

Research Article

The Determinants of Beef Cattle Market Participation on Beef Cattle Producers' Welfare: A Case Study of West Shewa Zone, Oromia Region, Ethiopia

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Due to their ability to produce meat, milk, leather, glue, gelatin, and other products that people may utilize, beef cattle are domesticated. Beef cattle production and marketing play a vital role in the growth and development of the globe and the African economy. Ethiopia has great potential for livestock population in Africa and in the world but earns less from beef cattle production and marketing. Ethiopian farmers are reluctant to beef cattle market participation. Their reluctant to participate in beef cattle marketing causes lack of beef cattle products in the market and causes high prices for beef cattle and its products. The research objective was to analyze the impact of beef cattle market participation on the welfare of beef cattle smallholder farmers in Ethiopia. The primary data come from 400 randomly selected beef cattle farmers involved in beef cattle production and marketing and actors. Descriptive statistics and inferential statistics propensity score matching (PSM) model have used to analyze the collected data. The data analysis result indicated that smallholder beef cattle farmers participating in beef cattle marketing and farmers' annual per capita consumption expenditure (economic welfare) increased by 84% more than the nonbeef cattle market participants. We assume this is a first result and investigation in the study area. The research study is important for farmers, policymakers, researchers, and the academia in general. Providing education and training, promoting the participation of more women in beef cattle marketing, and promoting and encouraging more full-time beef cattle farmers are suggested recommendations.

1. Introduction

Agriculture plays a major role during socioeconomic growth and development around the world. Moreover, agriculture is the mainstay of the African and Ethiopian economies. In Ethiopia, agriculture employs about 70% of the entire population and generates about 50% of the country's gross domestic product (GDP) and 12%–15% of foreign exchange earnings [1]. However, this sector is generally performed by smallholder subsistence farmers.

The mean landholdings of smallholder producers in Ethiopia are less than 1 ha; they are estimated to be 0.8 ha [2]. Less than 1ha of land is farmed by around 72% of farm families [3]. Furthermore, with a per capita gross national income of USD

890, Ethiopia's highlands are among the most populated and impoverished regions in the world [3]. Poverty, lack of food, and poor nutrition are persistent issues, particularly among the agricultural population, which are mostly dependent on low-yield semisubsistence farming. Several factors contribute to this tendency, including rising population, diminishing agricultural output, and producers' insufficient market engagement [4].

As the demand for animal products rises along with economic growth, nations with the highest living standards at the moment are those that have well-developed livestock and animal husbandry [5]. Despite the country's high potential population of livestock in general and of beef cattle in particular, there is still a persistent lack of these goods in the markets in Ethiopia [6]. According to Yigezu [6], this is mostly caused by

insufficient production, which includes restrictive cultural taboos surrounding feeding and the absence of appropriate processing and marketing activities. In this regard, raising market participation and marketing efforts for beef cattle will raise local revenue, increase the sector's contribution to the GDP, and raise both rural and urban residents' standards of living.

The biophysical and agroclimatic diversity in Ethiopia is immense. Ethiopia's wide biophysical diversity and favorable agroclimate make it a prime location for the raising of many breeds of cattle and other animals. Ethiopia's agricultural sector is fundamental to the production of livestock, which includes the raising of livestock in general and the raising and selling of beef cattle in particular. Livestock production is also a key component of Ethiopia's national economy. Ethiopia is home to the continent's biggest population of livestock, so it will need to work harder to take advantage of expanding markets for beef, cattle, and animal products on a worldwide scale.

The solution to emerging nations' underdevelopment is participation in marketing. As developing countries meet people's needs and raise their standard of living, adopting and putting into practice marketing will assist in developing the necessary technologies, open up employment possibilities and riches for entrepreneurs, and give people a way to finance education and leisure activities [7].

Ethiopia has the most beef, cattle, and animals, so it stands to benefit the most from the expanding worldwide markets for beef, cattle, and livestock goods. The country is home to the greatest stock of beef, cattle, and other livestock in Africa, but these animals were not managed to optimize the revenue of smallholder livestock producers. In the highland and lowland regions of the nation, large herds of livestock and beef cattle are kept for many years in order to provide milk and draught animal power for the household. The domestic and export sales of beef, cattle, animals, and their products have the potential to grow in Ethiopia in terms of both volume and value [7]. According to a study by Dinku et al. [8], this might be preserved by extending the commercialization of the production and sale of beef, cattle, and other animals and by boosting the involvement of the beef cattle market.

Producers and consumers are geographically divided; the majority of farmers are located in rural regions, whereas customers of the lucrative market have a location in metropolitan areas. In rural and urban settings, most beef cattle products distribution has been undertaken informally from producers to consumers. The country lacks a well-developed market infrastructure, including marketing facilities, rural roads, market information, beef, cattle grading systems, etc. Subsistence farming methods rather than modern production systems focused on the market are the consequence, which can also decrease incentives to participate in beef cattle commercial transactions. According to Beyene [9], one of the vital development difficulties is enhancing smallholders' ability to participate effectively in the livestock market, namely, the market for beef cattle.

In other words, the smallholder beef cattle producers are not engaged in beef cattle marketing as demanded by the beef cattle farmers in the West Shewa Zone generally and the three districts in particular. As a result, there is a persistent shortage of products and high costs in metropolitan areas. On the other hand, rural regions have an oversupply of beef, cattle, and its products at the lowest prices.

This situation decreases the income of both urban people and rural people. Moreover, the urban people are paying higher prices for beef cattle purchasing, hence short of supply; the rural people are getting low prices at farm gate markets, and this is a lower income for the rural community.

There is a beef cow shortage in the urban town, but there are too many beef cattle in the rural community. The urban people are facing higher prices for beef cattle, while the rural communities are with excess beef cattle population not supplied to urban markets. There is a mismatch of supply and demand for beef cattle in the region under study. Regardless of these gaps, there was no such study research undertaken in the research study area. The level of beef cattle sale activities, the financial situation, and income of local residents were not investigated.

Mebrate et al. [10] have demonstrated that the beef cow business has a great potential to raise peoples' standard of life through increased money from the sale of beef, cattle, and beef cattle products, as well as better nutrition brought on by the increased use of meat and dairy consumption.

Ethiopia ranks first in Africa in terms of cattle population [11], contrarily the livelihood of livestock producers in general, and smallholder beef cattle farmers, in particular, do not demonstrate the potential of this subsector.

