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Getahun Kassa (✉ zgetah@gmail.com)

Hawassa University

Tegegn Fantahun

Institute of Biotechnology

Desalegn Anshiso

Ethiopian Policy Research Institute

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Determinants of Beef Cattle Commercialization in Southwest Ethiopia

Getahun Kassa¹, Tegegn Fantahun², Desalegn Anshiso³

¹Hawassa University, Wondo Genet College of Forestry and Natural Resources,
zgetah@gmail.com, Hawassa, Ethiopia.

²Ethiopian Biotechnology Institute, Addis Ababa, Ethiopia.

³Ethiopian Development Research Institute, Addis Ababa, Ethiopia.

Abstract

Background: Ethiopia ranked first in Africa in the number of livestock production. However, the sector's potential contribution to the national economy has been hampered by the lack of a market-oriented livestock production system. 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.

Results: 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.

Conclusions: The market structure 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. 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.

Keywords: beef cattle, Commercial off take, Heckman two-step selection model, market participation

INTRODUCTION

Background

As the global population expands from 7 billion in 2010 to 9.8 billion in 2050, and as wages rise in developing countries, overall food demand is expected to climb by more than 50%, with demand for animal-based meals rising by almost 70% (World Resources Institute, 2018). For the foreseeable future, increases in animal protein demand and consumption are likely to keep livestock as one of agriculture's fastest-growing sub-sectors, particularly in low- and emerging-income nations (Global Agenda for sustainable livestock, 2014). In rising and developing economies, smallholder mixed crop-livestock systems are and will continue to be the dominant producers of ruminant products through 2050. (Herrero et al., 2014). Growing evidence indicates that sustained increases in animal protein consumption open up a slew of new development opportunities for smallholder livestock producers, who have previously been largely excluded from economic growth processes (Lubungu et al., 2016). Livestock's diverse functions in developing and emerging countries have the potential to accomplish economic, social, and ecological goals while simultaneously decreasing human and environmental health concerns associated with livestock (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. Around 85 percent of Ethiopia's population lives in rural areas, while livestock provides a living for around 80 percent of the rural population (ILRI 2011). Almost every Ethiopian farmer has cattle, and it is a major source of employment in rural areas (Fantu et al., 2018). The cattle industry accounts for 16.5 percent of national GDP, 47 percent of agricultural GDP, 15% of export revenues, and 30% of agricultural employment (Lamesegn, 2018). On both a macro and micro level, however, the livestock subsector's contribution in Ethiopia is now below potential (Gebremedhin et al. 2007). The inefficient livestock and livestock product market, which is subject to high margins and poor marketing facilities, appears to be one of the reasons, among others. Producers have no incentive to improve the quality of their animal products through appropriate management practices under these conditions. Long 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 limit the benefits from their productive activities (Hailemariam et al. 2009a). A well-functioning (efficient) marketing system is required to satisfy consumer demand with the smallest possible margin between consumer and producer prices (Belay 2013).

If livestock is to be used as a tool to alleviate poverty, producers must become more market-oriented (Herrero et al., 2012). In Ethiopia, however, many smallholder farmers and pastoralists do not participate in the livestock market. Furthermore, the transaction size (sale or purchase of cattle or shoats) is seen to be quite small for those smallholder farmers and pastoralists who participate in the market (Asfaw and Jabbar, 2008). The sector's potential contribution to the national economy has been hampered by the lack of a market-oriented livestock production system (Tegegne et al. 2006). In a nutshell, creating efficient value chains (including market development, service supply, proper institutional support, and so on) should be prioritized in the development agenda to encourage smallholders to join the market economy (Herrero et al., 2012).

