world, overall food demand is on course to increase by more than 50 percent, and demand for animal-based foods by nearly 70 percent (World Resources Institute, 2018). Projected increases in animal protein demand and consumption are likely to maintain livestock's position as one of the fastest growing sub-sectors in agriculture for the foreseeable future, particularly in low-income and emerging economies (Global Agenda for sustainable livestock, 2014). In emerging and developing economies, smallholder mixed crop-livestock systems are, and will remain, the main producers of ruminant products to 2050 (Herrero et al., 2014). Growing evidence indicated that the sustained increase in the consumption of animal proteins creates a host of new development opportunities to synergistically link smallholder livestock producers with the economic growth processes from which they have largely been excluded (Lubungu et al., 2016). To this effect, the diverse roles of livestock in developing and emerging countries create opportunities to meet nutrition, income, livelihood and ecosystem needs while mitigating livestock-related threats to human and environmental health (ILRI, 2019).

Livestock play a significant role in rural livelihoods and the economies of developing countries (Herrero et al., 2012). In Ethiopia, the livestock sector plays a vital role in the overall economic growth and development of the country. Approximately 85 percent of Ethiopia's population is rural-based, and livestock supports the livelihoods of about 80 percent of rural people (ILRI 2011). The livestock subsector contributes 16.5% the national GDP, 47% of the agricultural GDP, 15% of export earnings, and 30% of agricultural employment (Lamesegn, 2018). However, the current levels of contribution of the livestock subsector in Ethiopia, at either macro or micro level, is below potential (Gebremedhin et al. 2007). One of
the reasons, among others, seems to be the inefficient livestock and livestock product market subjected to high margins, and poor marketing facilities. Under these conditions, producers have no incentives to improve the quality of their animal products through appropriate management practices. The benefits from their productive activities are constrained by lengthy marketing processes, high transaction costs, the informal cattle trade, over-exploitation by brokers, weak and unfriendly linkages between the major marketing actors, and a lack of both market-oriented cattle production and modern cattle marketing channels (Hailemariam et al. 2009a). There is a need for a well-performing (efficient) marketing system which satiates consumer demand with the minimum margin between consumer and producer prices (Belay 2013).

If livestock is to be used as an engine for poverty reduction, it is essential that producers become market-orientated (Herrero et al., 2012). In Ethiopia, however, many smallholder farmers and pastoralists do not participate in the livestock market. Furthermore, for those smallholder farmers and pastoralists who participate in the market, the size of transaction (sale or purchase of cattle or shoats) is found to be very small (Asfaw and Jabbar, 2008). The lack of a market-oriented livestock production system has shadowed and demeaned the role it can play in the national economy (Tegegne et al. 2006). In a nutshell, investment in developing efficient value chains (including market development, service provision, adequate institutional support, etc.) should be high in the development agenda, to create incentives for smallholders to integrate in the market economy (Herrero et al., 2012).

In Ethiopia, livestock production plays a vital role in the rural economy. Livestock production is one of the essential components of livelihood and employment for rural households. Mixed livestock production system (crop with livestock), agro-pastoral, and pastoral production system dominantly practiced in the highland and lowland agro-ecological zones of Ethiopia. Despite high production potential, the benefit earned from livestock production is constrained by the traditional and low market-oriented production system, poor access to markets, poor market infrastructure, poor trader investment, low producers’ participation in the livestock market, illegal cattle trade, and the lack of value addition activities. There is a need to assess whether and how the existing small-scale and pastoral livestock production systems can provide sustainable and adequate live animal supply, which can meet the demand for domestic consumption and for export markets (Asfaw and Jabbar, 2008). While constraints in the livestock marketing are frequently discussed (Gebrekiros et al., 2021; Solomon, 2020; Gedefaw, 2020; Negassa et al., 2011; Ayele et al., 2003), empirical evidence on the performance of the beef cattle commercialization is rare in the Bench-Sheko and Kaffa zones of southwest Ethiopia. This paper will illuminate how to meet the rapidly growing demand for livestock products through identification of the major constraints that hinder market participation and intensity of participation and through formulation of interventions necessary to promote market oriented livestock production system.