In addition, beef cattle farmers face a variety of difficulties, including unofficial trade, limited access to production, and market-related information such as production systems, prices, rivals, and consumer preferences, as well as a lack of capital investment in resources, equipment, and input that would enhance quality. However, there are prospects [12], including the local abattoirs' strong desire for animals, rising official exports, and rising domestic meat consumption. There are no research studies done on the opportunities or problems that the study area's beef cattle farmers are experiencing.

The coordination of beef cattle marketing operations and the provision of market support services must be improved in Ethiopia in order to increase the competitiveness of beef animals, meat marketing, and export. Cost-effective marketing channels and coordinated supply chains that minimize nonvalue-adding transaction costs among multiple supply chain players are essential, if the need is to maximize sector efficiency, assure food security, and boost marketing and export performance.

It has to be clear that no research has done on the marketing of beef cattle, the channels used for marketing beef cattle, the involvement of beef cattle in the marketing, the economic welfare and way of life of beef cattle farmers, or the factors that affect the profitability and revenue of beef cattle marketing in the study region.

Furthermore, all research studies made were mainly on crop marketing and crop market participation and livestock marketing and market participation, and no research study has done on the determinants of engagement in the beef cattle market and beef cattle producers' economic welfare. In order to close this research gap, the suggested research project was expected.

Additionally, the degree of prosperity and style of life of a person or a group of people are known as their economic welfare. According to Bettenburg et al. [13], it explicitly refers to the utility acquired through reduction of income disparity, employment, and education. Welfare is a legal process and a social initiative intended to advance the fundamental material and physical welfare of those in need. Welfare may classify into two categories: social welfare and economic welfare. The welfare of the entire society, according to Bettenburg et al. [13], is not only the same as the standard of living but also more concerned with the quality of life, which includes elements like the environment's quality, crime rates, drug abuse rates, the accessibility of critical social services, as well as religion and other spiritual aspects of life.

To determine the degree of prosperity and the type of expectations for basic comforts in an economy, Jacobs and Slans [14] did a research study on the power of measurement, human well-being, and economic welfare. The study also looked at how economic features may assess using a range of metrics, including the GDP and other indicators that indicate the welfare of the populace, including and incorporating pollution levels, literacy, and other variables. A generic idea like economic well-being is difficult to define. In line with the World Development Indicator [15], real income (purchasing power, parity) and real GDP are commonly used to quantify economic well-being. Real production growth typically results in more expenses, indicating that people are doing better and that economic welfare has increased. Therefore, it is vital for farmers to grasp economic and social well-being from their point of view in order to comprehend the opportunity costs associated with the rearing of beef cattle.

According to a research by Abate et al. [16], commercializing smallholder agriculture can boost farmers' incomes. The families' and farmers' ability to buy goods and services, including food, health care, education, and other improved services that raise the standard of living and promote the sustainability and healthy of beef cattle farmers, may facilitate the growth in income. The study identified commercialization as a determinant factor in enhancing farmers' livelihoods and food security [17]. The study supported by Vink et al. [18], who also identified market access as a crucial factor in smallholder farmers' capacity to generate money and enhance their living conditions.

According to IFAD and UNEP [19], the vulnerability of smallholder cattle producers' livelihoods and food security is increased by a lack of market access. This article goes on to say that market involvement is essential for the growth of smallholder farmers in rural areas and among poor's. Markets, market access, market involvement, and higher returns can all help to enhance the living circumstances and levels of food security for smallholder farmers.

According to Nganga et al. [20], a beef, cattle, and livestock enterprise can maintain the potential to produce significant returns, which make it a means to improve livelihood, attain food security, and alleviate poverty. Contradicting [21, 22], contended that smallholder farmers in rural regions with marketable stock proceed to live in poverty because they lack access to lucrative markets. These opinions make it abundantly evident that fair pricing and market accessibility are crucial for reducing poverty and enhancing farmers' economic welfare.

The primary goal of this research study was to examine how market involvement in beef cattle marketing affects the economic welfare of beef cattle producers in the study area. Does participation in beef cattle marketing improve the economic and social well-being of smallholder farmers? was the research study's central question.

The output of the research study showed that involvement in the beef cattle market improves the welfare of beef cattle producers.

2. Materials and Methods

2.1. Description of the Study Area. The study search was carried out in Ethiopia's Oromia regional state's West Shewa Zone (Figure 1). Administratively, the West Shewa Zone is divided into 22 districts and one metropolitan center (Ambo), which acts as the capital urban hub for the region. Ambo serves as the West Shewa Zone's capital city.

The amount of livestock in West Shewa Zone is as follows: cattle 3,450,702, sheep 853,296, goat 1,260,383, horse 292,283, mules 50,622, donkey 268,780, and chickens 2,034,238. Agriculture, particularly food cultivation and animal husbandry, is the foremost source of income for the local population. The three primary soil classifications found in the zone are red (46%), black (44%), and mixed (10%), according to the Agriculture and Natural Resource Office for the zone.

2.2. Research Methods

2.2.1. Sample and Sampling Techniques. In selecting sample farm households, a three-stage sampling method has used. Because there is a lot of promise for beef cattle, the West Shewa Zone has been chosen purposively for the research in the initial stage. Additionally, the region does not reap the benefits of the potential for selling and producing of beef cattle. Farmers that raise beef cattle also contend with a number of obstacles.

