International Journal of Forest, Animal and Fisheries Research (IJFAF)
ISSN: 2456-8791
[Vol-8, Issue-1, Jan-Mar, 2024]
Issue DOI: https://dx.doi.org/10.22161/ijfaf.8.1
Article DOI: https://dx.doi.org/10.22161/ijfaf.8.1.3

Analysis of Value Chain of Cow Milk: The Case of Itang Special Woreda, Gambella, Ethiopia

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Received: 10 Dec 2023; Received in revised form: 15 Jan 2024; Accepted: 25 Jan 2024; Available online: 05 Feb 2024

Abstract *— Ethiopia has a long and rich history of dairy farming, which was mostly carried out by small and marginal farmers who raised cattle, camels, goats, and sheep, among other species, for milk. Finding the Itang Special Woreda cow milk value chain is the study's main goal. In order to gather primary data, 204 smallholder dairy farmer households were randomly selected, and the market concentration ratio was calculated using 20 traders. Descriptive statistics, econometric models, and rank analysis were used to achieve the above specified goals. Out of all the participants in the milk value chain, producers, cafés, hotels, and dairy cooperatives had the largest gross marketing margins, accounting for 100% of the consumer price in channels I and II, 55% in channels III and V, and 25.5% in channels V. The number of children under five, the number of milking cows owned, the amount of money from non-dairy sources, the frequency of extension service contacts, the amount of milk produced each day, and the availability of market information were found to have an impact on smallholders' involvement in the milk market. Numerous obstacles also limited the amount of milk produced and marketed. The poll claims that general health issues, sickness, predators, and a lack of veterinary care are plaguing farmers. In order to address the issue of milk perishability, the researchers recommended the host community and organization to construct an agro milk processor, renovate the dairy cooperative in the study region, and restructure the current conventional marketing to lower the transaction and cost of milk marketing.*

Keywords *— Cow Milk, Cost and Margin, Heckman Selection Model, Value Chain*

I. INTRODUCTION

For rural farmers, producing livestock is their main source of food and revenue. It has made a significant contribution to the nation's economic development. The availability of livestock products and byproducts helps to enhance people's nutritional condition by supplying the necessary animal protein (Mebrate, et al 2019).

As stated by Kiros et al. (2018), the main barriers to the dairy production system in the urban and peri-urban areas of Ethiopia's central Highlands were high feed costs, a lack of land and space, issues with feed quality, availability, and cost, as well as insufficient veterinary and extension services. Inadequate supply and quality of feed resources, coupled with a shortage of both purebred and crossbred dairy cattle, are further challenges facing

the subsector and have contributed to its low productivity (Tafere and Worku, 2015). However, the dominance of subsistence farming, the lack of a business-oriented agricultural production system, and the restricted or nonexistent access to market facilities lead to a low level of smallholder farmers' involvement in the value chain or in adding value to their output (CSA, 2011).

Value chains can have different stages, such as input supply, production, processing, marketing, and consumption, depending on the type of dairy production system under study. In this context, the term "value chain" refers to a variety of players and activities spanning from production to consumption as well as the dynamic interactions between participants in dairy production systems (Rich et al., 2011).

According to CSA, Ethiopia has the greatest population of livestock in all of Africa. Furthermore, according to CSA, the estimated number of cattle is 52.13 million. Additionally, Ethiopia produced 3.3 billion liters of milk in 2011–2, valued at $1.2 billion, and imported dairy products for an additional $10.6 million. The country's rural sedentary areas are anticipated to produce 3.2 billion liters of milk annually, with an average daily yield of 1.37 liters per cow (CSA, 2017).

However, due to Ethiopia's underdeveloped milk marketing system, the vast majority of smallholder milk producers have restricted access to the market. Dairy production is one of the most important aspects of the livestock production system in Ethiopia, where dairying has not yet been adequately promoted and exploited while being an important source of food and money from animals. Despite its vast population, Ethiopia's livestock subsector produces little overall and contributes less directly to the country's economy relative to its potential (Mebrate et al., 2019).

The challenges faced by Ethiopian smallholder dairy producers in marketing their fluid milk have been the subject of various theoretical analyses and empirical studies. Dairy cooperatives that are now in existence typically operate in regions that are easily accessible to markets and transportation. This implies that some producers continue to produce at a subsistence level and that a significant amount of milk does not reach the markets (Zelalem et al., 2011).

The Gambella region has the potential to increase dairy production despite being a low-lying territory that has a more extreme dry season than other nearby regions such as Benshangul Gumuz, Oromia, and SNNP regions. Furthermore, the agriculture sector is dominated by vast herds of cattle in particular and livestock in general because people take advantage of the opportunity to move their animals to pasture areas during the dry season when the grass wilts (Degife, et al., 2019).