Livestock production is extremely important in Southwest Ethiopia's rural economy. For rural households, livestock raising is an important source of income and employment. In Southwest Ethiopia's highland and lowland agro-ecological zones, mixed livestock production (crop with livestock), agro-pastoral, and pastoral production systems are the most common. In Southwest Ethiopia, 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 a lack of value-added activities all limit the benefit earned from livestock production. Existing small-scale and pastoral livestock production systems in Ethiopia must be investigated to see whether and how they can produce a sustainable and appropriate live animal supply to meet domestic and export market demand (Asfaw and Jabbar, 2008). While there is a lot of study on livestock marketing restrictions (Gebrekiros et al., 2021; Solomon, 2020; Gedefaw, 2020; Negassa et al., 2011; Ayele et al., 2003), there isn't much on beef cattle commercialization performance in the Bench-Sheko and Kaffa zones of southwest Ethiopia. By identifying the key impediments to market participation and intensity, as well as proposing the steps needed to promote a market-oriented livestock production system, this study will illustrate how to meet the rapidly rising demand for livestock products.

METHODOLOGY

Study Area

The research was carried out in the Zone Administrations of Bench-Sheko and Kaffa in South-Western Ethiopia. Tropical montane wet forests cover a significant portion of the region. Agricultural operations are the primary source of income for the locals. The main staple foods in the region are enset and maize, which are mostly used for subsistence. The main source of income is coffee. Similarly, livestock is the most valuable asset for households since it serves as insurance against drought and as a source of emergency food. Furthermore, for pastoralists, livestock, particularly cattle, serve as a source of social prestige.

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

The method used was a multistage sampling process. In the first stage, study sites were carefully chosen based on their ability to produce cattle. Bench-Sheko and Kaffa zone administrations were purposefully chosen in the second round based on cattle production potential and proximity to the market hub. In the third stage, the zone agricultural offices selected 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). In the fourth stage, three kebeles from each district were purposively selected based on livestock production potential and accessibility to the market center. Respondents were chosen at random in the final step using the formula $N \geq 50 + 8m$, where N is the minimum number of households necessary and m is the number of explanatory variables included in the study.



Fig 1: Rural Live animals market in the study area

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 defined as total sales as a proportion of a household's average stock is computed as (Asfaw and Jabbar, 2008):

$$\text{Gross commercial off – take rate} = \left(\frac{\text{sales}}{0.5(\text{opening stock} + \text{ending stock})} \right) * 100$$

Animal sales are included in the gross commercial off-take, but other exchanges such as on-farm transfers, on-farm exchanges, and on-farm slaughters must be netted out for off-take computations when the interest is in the quantity of cattle that actually leave the livestock owners and enter the market for slaughter (Asfaw and Jabbar, 2008). 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:

$$\text{Net commercial off – take rate} = \left(\frac{\text{sales} - \text{purchases}}{0.5(\text{opening stock} + \text{ending stock})} \right) * 100$$

For net purchasers, the net commercial off-take could be negative, zero for those whose sales and purchases are equal, or zero for those who are not in the market, and positive for net sellers (Asfaw and Jabbar, 2008).

The Heckman two-step model was utilized to identify the factors influencing household market participation decisions. Because participation in the beef cattle market is a discrete choice, people who engage may not sell all of their cattle, implying that the decision to sell and the decision to sell how much are two independent options. Heckman's (1979) two-step estimating approach is appropriate when both participation and the number of live animal sales are involved.

The first stage of the Heckman model attempts to identify factors affecting market participation decision (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). If there is selection bias, the coefficient on the inverse Mill's ratio will reveal that. If the coefficient of the "selectivity" factor is significant, the hypothesis that the participation equation is governed by an unobserved selection process is confirmed. In the second stage, the Mills ratio to the quantity of marketable surplus equation is determined using Ordinary Least Squares (OLS).

Two systems of equations make up the sample selection model's structure. The selection equation is stated in terms of the likelihood of beef cattle producers participating in the market ($Y1_i$), which is a discrete choice as indicated:

$$di^* = zi\gamma + ui \text{-----eqn 1}$$

$$di = \begin{cases} 1, & di^* > 0 \\ 0, & otherwise \end{cases} \text{----- eqn 2}$$

where d_i^* is a latent variable, γ is a $K \times 1$ vector of parameters, z_i is a $1 \times K$ row vector of observations on K exogenous variables and u_i is a random disturbance. Together, (eqn 1) and (eqn 2) define what is called a latent variable model.