**Methodology**

**Study Area**
This study was conducted in Bench-Sheko and Kaffa zone administrations in South-western Ethiopia. A considerable amount of the region is covered with tropical montane humid forests. Agricultural practices are the dominant livelihood source for the inhabitants. Enset and maize are the major staple foods in the region, and the two crops are mainly used for subsistence. Coffee is the major source of income. Similarly, livestock is the most worthy asset for households because they serve as insurance against a drought period and in meeting the other family emergency. Also, Livestock, particularly cattle, serve as the fount of social prestige among pastoralists.

**Source and Data Requirements**

Both primary and secondary sources of data were employed to meet the specific objectives of this study. Primary data were collected by using questionnaires drafted for producers and focus group discussions with traders. Hence, two FGD were conducted with traders each consisting of five members. Moreover, secondary data were obtained from organization records of each district’s a trade and industry office and previous research works.

**Sample Size and Method of Sampling**

**Sampling procedure**

A multistage sampling procedure was employed. In the first stage, study sites were purposively selected based on livestock production potential. In the second stage, Bench-Sheko and Kaffa zone administrations were purposively selected based on livestock production potential and accessibility to the market center. In the third stage, two districts from the Bench-Sheko zone (North Bench district and Shaiy Bench district) and two districts from the Kaffa zone (Gewata district and Saylem district) were selected in consultation with the zone agricultural offices. In the fourth stage, three kebeles from each district were purposively selected based on livestock production potential and accessibility to the market center. In the final stage, respondents were randomly selected using a formula \( N \geq 50 + 8m \): where \( N \) is the minimum required number of households, and \( m \) is the number of explanatory variables included in the analysis. For this study, 172 respondents were selected.

**Method of Data Analysis**

Data were analyzed using descriptive statistics, commercial off-take rate, and econometric analysis.

To compute the rate of commercialization, two types of off-takes are estimated for cattle produced in the study area. First, the gross commercial off-take rate, which is given as the total sales as a percentage of the average stock of a household is computed as (Asfaw and Jabbar, 2008):

\[
\text{Grosscommercial off-take rate} = \left( \frac{sales}{0.5(\text{openingstock} + \text{endingstock})} \right) \times 100
\]
The gross commercial off-take involves animal sales and excludes other outgoings and incomings such as transfers, exchanges, gifts and purchases.

When the interest is in the number of livestock that actually leaves the livestock owners and enter the market for slaughter, other exchanges such as on-farm transfers, on-farm exchanges and on-farm slaughters need to be netted out for off-take computations. Thus, from the point of view of assessing the supply of live animals by the households to the market, net commercial off-take rather than gross commercial off-take is a more relevant parameter to be estimated (Asfaw and Jabbar, 2008). The net commercial off-take rate is given as follows:

\[
\text{Netcommercialoff-takerate} = \left( \frac{sales - purchases}{0.5(\text{openingstock} + \text{endingstock})} \right) \times 100
\]

The net commercial off-take could be negative for net buyers, zero for those whose sales and purchases are equal or for those who are not engaged in the market, and it is positive for net sellers. In general, the livestock producers can buy and/or sell beef cattle.

To identify the factors affecting the market participation decision of households, the Heckman two-step model used. Since participation in the beef cattle market represented by a binary variable, those who participate might not sale all their livestock, which implies that the decision to sell and the decision of how much to sell are two separate decisions. If both decisions are involved: participation and number of live animal sales, Heckman (1979) two-step estimation procedure is appropriate.

The first stage of the Heckman model attempts to identify factors affecting market participation (a participation equation). This equation used to construct a selective term, known as "the Inverse Mills Ratio," which added to the second stage “outcome equation" that explains the factors affecting the quantity of marketed surplus. The inverse Mills ratio is a variable for controlling bias due to sample selection (Heckman, 1979). The second stage involves the Mills ratio to the quantity of marketed surplus equation and estimating the equation using Ordinary Least Squares (OLS).