Milk and its byproducts are essential commodities in the study region, where they can be traditionally processed into fermented form or drunk as fresh, fluid milk. A range of dairy products, such as fresh milk, fermented milk (Ergo), butter, and buttermilk (Arera), which were not intended for domestic use, were sold in the hamlet to generate revenue. Dairy is a vital industry in the research area for the support of the farming community and other products. Despite the potential for producing milk and milk products in the research areas, little is known about the current methods for managing, producing, and marketing milk (Hussien, 2020).

Thus, the goal of this study is to provide sufficient information on the participants in the cow milk value chain, as well as to assess the current state of the market and the opportunities and problems that producers face.

II. RESEARCH METHODOLOGY

Study Area

The Gambella People's National Regional State (GPNRS) occupies an area of roughly 29,782.82 km2, or 3% of the country, and is situated in southwest Ethiopia between the geographic coordinates of 6028'38" to 8034' North Latitude and 330 to 35011" East Longitude. The Southern Nations and Nationalities People's Regional State borders the territory to the south and east, the Republic of South Sudan borders the southwest, west, and northwest, and Oromia National Regional State borders the region to the north, north east, and east. The capital of the region is Gambella, which is located roughly 767 kilometers away from Ethiopia's capital, Addis Ababa. The area is split up into thirteen

administrative districts, which include the Anyuak, Nuer, and Mejenger zones, and three ethnic zones (Fig. 1).

According to the CSA (2013), there are 42,000 people living in the district as a whole. The study area's livestock population is estimated to be 99128 cattle, 832010 sheep, 38055 goats, 116712 poultry, and 6445 bee colony (Itang Special District Agricultural Development Office, annual crop assessment report, 2017).

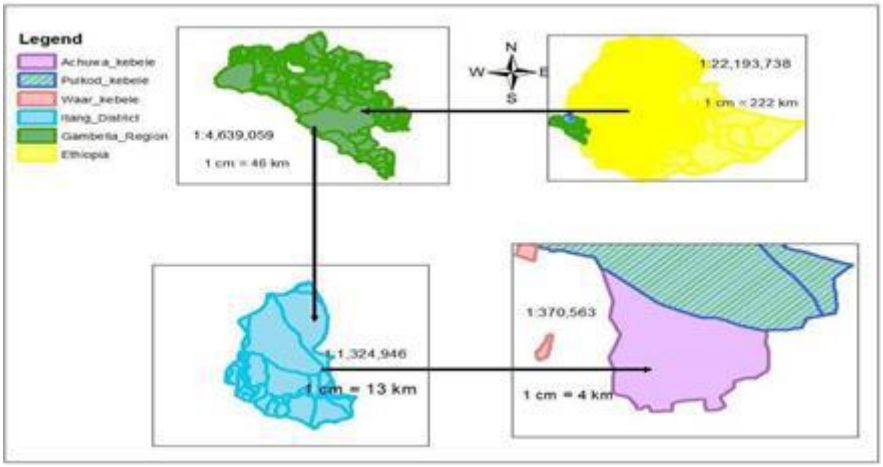

Fig.1: Map of study area

III. RESEARCH DESIGN

Smallholder dairy producer households in Itang Special Woreda were the target population. In the research area, the figures correspond to 1373 smallholder dairy producer households. In a short while, the Woreda's household-level smallholder dairy producers will be the unit of study (Table 1).

Table 1: Proportion of farmer households in each Kebele that produce milk

Name of Kebeles	Total Population of the selected Kebele	Total number of household	Total dairy producer household	Proportion of household sample
Achua	7892	1715	758	114
Pulkod	3967	862	364	57
Waar	2280	495	251	33
Total	14139	3567	1373	204

Source: Itang Special Woreda Agricultural Office, Kebele administrations, 2020

Sampling Design and Procedure

Utilizing a multi-phase sample technique, the goals of this investigation were met. Itang Special Woreda was specifically chosen in the initial phase. Second, out of the 21 rural Kebeles in the woreda, 8 were purposefully chosen based on their potential for dairy production. Thirdly, three of the eight Kebeles that were chosen were chosen using a straightforward random sample method. Fourth, in order to create a homogenous group of dairy and non-dairy farmers in each Kebeles, stratified sampling was used. Fifth, simple random was used to choose smallholder dairy producers from each stratum. Finally, the table created by (Kotrlik, et al., 2001) was used to establish the sample size of smallholder dairy producers. A total of 204 sample sizes were calculated, according to this author, for a population size of 1500 and a 95% confidence interval. As a result, 224 people made up the entire sample for this study (20 of whom are other market participants involved in the milk value chain, and

204 of whom are smallholder dairy producers). Diagrammatically, the process is illustrated as follows below (Fig. 2):