The linear model of interest is the second equation. The ordinary least squares regression strategy would be to use the equation to estimate the program's effect.

$$Y_i = X_i\beta_i + \epsilon \quad i = 1, 2, \dots, n \quad \text{eq 3}$$

Where Y_i an observable is random variable, β_i is an $M \times 1$ vector of parameters, X_i is a $1 \times M$ vector of exogenous variables, and ϵ_i is a random disturbance. As a result, Y_i is the probability of market involvement in the live animals market; it is a dummy variable with a value of 1 for market participants and 0 for non-market players.

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

$$E[Y_i | d_i > 0, X_i] = X_i\beta + \rho\sigma\epsilon \left[\frac{\phi(Z_i\gamma)}{\Phi(Z_i\gamma)} \right] \text{----- eqn 4}$$

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. ρ is the correlation between unobserved determinant and unobserved determinants, $\sigma\epsilon$ is the standard deviation of ϵ_i .

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.

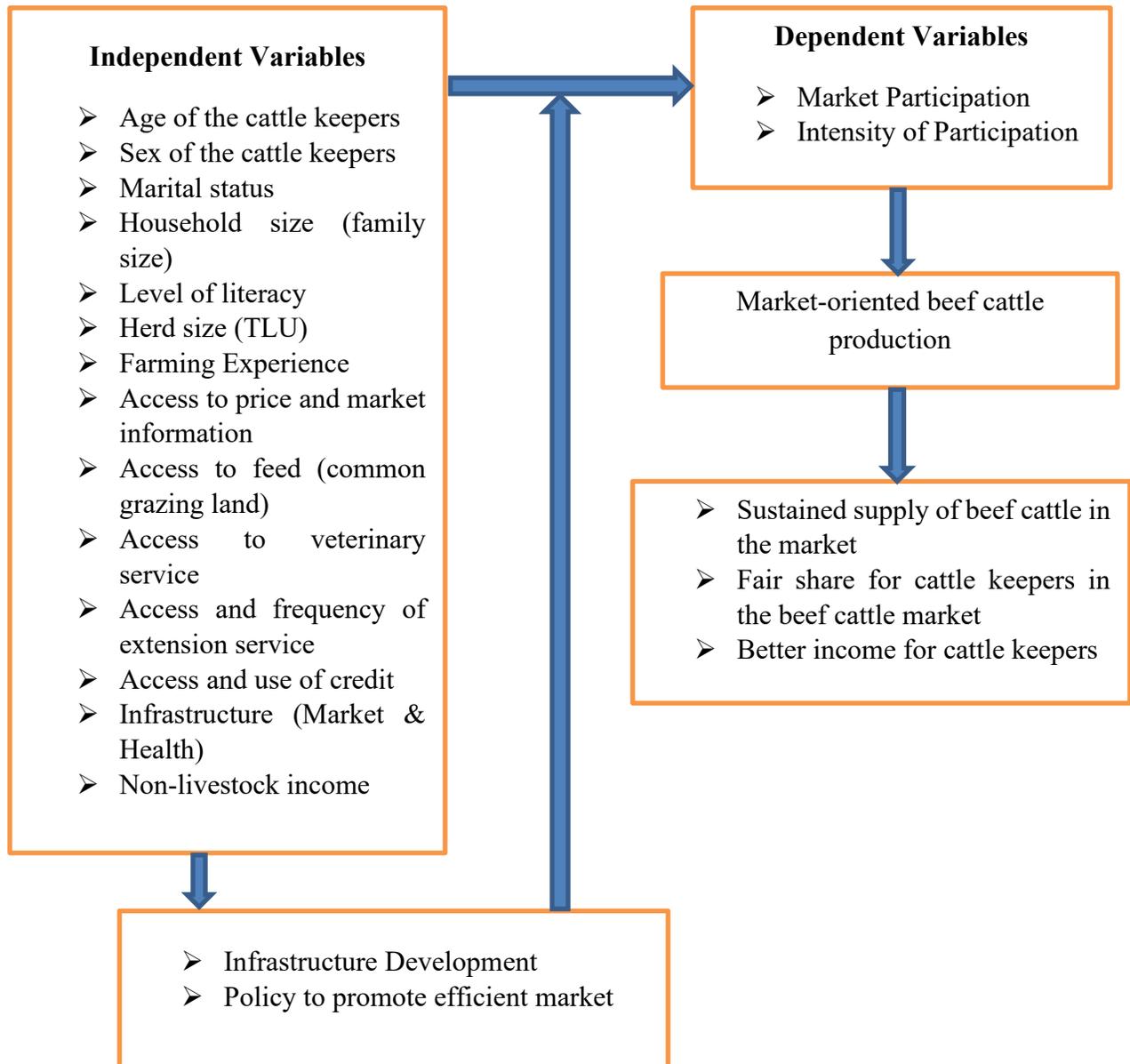


Fig 2: Conceptual Framework adopted from Kibona and Yuejie (2021)

RESULT AND DISCUSSION

Socioeconomic Characteristics of the Respondent

Male-headed households made up 95.35 percent of the total respondents, while female-headed households made up 4.65 percent. In terms of marital status, 90.12 percent of the respondents were married, while 9.88 percent were single. Educational attainment was used as a dummy variable in the analysis, with two levels: unable to read and write and capable to read and write. A greater number of responders were able to read and write (68.60 percent).

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. Improved access to agricultural extension services and feed appears to have a significant impact on market participation. Only 16.20 percent of the total respondents, on the other hand, had access to credit. In terms of age, the respondents were on average 37.83 years old. Similarly, respondents in the area had an average family size of 6.72 units and an average animal rearing history of 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.