In the second stage, three districts from three clusters (eight highlands, seven midlands, and four lowlands) (one Woreda from lowland, one district from midland, and one district from highlands) were randomly and proportionally selected. Third, three PAs from each Woreda were randomly chosen. Last, sample households have randomly taken from beef cattle-producing smallholder beef cattle farmers in each PA. The total number of beef cattle farmer respondents chosen for the research study survey was 400 based on the sample size determination formula used below, following a study by Yemane [21]. For the three districts that were selected, the sample sizes have calculated as follows:

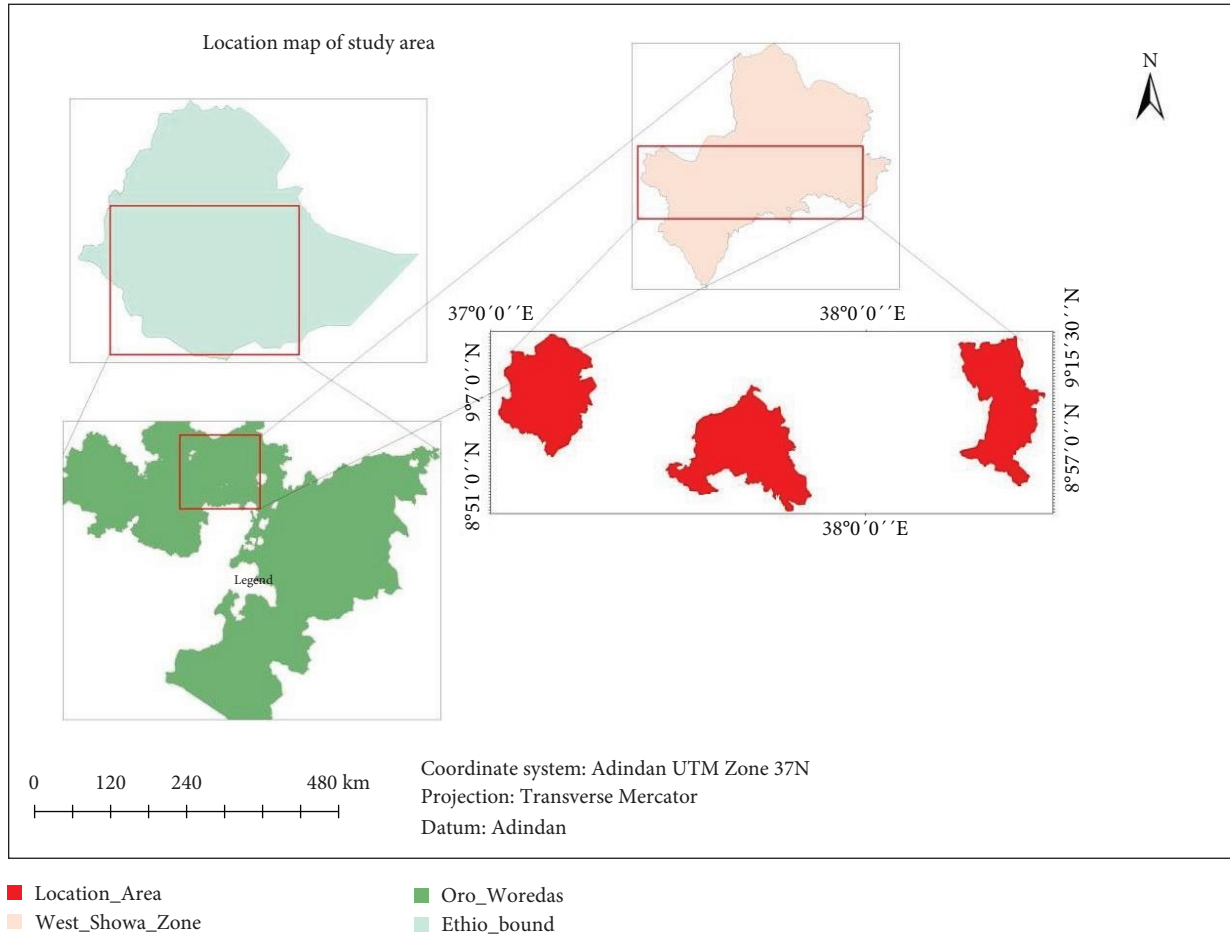


FIGURE 1: Map of the study area (Bako Tibe, Toke Kutaye, and Ejere). Source: Zone Agricultural Development Office and Own Computation (2023).

$$n = \frac{N}{[1 + N(e)2]}, \quad (1)$$

where N is sample size, N is population size, and e is level of accuracy articulated as a proportion = 0.05.

Accordingly:

$$n = \frac{235,516}{[1 + 235,516(0.05)2]} \approx 400. \quad (2)$$

Based on the size of the cattle herd and market accessibility, PAs and markets have chosen using a straightforward random sample approach. In the three districts, there were nine PAs, and using the simple random sampling approach, one PA has selected from each Woreda. The zone has divided into highland, midland, and lowland, three uniform clusters. One Woreda has randomly chosen from each district in a homogeneous cluster using lottery method. Thus, there is one Woreda from the highlands, one from the midlands, and one from the lowlands.

2.2.2. Methods of Data Analysis. The propensity score matching (PSM) model has been used to examine the financial

well-being of smallholder farmers involved in the trading of beef cattle.

The following steps have used to apply the PSM method: the participation equation has first put through a probit or logit model and the propensity score (a measure of the likelihood) that an individual would participate in an intervention has then predicted. The second step involves defining the region of common support (treatment observations have comparison observations “nearby” in the propensity score distribution), conditional independence (which states that a specific set of observable covariates is not affected by treatment), potential outcomes are independent of treatment assignment, and balancing tests (the treatment and control groups have to be balance in that similar propensity scores are based on comparable observed characteristics). In the third phase, participants are matched with nonparticipants using a number of matching methods, including nearest neighbor (NN) matching, radius matching, interval or stratification matching, kernel matching, and others. The fourth phase has to evaluate the quality of matching methods using several techniques, including the joint/overall significant test, likelihood test, pseudo R^2 test, mean bias test, and t -test [23].

The ex-post assessment, as in a study by Gayatri et al. [24], assesses the actual effects of the program intervention

on recipients. Ex post assessment was beneficial in a right away and is accurate. Ex post evaluation can also be much more costly than ex ante evaluation, since it requires collecting data on the actual outcome (per capita consumption expenditure) for treated/participants/and control/nonparticipants/group.

The major problem of impact evaluation is to ascertain what would have occurred to smallholder farmers if they had not taken part in beef cattle marketing. The conclusion is that the beneficiary's outcome in the absence of beef cattle market participation would be its counterfactual (control group), and the per capita spending of participants are to be calculated accordingly.

Ex post evaluation reveals that results like income intervention of participants on intended participants may raise concerns about changes in the well-being of intended participants. Does this modification directly connect to the intervention? Has this initiative led to an increase in income? In reality, it is hard to determine whether the outcome of the intervention may have directly linked to market participation with just a point of observation following treatment.

A comparison of the same smallholder beef cattle farmer's performance before and after assistance would be ideal. However, this is not feasible since a small-scale beef cattle farmer cannot occupy two residences simultaneously.