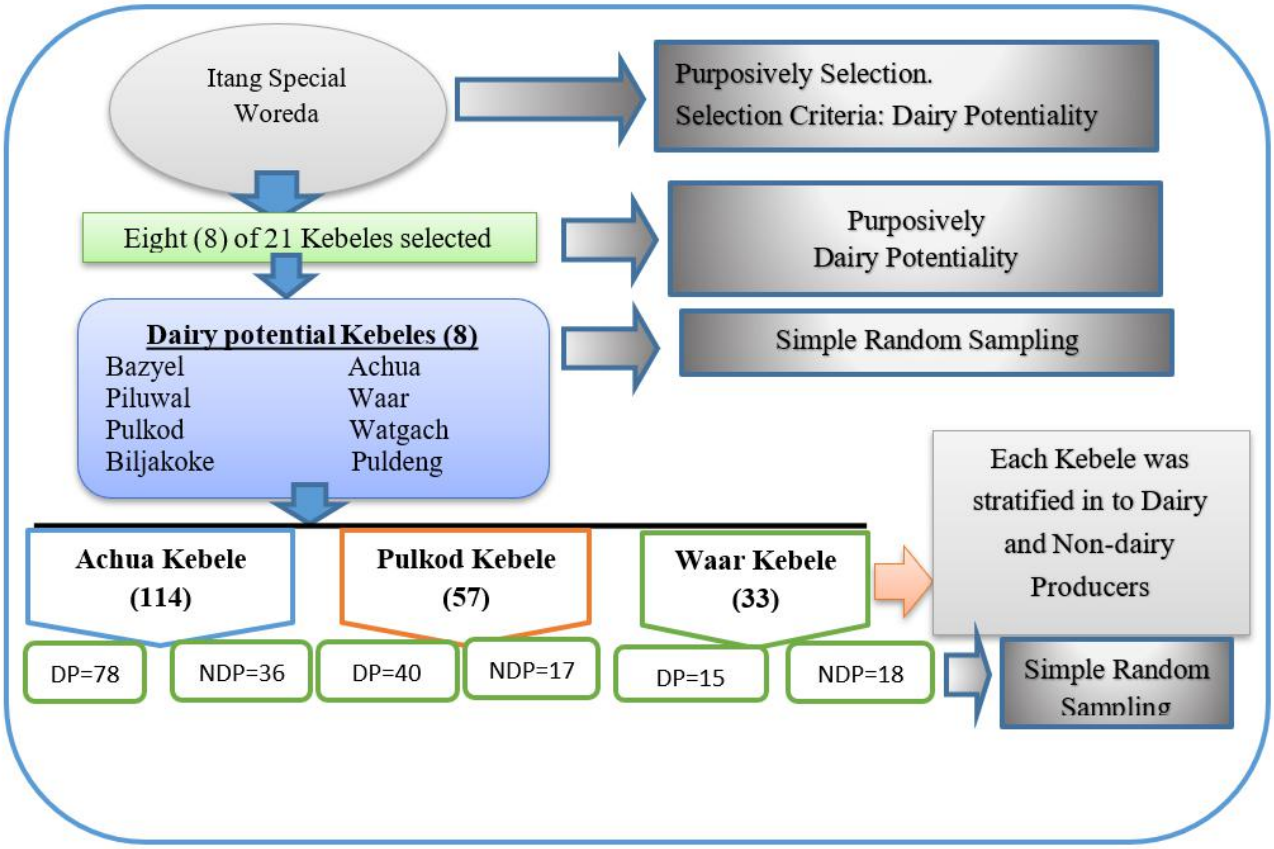

Fig. 2: Actors' market price shares from the end user

Types, Sources and Methods of Data Collection

From primary and secondary data sources, both qualitative and quantitative data were gathered. Primary data was gathered from smallholder dairy producers who were chosen at random. To gather primary data essential to understanding the respondents' socioeconomic characteristics, a systematic questionnaire was created. The district agricultural office, the central statistical agency, earlier research, the administrative office, additional published and unpublished materials and non-governmental groups whose written materials were made available for research and evaluations were the sources of secondary data.

Methods of Data Analysis

The data acquired from the respondents in this study was analyzed using econometric approaches, Likert Rank Analysis, descriptive analysis, and value chain mapping in order to satisfy the study's predetermined objectives.

IV. RESULT AND DISCUSSION

Demographic and Socio-Economic characteristics of sample households

A total of 204 household heads made up the sample group of respondents from households that were surveyed during the survey period. The sampled household respondents' ages ranged from 28 to 60 years old, with a mean age of 41.32 years, according to the survey results. It was discovered that the average age of milk market participants was 41.37 years. In the meantime, the non-participants' average age was 41.26 years. This indicates that because of the age and youth of the responders in each group, there is very little variation in the average age of the two groups. When these two groups were compared, it was found that the milk market participants were older on average than the non-participants; the mean

age difference between them was statistically not significant (Table 2).