Table 2: Concentration Ratio

Type of Livestock	CR ₄	Market Structure
Cattle	41.80%	Weak Oligopoly

Source: own survey

The computed CR₄ 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. Meshack (2015) found that capital deficiency is one of the challenges faced by traders, which is consistent with this finding.

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

Market participants are divided into two types in the cattle market chain: primary actors and secondary actors. Primary actors in the livestock market are those who have direct control over the process from production to consumption. Secondary actors, on the other hand, are those individuals or organizations who have an indirect impact on livestock markets in the research area.

Table 3: Primary and Secondary actors in the beef cattle sector in the study area

Primary actors	Secondary actors
<ul style="list-style-type: none">• Producers• Collectors• Small traders• Big traders• Processors (Hotels and Restaurants)• Consumers• Cooperative feedlot operators	<ul style="list-style-type: none">• Tax collectors• Brokers• Trekkers• Truckers/ transporters• Trade and industry office• Local police• Rope vendors

COMMERCIALIZATION OF BEEF CATTLE

Table 4 summarizes the estimated gross and net commercial off-take rates for cattle. The gross commercial off-take rate is calculated by multiplying total live animal sales over a year by the annual average stock. The net commercial off-take rate, on the other hand, is calculated by dividing the net animal sales (total sales minus total acquisitions) over a 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%

In the case of cattle, the gross and net commercial off-take rates were 55.68 percent and 18.21 percent, respectively. Male animals accounted for more than half of the net commercial off-take rate (56.30 percent for ox and 4.82 percent for bullock). Female animals (cow and heifer), on the other hand, had net commercial off-take rates of less than 8%. Similarly, calves had a negative net commercial off-take rate. Overall, the net commercial off-take rate for cattle indicates that the research area has a lower rate of beef cattle commercialization.