It is very important to evaluate how smallholder beef cattle producers who participated in beef cattle marketing would have modified their per capita spending if they had not participated with what would have occurred to their per capita consumption expenditure if they had. A comparison group is, therefore, required.

In this research study, the per capita consumption expenditure of treatment group, those who participated in beef cattle marketing and control group, and those who did not be compared with their contribution to the economic welfare of smallholder farmers to understand the effects of participation in beef cattle marketing on the economic welfare of farmers. Farmers' per capita consumption spending has been examined to determine how participation may contribute to welfare improvement. Impact assessments employ a variety of methodologies, and some have relied on several techniques that might help assess how solid the underlying assumptions are for various estimations. The method of assessment used in each circumstance, the quantity of information, the amount of time, the amount of resources, and the precise goals of the different evaluations. Social welfare, which is more qualitative than economic well-being in this study, and economic welfare, which is more quantitative, were separated from well-being as a general term. Economic well-being was the study's major concern, particularly the impact of beef cattle marketing participation [25].

The impacts of beef cattle marketing on per capita consumption expenditure of beef cattle producers have examined using PSM. When participants are not randomly assigned or by chance assigned to treatments or markets for beef cattle, self-selection problems and the estimate of treatment effects must be addressed by beef cattle market participants and control groups or nonparticipants.

2.2.3. Averaging Treatment Effect (ATE) and Propensity Score Matching (PSM). Many impact evaluation researchers have utilized PSM to create a statistical comparison group based on a model of chance of undergoing treatment using an observable features. The following participants and nonparticipants are matched based on this likelihood or propensity score. These authors claim that calculating the average treatment effect on the treated (ATT), which, in this case, refers to the average impact of smallholder farmers who engage in beef cattle marketing, is a method of getting robust impact evaluations. The mean differences in outcomes between these two groups have been used to assess the program's average treatment impact. PSM validity depends on two elements: (a) conditional independence (the unobserved factors do not impact participation) and (b) a significant amount of overlap and shared support between the samples of participants and nonparticipants.

The procedure enables a thorough analysis of the likelihood of involvement, the effect of participation on farmers' per capita consumption spending, and the heterogeneity of impact across farmers. The propensity score (PS) has first estimated as the likelihood that the sampled farmers would participate (D). A probit model has utilized, which includes a sizable number of conditioning factors (X) that might account for a population's members' likely nonrandom distribution as follows:

$$PS = P(D = 1/X)(1). \quad (3)$$

The elements of vector X 's variables are related to household demographics. The calculated PS represents the likelihood of participating in the study, and the estimated marginal effect indicates how the factors in X may have an influence on this likelihood. The findings of the probit estimate might provide information on whether participation is biased toward specific types of households. By matching treated observations or participating homes with untreated outcomes or nonparticipating respondents, an estimated PS has employed. The average difference between treated $Y(1)$ and matched controls $Y(0)$ in terms of consumer expenditure is an estimated average treatment effect (ATE) [26].

$$ATE \text{ is equal to } E(Y(1)Y(0)) = E(Y(1))E(Y(0)), \quad (4)$$

where ATE is average treatment effect, $Y(1)$ is treated (market participants), and $Y(0)$ is the control (to nonmarket participating) farmers.

According to Lambrecht et al. [27], with these methods, nonparticipants or control households with comparable observable characteristics have compared to participants or treated families' per capita spending in order to partially account for the nonrandom selection of participants.

It is possible to interpret the predicted ATE as the effect of market players on the per capita spending of beef cattle producers.

It has investigated how engagement affects per capita spending. The techniques described in [28] were used. The

TABLE 1: Beef cattle farmers, market participants, and nonmarket participants.

No.	Treatment	Number of observations	Percentage (%)
1	Beef cattle market participants (one)	300	75
2	Beef cattle market nonparticipants (zero)	100	25
	Total	400	100

Source: Survey data output, 2023.

influence of beef cattle market participants on income and poverty was measured using the ATT, which had been determined.

$$ATT = E[Y(1) - Y(0)/D = 1] = E[Y(1) - Y(0)/D = 1] - E[Y(0)/D = 1]. \quad (5)$$

Utilizing the kernel matching, closest neighbor matching, and radius matching methods, the estimated ATT was created and employed.

The NN matching technique is the easiest matching estimator, according to [29]. The comparison group member with the closest PS had chosen as a matching partner for a treatment person. NN matching undertakes the risk of poor match if the NN is far away, not as radius matching's, which can prevent by establishing a tolerance threshold on the greater PS distance (calipers), imposing caliper functions into the model, similarly to allowing for replacement. The matching algorithms mentioned, thus, far, kernel and local linear matching in particular, have the trait that just a small number of data from the comparison group has used to create the counterfactual result of a treated person.

Nonparametric matching estimators, such as kernel matching and local linear matching, employ weighted averages of every member of the untreated/control group to get the counterfactual result. Due to the similar size of participants and nonparticipants in the marketing of beef cattle in this study, NN matching was the most effective strategy.

By graphing ATT over the PS distribution and the distribution of the characteristics of farms and smallholder farmers and then smoothing the resulting curve, the impact heterogeneity was visually examined. We utilized an impact analysis to determine which features of agricultural and smallholder farmers had the most effects on per capita spending and poverty. These factors included gender, size of land, degree of education, marital status, etc.

It was necessary to describe and summarize the dependent variable (per capita expenditure), the independent variables to match participants and nonparticipants (gender, marital status, level of education, etc.), and the treatment variable in order to estimate the effect of participants on the per capita expenditure of smallholder beef cattle farmers using STATA 13.0.

The next step was to do a regression using participation dummy variables, which has been equivalent to running a t -test. A p -score was used to estimate the PSM, which was

another requirement. Here, the observation with comparable PS in the same range has compared.

Following the comparison, a test to determine whether the propensity score's balancing property has met was conducted. Therefore, the most crucial result that can be drawn from this PS model in order to determine the PS is an estimate of the expected chance of the PS matching later. The probability of having engaged in beef cattle marketing is PS. Then, with the help of the kernel matching method as a guide, different matching strategies have been looked in. The PS has matched using neighbor matching and radius matching approaches to test for robustness.