The structure of the sample selection model consists of two systems of equations. The first equation is the selection equation, which is defined as:

\[
di^* = zi\gamma + ui \quad \text{eqn 1}
\]

\[
di = \begin{cases} 
1, & di^* > 0 \\
0, & \text{otherwise}
\end{cases} \quad \text{eqn 2}
\]

where \(d_i^*\) is a latent variable, \(\gamma\) is a \(K\times1\) vector of parameters, \(zi\) is a \(1\times K\) row vector of observations on \(K\) exogenous variables and \(ui\) is a random disturbance. Together, (eqn 1) and (eqn 2) define what is called a latent variable model.
The second equation is the linear model of interest. The ordinary least squares regression technique would be to estimate the effect of the program using the equation.

\[ Y_i = X_i \beta + \epsilon_i = 1, 2, \ldots, n \]

Where \( Y_i \) an observable is random variable, \( \beta \) is an \( M \times 1 \) vector of parameters, \( X_i \) is a \( 1 \times M \) vector of exogenous variables, and \( \epsilon_i \) is a random disturbance. Hence, \( Y_i \) is the probability of market participation in the live animals market; which is a dummy variable assuming the value of 1 for market participants and 0 otherwise.

To estimate these models, Heckman has introduced the Heckman two-step estimator, which is as below

\[ E[Y_i | d_i > 0, X_i] = X_i \beta + \rho \sigma \epsilon \frac{\phi(Z_i \gamma)}{\Phi(Z_i \gamma)} \]

Where the quantities \( \lambda = \frac{\phi(Z_i \gamma)}{\Phi(Z_i \gamma)} \) are the inverse Mill's ratio evaluated at \( Z_i \gamma \). \( \Phi (\cdot) \) and \( \phi (\cdot) \) are the normal density and cumulative distribution functions, respectively. \( \rho \) is the correlation between unobserved determinant and unobserved determinants, \( \sigma \epsilon \) is the standard deviation of \( \epsilon_i \). The coefficient on the inverse Mill's ratio will indicate if there is selection bias. If the coefficient of the "selectivity" term is significant, then the hypothesis that an unobserved selection process governs the participation equation is confirmed.

**Conceptual framework**

To commercialize the beef cattle sector in Ethiopia for a sustainable supply of beef cattle to the market, this study conceptualized that beef cattle commercialization is dependent on the relationship between sales volume (intensity of market participation) and their determinants. The relationship between the determinant (independent) variables and the dependent variable included in the study are illustrated in Fig. 1. Based on the demographic, economic, and institutional factors, the expected outcomes are: market oriented beef cattle production, sustained supply of beef cattle, and equitable share of income and profit among market actors in the beef cattle sector.

**Result And Discussion**

**Socioeconomic Characteristics of the Respondent**

Out of the total respondents, 95.35 percent were male-headed households and the remaining 4.65 percent of them were female-headed households. Regarding the marital status of the respondents, 90.12 percent of the respondents were married and the remaining 9.88 percent of them were single. Educational attainment was included in the analysis as a dummy variable with two levels: unable to read and write, and capable to read and write. More respondents were capable to read and write (68.60%).
Table 1
Socioeconomic Characteristics of the Respondent

| Variable                | Participant | Nonparticipant | Total | Chi sq/ t value |
|-------------------------|-------------|----------------|-------|-----------------|
| Sex                     |             |                |       |                 |
| Male                    | 86          | 78             | 164   | 2.2985          |
| Female                  | 2           | 6              | 8     |                 |
| Marital status          |             |                |       |                 |
| Married                 | 80          | 75             | 155   | 0.721           |
| Unmarried               | 8           | 9              | 17    |                 |
| Education               |             |                |       |                 |
| Read & write            | 54          | 64             | 118   | 4.3864**        |
| Unable to read & write  | 34          | 20             | 54    |                 |
| Frequency of extension  |             |                |       |                 |
| Yes                     | 76          | 47             | 123   | 19.51***        |
| No                      | 12          | 37             | 49    |                 |
| Access to credit        |             |                |       |                 |
| Yes                     | 10          | 18             | 28    | 3.1944*         |
| No                      | 78          | 66             | 144   |                 |
| Access to feed          |             |                |       |                 |
| Yes                     | 74          | 19             | 93    | 65.3933***      |
| No                      | 14          | 65             | 79    |                 |
| Age of the HH           | 37.85       | 39.73          | 38.77 | 1.8668*         |
| Family size             | 7.15        | 6.27           | 6.72  | -2.2607**       |

Significance levels: *** p < 0.01, ** p < 0.05, * p < 0.1.

