Multiple Linear Regression Analysis of Marketable Supply of Beef Cattle in Kaffa Zone Southern Ethiopia

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Abstract
The share of meat and other slaughter by-products exported from the overall export commodities is not more than 2% and meat consumption is below the average of Sub-Sahara African countries. So, marketable supply of beef cattle have important role in making better income for smallholder farmers. As a result the study was aimed to investigate the impediment that affects beef cattle marketable supply in Gimbo district. Two- stage sampling technique was employed to pick up 196 target sample respondents from the sample frame in the study area. Multiple linear regression models were used for analysis. As the model result indicates: marketable supply of beef cattle were affected positively by: number of livestock fattened, sex of household head, perception of current price, access to credit , area of land allocated for grazing ,access to market information and educational status. So, improvement of fattening management systems should be taken in to consideration to increase marketable supply of beef cattle in the study area as well as at country level.
Keywords: marketable supply, beef cattle, multiple linear regression models, Gimbo, Ethiopia
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1 Background

International markets, fast-growing, middle and high income classes in many developing countries offer opportunities for developing country producers in national and international markets (Ponguru *et al.*, 2015). Trades of live animals are a major component of the agricultural sector in Sub-Saharan Africa (Motta *et al.*, 2019). Meat and other slaughter by-products being exportable to the foreign export earnings and GDP growth of Ethiopia. Even though, the share of meat and other slaughter by-products exported from the overall export commodities is not more than 2% and meat consumption is below the average of Sub-Sahara African countries (Tekeba *et al.*, 2018).

Ethiopia has the largest livestock population and the highest draft animal population in the continent i.e approximately 35 million cattle, 48 million sheep and 8.6 million equine goats, in the country (Ponguru *et al.*, 2015, Amistu *et al*., 2016, CSA, 2013). Despite the largest number of beef cattle population in the country, it lacks strategic and market-oriented production system which failed to assist in transforming subsistence farming system into a commercial production system (Solomon *et al*., 2019 and Sitti Nurani Sirajuddin *et al.,* 2015).

The cattle markets in most parts of Ethiopia are characterized by seasonality in flow and prices. For instance in pastoral lowland areas major factors contribute to seasonal flow include festivals, weather, pasture, seasonality of consumption demand (Zekarias *et al*., 2018).

As a result subsistence oriented and very low productivity of cattle becomes challenge in Ethiopia (*Eyob and Zewudu, 2016*). This lead to loss of: foreign exchange, income taxes and legal livestock trade. So, changing this bottle neck may lead to more rapid herd and animal growth, profitability of farmers and pastoral society's living standard scale up. Moreover animals are not managed for meat production as the required level due to bulky and costly nature of cattle to transport (Gezehagn *et al*., 2019 and Wenying Li *et al*., 2019).

The supply statuses of beef cattle are depending on the season of the year: i.e during holiday and time for paying cost of inputs like fertilizers and pesticides (Tamrat, 2019) .Due to this price of beef cattle dramatically increasing which is opposite demand of consumers. The high price of beef was influenced by many factors: one of the factors was low performance of beef cattle supply chain management **(**Sitti Nurani Sirajuddin *et al.,* 2015).

Many empirical studies were done (Such as: Amistu *et al*., 2016; Dinku *et al*., 2019; Gemechu *et al*.,2020; Gezahegn *et al*., 2019; Solomon *et al*., 2019; Ponguru *et al*., 2015;Sicelo *et al*., 2019; Tamrat ,2019 and Sitti Nurani Sirajuddin *et al*., 2015) in different areas with different discipline. Even if those studies were done, additional empirical studies would be needed to increase beef cattle marketable supply in the country, specifically in the study area. So, this study was aimed to identify factors affecting marketable supply of beef cattle to provide useful insights towards the designing and implementation of strategies to alleviate the shortage of beef cattle supply to the market which in turn meet the demand of domestic consumption and export market.

2 Research methodology
2.1 Description of the study area
This study was conducted in Gimbo district which is one of the district in southern nations, nationalities and

peoples regional state of Ethiopia, part of Keffa zone. The district is located at 440 kilometer from Addis Ababa and 9km from Bonga. The district bordered in south by Decha district, in west by Chena, in north by Gojeb River and in east by Menjiwo. The elevation of this district ranges from 3300 to 4300 meter above the Sea level. The total population of the district is 89892 of whom 44774 are men and 45118 women (CSA, 2014) Ethiopian population census. 81.32% the population were orthodox Christians, 13.67% were catholic and 2.13% were Muslims. In other ways 85% of the populations are rural dwellers' and 15%' are urban dwellers' (GDO, 2019).

2.2. Sampling techniques and sample Size

Two- stage sampling technique was employed for this study. In the first stage thirty five smallest administrative units were purposely selected based on livestock production potential among thirty nine smallest administrative units (kebeles) in Gimbo district. In second stage five kebeles were selected by simple random sample methods from 35 rural kebeles. Finally 196 sample sizes were determined by using Cochran's (1963) formula. i.e $n = z^2 \frac{pq}{e^2}$, Where, n=sample size, p = population proportion, e= level of precision, z= level of confidence, $i.e\ n = 1.96^2 \frac{0.5*0.5}{(0.07)^2} = 196$.