The World Development Indicator [15] states that real income (purchasing power, parity) and real GDP have typically used to gauge economic well-being. Spending often rises when real output does, suggesting that people are doing better and that there has been an improvement in economic well-being. Therefore, it is vital for farmers to grasp economic well-being from their point of view to comprehend the opportunity costs associated with the moving of raising beef cattle.

The model is first run with per capita consumption expenditure for model definition, and a very large coefficient and constant have been found. With the use of the formula $\log AC = \ln$ (annual income per capita), we were able to overcome the issue of a large coefficient. We attempted to use natural log variables for additional variables, such as total assets, autonomous consumption, and total spending, utilizing the K density test to get better results.

3. Results and Discussions

3.1. Descriptive Statistics Analysis. Descriptive statistics and econometric model analyses have used to analyze the quantitative data. The influence of beef cattle market involvement on the household economic well-being (per capita consumption spending) of smallholder beef cattle farming families in the research area has examined using the PSM model.

3.1.1. Beef Cattle Market Participants and Nonparticipants. The research study has looked at how smallholder beef cattle producers' per capita spending was affected by their involvement in the beef cattle market. According to the results of the survey, 300 smallholder beef cattle farmers (or 75% of them) participated in beef cattle marketing because they had discovered selling beef cattle during the study period, while 100 (or 25%) of them have resulted as nonparticipants because they had not resulted selling beef cattle during the study period (Table 1).

TABLE 2: Beef cattle market socioeconomic and demographic characteristics (categorical variables) participants and nonparticipants.

Variables	Category	Percentage of sampled producers that participated in the beef cattle market						X ² -value
		Participants (75%, 300)		Nonparticipants N (100, 25%)		Total (400, 100%)		
		N	%	N	%	N	%	
Sex of households	Female	35	8.75	66	16.65	101	25.25	6.71***
	Male	65	16.25	264	66	299	74.25	
Education level	Primary school	84	21	30	7.5	114	28.5	51.77***
	Secondary school	62	16.5	88	22	150	37.5	
	College diploma	0	0.00	82	20.5	82	20.5	
	Degree	4	1	22	5.5	26	6.5	
	Above degree	4	1	24	6	28	7	
Marital status	Married	11	2.75	89	22.25	100	25	13.35***
	Single	215	53.75	85	21.25	300	75	
Participation in civic organizations	Participant	276	69	55	13.75	300	75	108.0***
	Nonparticipant	24	6	56	14	100	25	

Source: Survey data output, 2023; *** = significant at $p \leq 1\%$ significance level.

TABLE 3: Age of respondents and their beef cattle market participation.

Age (years)	%	Participants	%	Nonparticipants	%	Minimum	Maximum
<25	3.5	12	3	2	0.5		
25–35	18.5	30	7.5	44	11		
36–45	37.5	120	30	30	7.5		
46–55	23	82	20.5	10	2.5	17	88
56–65	19.5	43	10.75	11	2.75		
65+	4	13	3.25	3	0.75		
Total	100	300	75	100	25		

Source: Survey data output, 2023.

3.1.2. Demographic and Socioeconomic Profiles of Respondents.

Furthermore, it was resulted that 35 (8.75%) females and 65 (16.25) male beef cattle farmers participated in beef cattle marketing. Eighty-four (21%) primary school level, 62 (16.5%) secondary school level, four (1%) degree level, and four (1%) above degree education level have participated in beef cattle marketing. Eleven (2.5%) married and 215 (53.75%) single beef cattle farmers participated in beef cattle marketing. Two hundred and seventy-six (69%) civic organization participants and 24 (6%) noncivic organization participants have participated in beef cattle marketing (Table 2).

3.1.3. Age Distribution of Beef Cattle Farmers. As you can observe from Table 3, less than 25 years, 12 (3%) cattle market participants and two (0.2%) nonparticipants, 25–35 years 30 (7.5%) participants, and 44 (11%) nonparticipants, 36–45 years 120 (30%) participants and 30 (7.5%) nonparticipants, 46–55 82 (20.5%) participants and 10 (2.5%) nonparticipants, 56–65 years 43 (10.75%) participants, and 11 (2.75%) nonparticipants, more than 65 years 13 (3.25%) participants and three (0.75%) nonparticipants (Table 3).

3.1.4. Beef Cattle-Keeping Experience of the Household. Beef, cattle-keeping experience from 2 to 10 years was found to be 170 (43%) for participants and 70 (17.5%) for nonparticipants,

TABLE 4: Respondents' beef cattle-keeping experience.

No.	Experience range	Participation in beef cattle marketing			
		Participants	%	Nonparticipants	(%)
1	2–10	170	43	70	17.5
2	11–20	106	27	17	4.25
3	21–30	13	3	10	2.5
4	31–40	11	3	3	0.75
Total		300	75	100	25

Source: Survey data output, 2023.

11–20 years of experience 106 (27%) for participants and 17 (4.25%) for nonparticipants, 21–30 years of experience 13 (3.25%) for participants and 10 (2.5%) for nonparticipants, and 31–40 years of experience 11 (2.75%) for participants and three (0.75%) for nonparticipants (Table 4).

3.1.5. Access to Beef Cattle Market Information. As shown in Table 5, 217 (54.25%) beef cattle market participants and 74 (18.5%) nonbeef cattle market participants have access to beef cattle information, but 83 (20.75%) participants and 26 (6.5%) nonbeef cattle market participants did not get market information (Table 5).

TABLE 5: Respondents' access to market information.

No.	Description	Participants		Nonparticipants		Total	%
		Number	%	Number	%		
1	Access to market information	217	54.25	74	18.5	291	72.75
0	No access to market information	83	20.75	26	6.5	109	27.25
	Total	300	75	100	25	400	100

Source: Survey data output, 2023.

TABLE 6: Respondents' distance from the nearest market.

No.	Distance range	Participants		Nonparticipants		Total	%
		Number	%	Number	%		
1	0.15–1.00	185	46.25	67	16.75	252	63
2	1.25–2.00	67	16.75	9	2.25	76	19
3	2.5–5.0	45	11.25	22	5.5	67	16.75
4	13.0–20.0	3	0.75	2	0.5	5	1.25
	Total	300	75	100	25	400	100

Source: Survey data output, 2023.

TABLE 7: Respondents' land holding size and market participation.