Regarding having access to extension service and feed, 71.51 percent of the respondents had access to extension, while 54.07 percent of them had access to feed. Having better access to agricultural extension service and feed appear to contribute greatly to market participation. On the other hand, out of the total respondents, only 16.20 percent of them had access to credit. Regarding age, the mean age of the respondents was 37.83 years old. Similarly, the average family size and animal rearing history of respondents in the area was 6.72 units and 8 years.

**Characteristics of the Beef Cattle Market**

A) **Market Concentration Index**

The industry market structure is determined once the market concentration ratio for the biggest four firms is computed. According to Curtis and Irvine (2015), a high degree of concentration suggests market power and possible economies of scale. Kohls and Uhl (1985) denoted that a concentration ratio of 50
percent or more is an indication of a strongly oligopolistic industry, 33-50 percent a weak oligopoly, and less than that of a competitive industry.

| Type of Livestock | CR<sub>4</sub> | Market Structure  |
|------------------|---------------|-------------------|
| Cattle           | 41.80%        | Weak Oligopoly    |

The computed CR<sub>4</sub> index for cattle is 41.80 percent indicating the existence of a weak oligopoly. Compatible with our finding, Zekarias and Teshale (2015) found an oligopoly market structure for cattle in Moyale.

B) Price and standard Setting Mechanisms

The price of beef cattle is set by bargaining once both agents (buyers and sellers) participating in the market accepted an offer of agreement. The Colour of an animal, its body size, age of the animal, sex, and height were important undertakings during price negotiation. Similarly, seasonal variation (festive seasons) gives producers little leverage on price. Otherwise, looking for alternative marketplaces or dates is considered a way of bypassing an offer for a low price. In line with our findings, Herbert et al (2008) found that expected carcass yield, carcass fat thickness and marbling, the color of fat (white was preferred to yellow fat), age of the animal (young was preferred to old), and sex (the castrated male was preferred to bull or female) were instrumental during price negotiation.

On the other flank, the quality of beef cattle is determined by eye appraisal. Good quality is characterized by the color of an animal (brown is preferred to black), its body size, age of the animal (young is preferred to old), sex (male is preferred to female animal), and its height (tall and medium animals are preferred to short) would be important indicators of good quality. In line with our findings, the findings by Hailemariam et al (2009a) revealed that, in all the livestock markets in Ethiopia, there is no objective standard for selling and buying animals except for the visual observation of animals in most of the markets. In their finding, they stated that in the absence of stringent and formal standards and requirements for quality characteristics, the market still considers and gives weight to some of the quality parameters than others (Ibid). Another research conducted by Herbert et al (2008) denoted that with no applicable standards for uniform grading of live animals or existence of weighing facilities, farmers (who most of the time are deficient in market information and negotiation skills) are disadvantaged price takers.

C) Entry Barriers

There were barriers to entry and exit in the beef cattle industry. Traders stated that capital requirement, knowledge of the local language, social relationship, and geographic cartel impeded entrance in primary
and terminal markets. Accordingly, more than 93 percent of the respondents stated that capital was the major challenge to penetrate the livestock market. In line with this finding, the finding by Meshack (2015) denoted that capital inadequacy is one challenge faced by traders.

In accessing channels, the traders in the study area stated that developing a friendly rapport with traders at terminal markets much-influenced entrance and sustainable supply of livestock. In other words, the sanctity of business in the study area rested on the social relationship producers built with traders, not on contractual agreements. In line with our findings, the findings by Legese et al (2014) denoted that the relationships between collectors versus small traders are based on trust and not contracts. Another finding by Herbert et al (2008) indicated that all livestock transactions examined were based on informal verbal contracts.

Geographic cartel forged in primary markets was another impediment for new entrants in the beef cattle industry. In this case of geographic sharing of the market, small traders usually take advantage of collectors' knowledge of the local language to prevent new entrants from encroaching into their self-claimed market territory.

D) Information Asymmetry

There was no formal source of information for producers in the study area. Neighbors, brokers, and traders were the dominant sources of informal information. Regarding transparency, there was an imperfect exchange of information between producers and traders in the area. The lack of formal and up-to-date information on price made cattle keepers rely on informal sources. In the absence of a perfect exchange of information, the market fails to function efficiently since the economic problem of ‘how much to produce’ and ‘how much to supply’ is determined by market information. Our finding accords with the finding of Hailemariam et al (2009b) who denoted that poor market information system development in pastoral areas tempted traders to keep it secretly to make use of the ignorance of their competitors. In the same vein, the finding by Phuong (2008) revealed that market price information from village middlemen was not reliable or usable since village middlemen were both the traders and providers of market information.