2.3 Data collection and analysis

Primary and secondary data were used. Descriptive statistics and multiple linear regression models were employed for analysis and STATA 14 was used as a tool of analysis.

2.4. Multiple linear regression model specification

Regression of independent variables on one dependent variable is called multiple regression model (Kaya & Guler, 2013). Rather than modeling as a simple regression, better to model dependent variable as a function of several explanatory variables (Gemechu et al., 2020).

Multiple linear regression model (MLRM) is selected for its simplicity and practical applicability (Greene, 2003 and Dessie et al., 2019). Moreover this model is used to test both economic theories and non-experimental data because it can accommodate many cause variables which may be correlated (Maddala and Lahiri, 1992). Unlike simple regression analysis, multiple linear regression analysis is more responsive to ceteris paribus analysis because it allows us to explicitly control many other factors which simultaneously affect effect variable .So, multiple linear regression models were used to analyze factors affecting beef cattle marketable supply in Gimbo district for this study.

The functional relationship of MLRM: $y = f(x1, x2, x3, ..., xn, Em)$ ……………………… (1)

Where y =beef cattle marketable supply, xn = cause variables and εm = error terms.

MLRM: $y = \alpha + \beta 1x1 + \beta 2x2 + \beta 3x3 + \cdots + \beta nxn + εm$…………………….......... (2)

Where y = effect variable, Xn = cause variables, α = constant, βn = parameters associated with cause variable and εk = error terms.

Table1 Description and working hypothesis of variables in MLRM

		Descriptions	Nature of variables	Unit of measurement	Sign
	DV	Dependent variable	Continous		
	IV	Independent variables			
	AGE	Age of household head	Continous	Year	+
	SEX	Sex of household head	Dummy	1= male,0=female	+
	EHH	Education of the house head	Continous	Grade	+
	FS	Family size	Continuous	Adult equivalent	+/-
	LAFG	Land allocated for grassing	Continous	In hectare	+
	TNLU	Total livestock in the family	Continous	TLU	-
	MS	Marital status of house hold head	Dummy	1 for married , 0 otherwise	+
	PCP	Perception of current price	Perception	Index	Favorable
	NLF	Number of livestock fattened	Continous	TLU	+
	FEC	Frequency of extension contact	Continuous	In number	+
	DTM	Distance to the market center	Continous	Walking in minute	-
	ATC	Access of credit	Dummy	1 for access of credit, 0 otherwise	+
	AMI	Access of market information	Dummy	1 for access of information, 0 otherwise	+

2.5. Diagnosis tests

Before multiple linear regression models were analyzed: multicollinearity tests were conducted to identify the variables that are highly correlated. As (Gujarati, 2004) variance inflation factor (VIF) is used to check multicollinearity among continuous variables before including variables in the model. As a rule of thumb, if the value of VIF is greater than 10, the variables are said to be highly collinear. Likewise, the multicollinearity between discrete variables can be calculated using contingency coefficient (CC). The value ranges between 0 and 1, 0 indicating no association between the variables and value close to 1 indicating a high degree of association between variables. As a rule of thumb, if the value of CC is greater than 0.75, the variables are said to be collinear.

3 Results and discussions
3.1. Descriptive statistics results for continues variables

The mean age of household head is about 46 years with standard deviation 11.2 meaning majority of them were productive age Table 2. The average family sizes for livestock producers were 5 persons per household almost similar to the national average which is 5.1 per household (CSA, 2013). So, family size is a peculiar trait in rural societies of many developing countries such as Ethiopia (Shumetie and Mamo, 2019). The average educational status of respondents was 4.58 with standard deviation of 4.29. Thus educations contribute to improve beef cattle marketable supply. The average grazing land of sampled farmers is found to be 4.3 hectare which is greater than the national average i.e 1.37 hectare but it varies from place to place as (CSA, 2013). The average of livestock holding per household was 6.61 with standard deviation of 3.96 in the study area.

Table 2 Descriptive results for continues variables

Cause variables	Minimum	Maximum	Mean	Standard deviation
Age of Household head	26	71	46.1	11.02
family size	2	9	5	1.001
Educational status	0	12	4.58	4.29
Farm size for grassing	0.75	11	4.31	1.74
Total area of land	0.5	3	1.29	.538
Number of beef cattle fattened	3.25	17.00	7.84	3.34
Total livestock holding	1.3	23.36	6.61	3.96

 (Own survey, 2019)

Among 196 target respondents: 139 were male and the remaining 57 were female headed household Table 3. The marital statuses of sample respondents were 84.6% married, 15.4% single. From 196 sample respondents' 81.5% access to credit and 18.5% not access to credit service. Moreover 90.8% of the respondents' access market information while 9.2% not access market information.