No.	Land size range/hectare	Participants		Nonparticipants		Cumulative (%)
		Number	%	Number	%	
1	0–1.0	40	10	25	6.25	16.25
2	1.2–2.0	135	33.75	37	9.25	43
3	2.5–3.5	105	26.25	26	6.5	32.75
4	4.0–8.5	20	5	12	3	8
	Total	300	75	100	25	100

Source: Survey data output, 2023.

TABLE 8: Respondent's per capita consumption expenditure and market participation.

Per capita consumption expenditure	Participants	Nonparticipants	Remark
Average (Birr) both average (Birr)	90,116.96	8,705.00	
		69,763.97	

Source: Survey data output, 2023.

3.1.6. Distance from the Nearest Market. As shown in Table 6, as the distance to the nearest market, the farmer increases, beef cattle market participation of the farmer's decreases. Accordingly, 0.5–1 km 185 (46.25%) participants and 67 (16.75%) nonparticipants, 1.25–2 km, 67 (16.75%) participants and nine (2.25%) nonparticipants, 2.5–5 km, 45 (11.25%) participants and 22 (5.5%) nonparticipants, and 13–20 km, three (0.75%) participants and two (0.5%) nonparticipants were found (Table 6).

3.1.7. Ownership and Size of the Land. As the amount of land holding of the farmer increases, beef cattle market participation increases. Accordingly, land to 1 ha owner participants, 40 (10%), 25 (6.25%) nonparticipants, 1.2–2 ha owners, 135 (33.75%) participants and 37 (9.25%) nonparticipants, 2.5–3.5 ha, 105 (26.25%) participants and 26 (6.5%) nonmarket participants, and 4.0–8.5 ha, 20 (5%) participants, and 12 (3%) nonmarket participants were indicated (Table 7).

3.1.8. Market Participation and Per Capita Consumption Spending. The mean per capita expenditure was found to be Birr 8,705.00 for beef cattle market nonparticipants and Birr 90,116.96 for beef cattle market participants and Birr 69,763.97 for both participants and nonparticipants; therefore, one can conclude that people who participate in beef cattle marketing have a high per capita spending when compared to those who do not. The distinction shows that participants in beef cattle marketing were very different from nonparticipants in beef cattle marketing (Table 8).

3.2. Econometric Analysis

3.2.1. Propensity Score Matching. Multicollinearity diagnostic has made for the exogenous variables prior to performing the econometric analysis. A collinearity indicator is the variance inflation factor (VIF). No variable with a VIF more than 10 has been found. For this reason, there was no multicollinearity

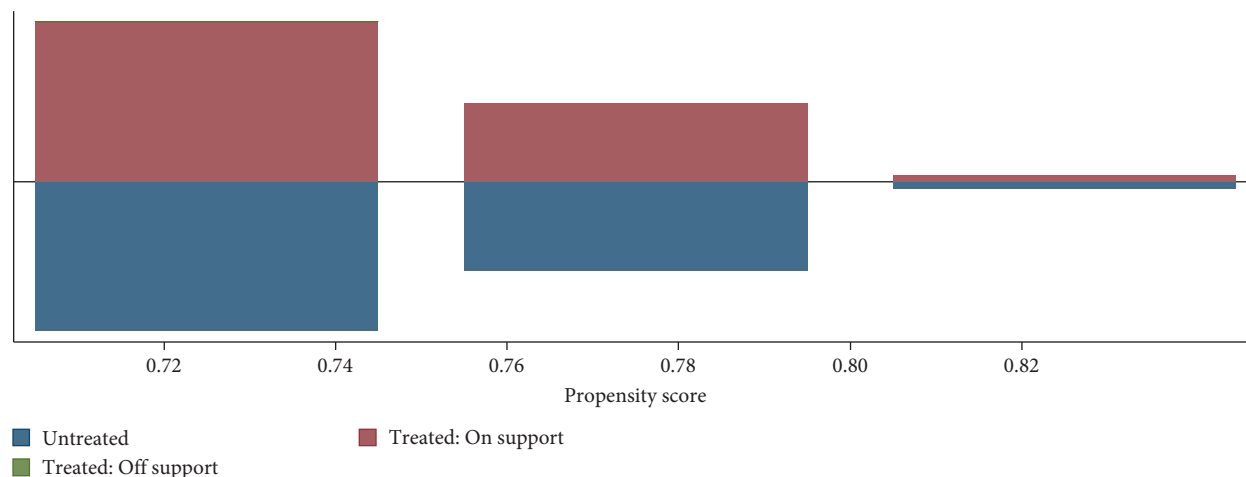


FIGURE 2: Common support for propensity score and propensity score matching distribution estimation via the kernel matching method. Source: Survey data output, 2023.

TABLE 9: The impact of beef cattle market participation on per capita consumption expenditure of beef cattle farmers (kernel-based matching algorithm, bandwidth $\frac{1}{4}$ 0.06).

Outcome variable	Sample	Participants	Nonparticipants	Difference	SE	T _{stat}	Average treatment effect with bootstrap standard error			
							ATE	Bootstrap SE	Z	P> z
Per capita consumption expenditure (Birr in “000”)	Unmatched	90.11	8.7	81.41	0.874	1.35	—	—	—	—
	ATE	90.09	8.1	81.99	0.946	1.65*	1.56	0.893	1.75	0.080*

Note: *P<0.1. Source: Field survey result, 2023.

for the numerical variables. The presence of multicollinearity among category variables was detected using the contingency coefficient; however, there was no multicollinearity issue among categorical variables (Tables 12–14).

The study employed a psmatch2 STATA 13 command to estimate the PS for matching purposes by utilizing a binary logit regression model in order to determine the effect of small-holder beef cattle producers’ involvement in the beef cattle market on their per capita consumption expenditure. The variables between the beef cattle market participants and nonparticipants were balanced using the NN matching, kernel matching, radius matching, and caliper matching procedures. The variance ratio (R) and absolute standardized means difference (B) values have used as criteria to choose a matching process that can provide a satisfactory balance between the two groups. Instead of using t-tests to compare the covariate values between the two groups, Benjamin et al. [30] advised comparing the absolute standardized differences for each treatment group for each covariate. With B 25% and R between 0.5 and 2, it has been assumed that the samples are well balanced when using matching algorithms, according to Rabbi et al. [31]. In order to evaluate the impact of market involvement on the outcome mentioned variables, it is resulted that the kernel and radius matching procedures, as opposed to others, best meet requirements. To confirm that, if the market participants have adequate matches with their counterparts, the common support assumption was also visually evaluated.