E) Major actors in the beef cattle market chain

In the livestock market chain, market actors classified into two categories as primary actors and secondary actors. Primary actors are agents who have direct influence from production to consumption in the livestock market. Secondary actors, however, are those agents (people or organizations) who indirectly influence livestock marketing in the study area.
### Table 3
Primary and Secondary actors in the beef cattle sector in the study area

| Primary actors                  | Secondary actors                  |
|--------------------------------|-----------------------------------|
| • Producers                    | • Tax collectors                  |
| • Collectors                   | • Brokers                         |
| • Small traders                | • Trekkers                        |
| • Big traders                  | • Truckers/ transporters           |
| • Processors (Hotels and Restaurants) | • Trade and industry office     |
| • Consumers                    | • Local police                     |
| • Cooperative feedlot operators| • Rope vendors                     |

### COMMERCIALIZATION OF BEEF CATTLE

The summary of gross and net commercial off-take rates estimates for cattle are given in Table 4. The gross commercial off-take rate is obtained by dividing the total sales of live animals over one year period by the annual average stock. On the other hand, net commercial off-take rate is obtained by dividing the net sales of animals (total sales minus total purchases) over one year period by the annual average stock.

### Table 4
Gross and net commercial off-take rates

| Description | Gross commercial off take rate | Net commercial off take rate |
|-------------|-------------------------------|-------------------------------|
| Ox          | 88.65%                        | 56.30%                        |
| Cow         | 45.91%                        | 0.80%                         |
| Heifer      | 32.93%                        | 5.47%                         |
| Bullock     | 35.37%                        | 4.82%                         |
| Calve       | 23.80%                        | -5.50%                        |
| Cattle      | 55.68%                        | 18.21%                        |

The gross and net commercial off-take rates for cattle was 55.68 percent and 18.21 percent, respectively. More than half of the net commercial off-take rate involved male animals (56.30% for ox and 4.82% for bullock). However, for female animals (cow and heifer) the net commercial off-take were rates below 8%. Similarly, the net commercial off-take rate for calves was negative. Over all, the net commercial off-take rate for cattle implies there is lower rate of cattle commercialization in the study area.
DETERMINANTS OF MARKET PARTICIPATION

Determinants of beef cattle Market Participation

Heckman’s two step model used to analyse the factors affecting livestock keepers’ market participation. The model chi-square test shows that the overall goodness of fit of the model is statistically significant at less than 1%. This shows the explanatory variables included in the model jointly explain the level of market participation.
### Table 5
Determinants of Market Participation

| Variables                        | Coef.    | P>|z| |
|----------------------------------|----------|---|
| **Intensity of participation (sales volume)** |          |   |
| Age                              | 0.0919213| 0.398 |
| Family size                      | 0.269639 | 0.141 |
| Education                        | -1.535589| 0.192 |
| Market distance                  | -4.709577| 0.001 |
| Non liv income                   | -0.0001623| 0.042 |
| Extension                        | 0.8744954| 0.555 |
| Information                      | 2.592441 | 0.026 |
| Lagged price                     | 0.0009933| 0.999 |
| Herd size                        | 0.1911515| 0.000 |
| Access to feed                   | -2.844533| 0.239 |
| _cons                            | 6.225521 | 0.134 |
| **Market Participation for beef cattle** |          |   |
| Age                              | -0.0579914| 0.011 | -0.0214825 |
| Family size                      | -0.0121693| 0.851 | -0.004508 |
| Education                        | 0.7173306| 0.040 | 0.246311 |
| Market distance                  | -0.0897359| 0.795 | -0.0331043 |
| Non liv income                   | -0.000015 | 0.618 | -5.56e-06 |
| Extension                        | 0.5250406| 0.088 | 0.1997237 |
| Information                      | -0.1191036| 0.705 | -0.044565 |
| Lagged price                     | -0.1034258| 0.731 | -0.037963 |
| Herd size                        | 0.040504 | 0.067 | 0.0150044 |
The level of beef cattle market participation is ascribable to six factors: age of the household, education, extension, herd size, distance to veterinary clinic, and access to feed. However, age, and distance to veterinary clinic negatively and significantly the decision to beef cattle market participation. On the other hand, the output decision in the Heckman selection model significantly affected by factors such as: distance to market, non-livestock income, access to market information and herd size. However, distance to market and non-livestock income negatively and significantly correlated with the intensity of market participation.