Table 3 Descriptive result for dummy variables

Dummy variables	Total sample		chi 2-value	Sign –value
	N	%		
Sex Female	57	29.02	1.66	0.197
Male	139	70.8		
Marital status				
Single	30	15.4	2.47	0.116
Married	166	84.6		
Access of credit				0.007***
No	36	18.5		
Yes	160	81.5	7.23	
Access to market information				
No	18	9.2	1.924	0.165
Yes	178	90.8		

Note: *** indicate at 1% level of significance
(Own survey, 2019)

3.3. Econometric model result

Before model analysis, diagnosis tests were carried out i.e the mean value of VIF is 1.32 which is less than 10 and Contingency Coefficient (CC) value less than 0.75 indicate there is no serious correlation among the suggested explanatory variables. As a result, thirteen cause variables were included for estimation to identify factors affecting beef cattle Marketable supply of target respondents in the study area.

Table 4 multiple linear regression model result

Variables	Coef.	Std. Err.	P>|t|
AGE	.0095	.0124	0.443
SEX	.8473**	.3236	0.010
EHH	.1924*	.1115	0.087
FS	-.2183	.1525	0.154
LAFG	.7488**	.2869	0.010
TNLU	.0311	.0347	0.371
MS	.3363***	.0427	0.000
PCP	.6692***	.2519	0.009
NLF	.8053***	.1204	0.000
FEC	-.0684	.1244	0.583
DTM	.0109	.0917	0.905
ATC	1.022***	.2767	0.000
AMI	.6985**	.2907	0.017
cons	.0580	1.153	0.960
F statistics	0.0000		
R^2	80.27%,		
Adj R^2	78.57 %,		

Note: ***, ** & * indicate 1%, 5% and 10% level of significance respectively
(Own survey, 2019)

Sex of the household head (SHH)**:** this variable affected beef cattle marketable supply positively at 5% level of significance. This implies that as compared with female household head, male household head can increase marketable supply of beef cattle by 0.8473 positively due to the fact that males have relatively better labor advantage to produce and supply as compared female household head. This result in line with (Gezehagn *et al*., 2019) determinants of market participation and supply of beef cattle value chain as well as (Sicelo *et al*., 2019) double hurdle estimation of sales decisions by smallholder beef cattle farmers in Eswatini positively.

Education of the household head (EHH): this variable affects marketable supply of beef cattle positively at 10% significance level. This implies that an increase in year of schooling by one year, beef cattle supply increased by 0.1924. This is in line with (Gemechu *et al*., 2020, Dinku *et al.*, 2019) factor affecting beef cattle value chain analysis and (H. D. Utami *et al,* 2018) determinants affecting small holder beef cattle farmers' income.

Number of livestock fattened (NLF): this variable affect marketable supply positively at 1% significance level. If the number of livestock fattened increase by one number leads an increase beef cattle marketable supply by 0.3363. This finding is in line with (Dinku *et al*., 2019) marketable surplus of paddy is positively related to the volume of production.

Land allocated for grazing (LAFG): the estimated coefficient of this variable was found to be affect marketable supply positively at 5% significance level. If land allocated for grazing increase by one   hectare, number of beef cattle supplied to the market increase by 0.7488. This indicates farmers, who have more farm size most likely to supply beef cattle. This result go with (Dinku *et al*., 2019) farmers who have more farm size, are most likely to produce sesame, in turn increase marketable supply.

Perception of current price (PCP): this variable affects marketable supply of beef cattle positively at 1% significance level. This implies that, if the price of beef cattle increases by one unit, beef cattle marketable supply increased by 0.6692. This is in line with the results of previous studies by (Dinku *et al*., 2019) price of paddy received by farmers affects marketable surplus of crops positively.

Access to market information system (AMI): the result of estimated coefficient of this variable affects marketable supply of beef cattle positively at 5% level of significance. This means as the farmer access to market information increase by one unit, marketable supply of beef cattle increased by 0.6985. This result goes with (Gemechu et.al, 2020) factor affecting beef cattle value chain analysis.

Access to credit (ATC): beef cattle marketable supply affected positively at 1% significance level. Being access to credit, increase marketable supply by 1.022. This study in line with (Gemechu *et al*., 2020) factor affecting beef cattle value chain analysis.

4 Conclusion and recommendations

As multiple linear regression model result indicate: marketable supply of beef cattle was affected positively by: number of livestock fattened, sex of household head, perception of current price, access to credit, and area of land allocated for grazing, access to market information and educational status. As a result, those factors have to be promoted by concerned body through facilitation of agricultural inputs including credit service, education, and extension service to increase beef cattle marketable supply in the study area. The result recommended that:

development of fattening management systems should be taken in to consideration by development agents, governmental and non-governmental organizations', to create awareness for beef cattle production and marketable supply of beef cattle sectors.

Abbreviations: *CSA: Central Statics Agency, GDO: Gimbo District Office, MLRM: Multiple Linear Regression Model*

Availability of data
The raw data which confirm the output of this study can be found from the author based on permissible request.

Competing interests
There are no competing interests.

Authors' contributions
Plan, analysis and revision of this paper were done by this author.

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