The common support graph was presented only for the kernel-based matching technique, as it has the lowest standardized mean difference compared to other matching methods (Figure 2).

While estimating the impact of an intervention on the treated and control groups, PSM has restricted to taking unobserved factors (hidden bias) into account. As a result, it can conclude that estimations using the PSM method are not resistant to hidden bias caused by unobserved factors that have an impact on both the outcome variables and the assignment to treatment at the same time. In order to determine if the findings of covariate matching are sensitive to factors that have not observed, the sensitivity analysis suggested by Rosenbaum [32] was conducted (Table 9).

As shown in Table 10, there are differences in the resulting variables’ resilience to hidden bias. The lowest critical value (I), which includes zero, was shown to have a positive impact on per capita consumption expenditure and was 3.4 (95% confidence interval) and 5.4 (Hodges–Lehmann point estimate). It indicates that if an unobserved factor caused the odds ratio of the treatment assignment (participation in the beef cattle market) to differ between participants and nonparticipants by a factor of 3.4 and 5.4, respectively, the confidence interval and the Hodges–Lehmann point estimate for the per capita consumption expenditure effect would include zero. That provides compelling evidence that the result is impervious to hidden bias, which suggests that beef cattle

TABLE 10: Robustness to hidden bias differs among the outcome variables.

Outcome variables	*Gamma (hidden bias magnitude)	Significant level		Hodges–Lehmann point estimation		Confidence interval	
		The upper bound	The lower bound	The upper bound	The lower bound	The upper bound	The lower bound
Per capita consumption expenditure (Birr, “0000”)	1	2.8e-15	2.8e-15	902.698	902.698	707.293	1,093.13
	2	0.000011	0	514.837	1,279.24	312.152	1,481.46
	3	0.007773	0	305.433	1,487.96	67.3558	1,713.45
	3.01	0.011387	0	278.825	1,503.73	46.5587	1,734.6
	3.12	0.017180	0	279.344	1,522.31	26.3397	1,755.54
	3.3	0.022348	0	253.181	5.5909	5.5909	1,774.61
	3.4	0.030089	0	237.798	-10.8594	-10.8594	1,792.03
	4	0.117203	0	152.366	-109.049	-109.049	1,887.92
	5	0.400121	0	32.4502	-227.191	-227.191	2,010.93
	5.1	0.432392	0	19.4553	-237.443	-237.443	2,021.96
	5.2	0.464475	0	9.72024	-249.618	-249.618	2,032.68
	5.3	496,172	0	1.68402	-256.868	1779.74	2,043.54
	5.4	0.5273	0	-9.33009	-264.469	1788.98	2,051.62

Note: *Gamma (I)–log odds of differential assignment because of unobserved factor. Source: Survey data output, 2023.

TABLE 11: Average treatment effect of different matching techniques.

Matching technique	ATE	t
Kernel matching	0.8395111	–
Nearest neighbor matching	0.8424085	6.38
Radius matching	0.8412034	7.79

Source: Survey data output, 2023.

market participation interventions are linked to the increase in per capita consumption expenditure.

The impact estimates are discovered to be insensitive to hidden biases; since, in general, the hidden bias size (I) required to contest the results on the positive effects of beef cattle market participation on the per capita consumption expenditure variable is significantly greater.

This research study looked at how beef cattle market participation affected smallholder beef cattle producers’ per capita consumption expenditure, which is a good indicator of their economic welfare.

The average per capita expenditure for beef cattle market participants has found to be Birr 90,116.96 and Birr 8,705.00 for nonparticipants. It has indicated that almost 75% of smallholder farmers participated in beef cattle marketing (Table 11).

Therefore, compared to individuals who did not participate in beef cattle marketing, those who take part in beef cattle marketing have high per capita expenditures (economic well-being). The distinctions between the two groups have explained the differences between individuals who engaged in beef cattle marketing and those who did not. The research study question was, “Does participation in beef cattle marketing increase the welfare of smallholder beef cattle farmers?” is, therefore, answered in the affirmative. In this instance, the response is affirmative.

The assessment of the ATE for the various approaches is shown in Table 10. ATE, also known as the outcome, is the

difference between the per capita expenditure of beef cattle market participants and the per capita expenditure of the control group/nonparticipants. With kernel matching, the ATE was 0.84, which has indicated a smallholder farmer’s yearly per capita consumption spending would rise by 0.84 Birr if he or she participated in beef cattle selling. This suggests that those who participate in the market for beef cattle do so at a higher level of economic well-being than those who do not participate in beef cattle marketing.

The ATE with the NN matching has shown that the yearly per capita spending of the smallholder farmers engaging in beef cattle marketing rose by 0.84 Birr. The radius matching study supported this finding, showing that when smallholder farmers participate in beef cattle markets, their yearly per capita consumption expenditure increases by 0.84 Birr compared to those who do not participate in beef cattle marketing (Table 11).

To our knowledge, this is the first time in the study area that a detailed and extensive explicitly developed for beef cattle smallholder farmers has been used to examine the smallholder beef cattle farmers market participation on their economic welfare (Table 11), irrespective, of the missing match of supply and demand of beef cattle between rural and urban people in the study area, that is excess of beef cattle and its products and chronic shortage of beef cattle and its product’s in urban area, which indicated mismatch of supply and demand-based higher prices in urban areas and lower prices in rural areas; in spite of this gap, all research studies undertaken in the study area were mainly on crop marketing and crop market participation and farm marketing and marketing participation, and no research study has undertaken on the determinants of beef cattle market participation and beef cattle producers’ economic welfare; research study has expected to fill this research gap.

The research study output indicated that beef cattle farmers participating in beef cattle marketing had got 84% more

TABLE 12: Multicollinearity test.

	Collinearity tolerance	VIF
(Constant)		
Age of HH	0.523	1.910
Land size in hacks	0.807	1.238
Distance in KMs	0.797	1.254
Number of hired labor	0.649	1.541
Marital status	0.740	1.351
Experience in cattle keeping	0.439	2.278
Number of household members	0.682	1.467
Off farm income	0.655	1.526
Number of extension visits/year	0.531	1.884
Dependency ratio	0.855	1.170

Note: Dependent variable: participation in beef cattle marketing.

TABLE 13: Multicollinearity test for numerical variables.