**Inverse Mills Ratio**

Inverse Mills Ratio (Lambda) or selectivity bias correction factor has affected the marketed surplus of beef cattle. There is sample selection bias implying the existence of some unobserved factors responsible for cattle keepers’ the level of market participation. The negative sign of lambda shows unobserved factors negatively affecting both the participation decision and intensity of participation, justifying the appropriateness of the Heckman two-step selection model for identifying the determinants of beef cattle market participation and intensity of participation.

Negative rho for beef cattle indicated that the indirect correlation of unobserved factors with one another. Sigma = 4.6774685 represents the adjusted standard error for the level of market participation equation and the correlation coefficient between the unobserved factors influencing decision into market participation and unobservable that determine participation level is given by rho = -0.99130.

**Discussion**

**Selection model**

The regression result indicated that the age of the household head is negatively associated with the households’ market participation. This implies young age is essential to commercialize beef cattle production since younger cattle keepers understand the marketing system better relative to their older counterparts. The marginal effect confirms that as age increases by one unit, holding other factors constant, the household's tendency to take part in the beef cattle market will decrease by 2.15 percent.
Our finding concurs with the finding of Barret (2007) who denoted that younger people actively took part in the market because they are more receptive to new ideas and are less risk-averse than their older counterparts. In the same vein, a finding by Kapimbi and Teweldemedhin (2012) denoted that as age increases, participation in marketing is reduced, which suggests that younger and middle-aged farmers tend to take part more actively in cattle marketing, understand the marketing system better, and have more energy to walk long distances. Contrary to our finding, a finding by Sebatta et al (2014) revealed that a farmer’s age had a positive and significant impact on the decision to participate in the market.

Education attainment is positively associated with market participation. This implies higher educational attainment appears to enhance market participation. Conversely, the low levels of education of cattle keepers could lead to several market inefficiencies, which eventually affect the incentive from market participation. The marginal effect confirms that as educational attainment increases by one level, holding other factors constant, the tendency of participation in the beef cattle market increases by 24.63%. Our finding accords with the finding of Dlamini and Huang (2019) who found that educated farmers sell more cattle than their less-educated counterparts since education improves competence in production and marketing processes. Similarly, Zelalem et al (2012) indicated that as the literacy level of the household head increases, the number of sheep sold increases. Another finding by Chipasha et al (2017) denoted that the low levels of education of smallholder farmers could lead to the number of inefficiencies along the market chain including their ability to select the type of market outlet, and how to use the existing market information.

A direct association exists between access to extension service and a household’s market participation decision. This implies acquiring professional consultation from the development agents appears to influence farmers to commercialize their products. Holding other factors constant, the marginal effect confirms that as the frequency of extension contact increases by one unit, the likelihood of participation in the beef cattle market increases by 19.97%. Our finding accords with the finding of Bahta and Bauer (2007) who noted that an extra visit by an extension officer increases the chance that the farmer sells his/her livestock. In a similar vein, Dlamini and Huang (2019) denoted that acquiring more extension and veterinary support improves farm productivity and marketable surplus.

There was a positive association between herd size and the smallholders’ beef cattle market participation. This implies the higher the number of livestock owned by households, the higher the tendency to take part in the beef cattle market. The marginal effect confirms that as herd size increases by one unit, holding other factors constant, the tendency of participation in the beef cattle market increases by 1.50 percent. Consistent with our findings, Barrett et al (2007) found households with larger herd sizes have a higher ability to generate surplus animals and are, therefore, more likely to sell. Likewise, Bellemare and Barrett (2006) denoted the positive influence of herd size on the intensity of livestock market participation.