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

Heckman selection model -- two-step estimates (regression model with sample selection)		Number of obs = 172 Selected = 88 Non-selected = 84 Wald chi2(10) = 91.12 Prob > chi2 = 0.0000	
Variables	Coef.	P> z	
Intensity of participation (sales volume)			
Age	.0919213	0.398	
Family size	.269639	0.141	
Education	-1.535589	0.192	
Market distance	-4.709577	0.001	
Non liv income	-.0001623	0.042	
Extension	.8744954	0.555	
Information	2.592441	0.026	
Lagged price	.0009933	0.999	
Herd size	.1911515	0.000	
Access to feed	-2.844533	0.239	
cons	6.225521	0.134	
Market Participation for beef cattle			Marginal Effect
Age	-.0579914	0.011	-.0214825
Family size	-.0121693	0.851	-.004508
Education	.7173306	0.040	.246311
Market distance	-.0897359	0.795	-.0331043
Non liv income	-.000015	0.618	-5.56e-06
Extension	.5250406	0.088	.1997237
Information	-.1191036	0.705	-.044565
Lagged price	-.1034258	0.731	-.037963
Herd size	.040504	0.067	.0150044
Distance to vet clinic	-1.213297	0.021	-.3791353
Access to feed	1.273887	0.000	.4533549
cons	1.864564	0.091	
Mills lambda	-4.63678	0.063	
	Rho -0.99130		
	Sigma 4.6774685		

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: The marketed surplus of beef cattle has been modified by the Inverse Mills Ratio (λ) or selectivity bias correcting factor. There is sample selection bias, meaning that there are some unobserved factors influencing cattle keepers' market participation levels. The negative sign of λ indicates that unobserved factors have a negative impact on both the decision to participate and the intensity of participation, demonstrating the suitability of the Heckman two-step selection model for determining the determinants of beef cattle market participation and intensity.

The indirect association of unobserved factors with one another was demonstrated by a negative ρ for beef cattle. The adjusted standard error for the level of market participation equation is $\sigma = 4.6774685$, and the correlation coefficient between unobserved factors influencing market participation and unobservable that determine participation level is $\rho = -0.99130$.

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 reveals that when herd size grows by one unit, the likelihood to participate in the beef cattle market increases by 1.50 percent,

while all other parameters remain constant. Barrett et al (2007) discovered that households with bigger herd sizes have a greater ability to generate surplus animals and are thus more willing to sell. Similarly, Bellemare and Barrett (2006) found that herd size has a favourable impact on the intensity of cattle market involvement.

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. Gebremedhin et al (2015) also discovered that the further a household is from the nearest livestock market, the less probable it is to engage in selling due to both fixed and variable marketing costs. Contrariwise,

contrast, Kibona & Yuejie (2021) found that the higher and more profitable the price for beef cattle in rural areas, the farther the market location..

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, Kibona 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.

Furthermore, obtaining non-livestock income is linked to a decrease in the rate of beef cattle sales. Livestock ranchers who supplement their income with crop sales reported decreasing sales rates. Our findings are consistent with those of Asfaw and Jabbar (2008), who discovered that off-farm income was negatively associated with a household's decision to sell animals at a market.

CONCLUSION

Smallholder farmers in Southwest Ethiopia had a very low net commercial off-take rate of cattle, according to the study. Furthermore, a big percentage of beef cattle sold are old, and many of them are unlikely to meet the criteria of wholesalers and abattoirs that export meat. The great social value attributed to livestock by pastoralists could be one of the reasons for the low net commercial off-take rate and limited market participation. According to the results of this poll, 51 percent of cattle keepers engaged in the beef cattle market. Age, herd size, accessibility to market, frequency of extension, distance to veterinary clinic, and access to feed are all factors that influence market

participation in the area. 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

Ethics approval and consent to participate

The participants of the survey were informed of the study and consented to participate by completing the questionnaire.

Consent for Publication

Not applicable

Availability of data and materials

The datasets are available from the corresponding author on reasonable request.

Authors' Contributions

GK designed the study, wrote the protocol and wrote the first draft of the manuscript. TF and DA managed the literature searches and participated in data analysis.

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Competing Interests

The authors declare that they have no competing interests.

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