Variable	Collinearity statistics	
	Tolerance	VIF
Age of HH	0.511	1.957
Dependency ratio	0.855	1.170
Land size in hectares	0.523	1.910
Distance in KMs	0.807	1.238
Number of hired labor	0.797	1.254
Experience in cattle keeping	0.740	1.351
Number of household members	0.439	2.278
Off farm income	0.682	1.467
Number of extension visits/year	0.655	1.526

Source: Survey data output, 2023.

TABLE 14: Multicollinearity test for categorical variables.

.corr sexh pco ms edl (obs = 400)				
	sexh	pco	ms	edl
sexh	1.0000			
pco	-0.1036	1.0000		
ms	-0.2251	0.0192	1.0000	
edl	-0.0037	0.2062	-0.1902	1.0000

economic welfare than the nonbeef cattle market participants; it means the market participants are better off than the nonbeef cattle market participants in per capital consumption expenditure compared to nonmarket participants, and they have a better standard of living; research conducted in Tanzania by Supadmi et al. [33] found a similar outcome, if or not a farmer participates in the market for rice yield determines the welfare of he or her. Farmers' economic and social welfare has grown as they participated in the market for rice production. Sharifuddin et al. [34] discovered a comparable outcome. Farmers' incomes in Kenya benefit from their participation in avocado export markets.

The research study carried out by Ayele [35] on Cereal Crop Commercialization and Household Welfare in Guji Zone, Ethiopia, has also showed the beneficial welfare impacts of cereal crop commercialization between market participation

and economic welfare. That has also highlighted the potential for further reducing their consumption costs by increasing the level of commercialization, provided that the right policies are developed and put into action. Moreover, Ji-liang et al. [36] research report on commercial cash, crop output, and households' economic welfare in rural China demonstrated how household farm income and economic well-being have grown as a cause of commercial pulse production and marketing.

The impact of agricultural market links on small-scale farmers' welfare in Tanzania was been studied by Bueno [37], who found that participation in market linkages improves household economic welfare.

According to a research by Miller et al. [38], commercializing smallholder agriculture can boost farmers' incomes. The families' and farmers' ability to buy several kinds of things, including food, health care, education, and other improved services that raise the standard of living and promote sustainable, healthy lives have improved with the growth in revenue. The study identified commercialization as a major factor in enhancing farmers' livelihoods and food security. The study was supported by Vink et al. [18], who also identified market access as a crucial factor in smallholder farmers' capacity to generate money and enhance their standard of living.

World Development Indicator states that real income (purchasing power, parity) and real GDP have typically used to gauge economic welfare. Spending often rises when output does, suggesting that people are doing better and that there has been an improvement in economic and social welfare.

The well-being of the entire society, according to Just et al. [39] and William [40], is not only the same as the standard of living but also more concerned with the quality of life, which includes elements like the environment's quality, crime rates, drug abuse rates, the accessibility of critical social services, as well as religion and other spiritual aspects of life.

Numerous studies [10, 40–42] have demonstrated that the beef cattle industry has a great potential to raise peoples' standards of living through increased income from the sale of beef cattle and beef cattle products, as well as improved nutrition resulting from the consumption of dairy products and meat. A huge majority of farmers are located in rural regions, whereas customers or lucrative markets have been found in metropolitan areas. This separation between producers and consumers occurs spatially. In both rural and urban locations, the majority of product supply is transferred from producer to consumer through unofficial channels.

The country lacks well-developed marketing facilities and market infrastructures such as rural roads, market data, beef, cattle grading systems, etc. As a result, this lowers the incentives to participate in beef cattle commercial transactions and leads to subsistence farming systems rather than production systems that are market-oriented. Therefore, one of the most significant development problems is to strengthen smallholders' ability to participate effectively in the livestock market in general and the beef cattle market in particular [10, 42].

3.2.2. *Implications of the Study.* The research study has several limitations. In particular, in the process of survey data

collection, some respondents were not volunteered to give us information, and some respondents gave us incorrect data. However, we increased the number of respondents to solve the problem. Accordingly, we were able to replace these respondents by other similar respondents.

3.3. Future Directions

3.3.1. Farmers Education and Farmers Training. Education and training of beef cattle farmers on cattle production, cattle transportation, and beef cattle marketing increase their beef cattle market participation and, as a result of beef cattle marketing, their economic welfare increases. In this regard, the concerned government organizations and nongovernmental organizations have to plan and teach/train/beef cattle farmers on beef cattle handling and beef cattle marketing methods and techniques.

3.3.2. Fostering the Involvement of Women in the Marketing of Beef Cattle. The study area's successful production and participation in the beef cattle market can two benefits indirectly by encouraging the involvement of more women in cattle marketing. If such programs are to be fruitful and profitable in the West Shewa Zone of Oromia, Ethiopia, more women must be encouraged to engage in beef cattle marketing.

Once these suggestions have implemented into practice, additional empirical research on integrated agricultural financing in the smallholder farming sector will be needed. The impact of agricultural cooperatives on the value chain has to be examined further in order to include agricultural financing for smallholder beef cattle farmers.

4. Conclusions

This study examined the effects of smallholder beef cattle farmers in the Ejere, Toke Kutaye, and Bako Tibe districts (West Shewa Zone, Oromia Regional State, Ethiopia) participating in the beef cattle market on their financial well-being. A univariate analytic technique that includes frequency, mean, and standard deviation has been used to analyze the qualitative and quantitative data collected from the selected three districts. The logit regression model demonstrated that factors like hired labor, marital status, dependency ratio, involvement in civic organizations, and access to information had positive and significant effects on farmers' decisions to participate in the beef cattle market at various significant levels.

The economic well-being of smallholder beef cattle producers has evaluated using PSM, which looked at the effect of beef cattle marketing participation. The PSM findings revealed that smallholder beef cattle producers' yearly per capita consumption expenditure (economic well-being) improved by 84% than beef cattle farmers who were not participating in beef cattle marketing. This result indicates that participation in beef cattle marketing increases the welfare of smallholder beef cattle farmers. It has been regarded as to be the first finding in the research field in the study area. All diagnostic tests like multicollinearity test, multicollinearity test for numerical variables and multicollinearity test for categorical variables (Tables 12,

13, and 14 respectively) were undertaken and there were no such a problem.

Data Availability

On request, the initial author will provide data immediately.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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