Distance to veterinary clinic negatively affected households’ market participation for beef cattle at a less than 10% significance level. Holding other factors constant, the marginal effect confirms that one unit
increase in the distance to veterinary clinic, the tendency of taking part in the beef cattle market decreases by 37.91 percent. The negative association between distance to veterinary clinic and market participation implied the essentials of accessibility to veterinary service in keeping a healthy and stable flock size. In line with our findings, Zelalem et al (2012) denoted the accessibility of veterinary service is an important impetus to market participation as a result of large and more stable flock size. Similarly, Belachew and Jemberu (2003) denoted that efficient marketing requires improved infrastructure that allows efficient flow of livestock, processing, and marketing.

Access to feed positively affected smallholders’ beef cattle market participation. The positive correlation between access to feed and market participation implied the essentials of feed-in keeping large and stable flock size. Keeping other factors constant, the marginal effect result suggests that improved access to feed appears to increase the tendency of market participation by 45.34 percent. Compatible with our finding, Dlamini and Huang (2019) denote setting aside sufficient grazing land promotes the farmer's extent of market participation.

**Outcome model**

An important explanatory variable that was negatively associated with the intensity of market participation was the proximity to the market center. This variable affected the intensity of market participation at a less than 1% significance level. The result further revealed that an additional one km distance away from the market decreases the intensity of market participation by 12.76 units, keeping other factors constant. In line with our findings, Chipasha et al (2017) found market proximity as one of the constraints that affect the efficiency of the livestock market. Another concurrent finding by Gebremedhin et al (2015) denoted that the farther the household resides from the nearest livestock market, the less likely it is involved in selling due to both fixed and variable marketing costs. In contrast, Kibona & Yuejie (2021) indicated that the farther the market location the higher and more profitable the price for beef cattle in rural areas.

Access to market price information through informal sources was positively associated with the quantity sold. Keeping other factors constant, exposure to market price information is related to a 3.74 unit increase in the intensity of market participation (quantity sold). The implication is that market information increases the likelihood of beef cattle productivity, hence it leads to increased volume of sales. In line with this finding, Dlamini and Huang (2019) denoted that establishing intra and inter-communal communication networks enhances exposure to market information, implying an increase in the intensity of market participation.

There was a positive association between herd size and the intensity of market participation. This implies the higher the number of cattle owned by households, the higher is the intensity of market participation. The result confirms that a one-unit increase in herd size inflates the number of beef cattle sold by 0.245 units, holding other factors constant. Consistent with our findings, Kibonal and Yuejies (2021) indicated that as beef cattle herd size increased, the volume of beef cattle offered for sale also increased. In a
similar vein, Dlamini & Huang (2019) indicated that the larger the beef cattle herd size, the more likely it is to enter the market by selling more beef cattle.

Moreover, earning non-livestock income relates to a decline in the beef cattle sales rate. In the meantime, cattle keepers with alternative income sources from crop sales reported having lower sales rates. Our finding is compatible with the findings of Asfaw and Jabbar (2008) who found that off-farm income was negatively associated with the household's decision to participate in the livestock market as a seller.

**Conclusion**

The study revealed that there is very low net commercial off-take rate of cattle for smallholder farmers in Southwest Ethiopia. Furthermore, a large proportion of the beef cattle sold are aged that many of them are unlikely to meet the needs of wholesalers and meat export abattoirs. One of the reasons for the low net commercial off-take rate and limited market participation could be the high social value attached to cattle by pastoralists. Empirical estimate indicated that 51% of cattle keepers in this survey participated in the beef cattle market. However, market participation in the area are subjected to different factors such as age, herd size, proximity to market, frequency of extension, distance to veterinary clinic, and access to feed. Likewise, the market surplus of beef cattle is affected by proximity to market, non-livestock income, educational attainment, frequency of extension, and market information. The market structure, on the other hand, is characterized by imperfect competition implying that under the current production and marketing conditions, small-holder farmers and pastoral livestock production systems do not provide regular and adequate market supply of beef cattle at competitive price, which adversely affects the efficiency of the beef cattle market in the domestic and export markets. In a nutshell, it will be better to foster market oriented beef cattle production through improving the market and health infrastructure, providing capacity building for producers, and improving access to feed in the study area.

**Declarations**

Competing interests: The authors declare no competing interests

Consent: The participants consented to participate in the research study.

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Figures

Figure 1

Rural Live animals market in the study area
Figure 2

Conceptual Framework adopted from Kibona and Yuejie (2021)