Table 2: Demographic and Socio-Economic characteristics of sample households

Variables	Participants (133)		Non-participant (71)		P-Value
	Mean	Std dev	Mean	Std dev	
Age	41.37	7.71	41.26	7.83	0.95
Family size	5.50	1.63	4.75	1.45	0.01***
Landholding size	0.38	0.18	0.369	0.17	0.81
Income from the non-dairy source	1375.35	1935.9	1280.14	1256.5	0.672
Education Level of HH	3.82	4.39	3.62	4.15	0.000***
Extension frequency contact/month	2.58	1.66	2.51	1.46	0.000***
Variables	**Frequency**	**Per%**	**Frequency**	**Per%**	**P-Value**
Sex of HH					
Male	90	44.11	45	22.05	0.321
Female	43	21.07	26	12.74	
Credit Use					
Using Credit	3	1.47	2	0.98	0.570
Not Using Credit	130	63.72	69	33.82	
Milk Market Information					
Access Milk info	57	27.94	1	0.50	0.000***
No Access Milk	76	37.25	70	34.31	

*Where *** p<0.01, ** p<0.05, and * p<0.1implied the probability level of significance at 1%, 5%, and 10%, respectively.*

According to the survey results, the average number of years of schooling for participants who ate dairy products and those who did not was 3.82 and 3.62 years, respectively. This difference in average is highly significant at the 1% precision level. Furthermore, in the research location, the mean average of dairy participants is higher than that of non-dairy individuals. The data suggests that a higher education level is associated with an increase in milk participation knowledge and attitude. Additionally, the development agent (extension worker) provided monthly service contact frequency of 2.58 and 2.58 for dairy and non-dairy participants, respectively, to sample households. These results are statistically significant at the 1% precision level for both groups (Table 2).

The survey's findings regarding market information reveal that, respectively, 27.94% and 37.25% of milk market participants use information, while others do not have access to it. On the other hand, a significant difference from those who do not participate in the milk market is shown, indicating that 34.31% do not have access to knowledge on the milk market, while 0.5% can access and utilize it. This could be as a result of information asymmetry brought on by the lack of a structured milk marketing system in the area (Table 2).

Milk Production Summary of sample households

A statistically significant difference was observed between the mean average number of dairy cows owned by participants in the milk market (2.42) and those owned by non-participants (0.70) (Table 3).

Additionally, a highly significant difference was seen between the average amount of milk produced daily by participants (4.68) and non-participants (0.85). It is clear that, at less than 1% significance level, the milk volume produced by those participants and not by participants in liters indicates a highly significant difference. This could be because non-participant households have less access to information about the milk market, own fewer milking cows, and have more children under the age of five, who may consume a significant portion of the produced food even though the model indicates it is statistically insignificant.

Table 3: Milk Production Summary of sampled household

	Variables	Participant (133)		Non-participant (71)		P-Value
		Mean	Std dev	Mean	Std dev	
Total HH	Children under age five	1.71	0.936	0.281	0.831	0.2411
	Total number of milking cow	2.42	1.23	0.70	0.55	0.0012***
	Volume of milk yield per day	4.68	2.58	0.85	0.74	0.0000***
Achua	Children under age five	3.24	1.12	2.06	1.21	0.0021***
	Total number of milking cow	4.6	2.43	1.13	0.86	0.5280
	Volume of milk yield per day	8.89	3.56	1.36	0.45	0.0000***
Pulkod	Children under age five	3.34	1.45	3.18	1.82	0.0000***
	Total number of milking cow	4.53	1.92	1.38	0.79	0.2480
	Volume of milk yield per day	9.19	5.63	1.72	0.97	0.0421**
Waar	Children under age five	5.45	3.21	3.45	1.32	0.2631
	Total number of milking cow	7.90	3.90	1.63	0.98	0.0021***
	Volume of milk yield per day	16.13	11.3	2.0	0.99	0.5623

*Where *** p<0.01, ** p<0.05, and * p<0.1implied the probability level of significance at 1%, 5%, and 10%, respectively.*

Access/Use to Dairy Service

In addition, household respondents were questioned about their usage of and access to various services, such as obtaining credit and market data, as shown in Table 4. As can be seen here, their primary motivation for taking the money was to buy a dairy cow and upgraded facilities. Additionally, at a significance level of less than 1%, there is a statistically significant difference in the participants' and non-participants' access to current market information. In Achua and Waar, there was no statistically significant difference in the sampled households' access to Kebeles' credit service between the two groups (participant and non-participant).

Table 4: Use/Access to dairy service

	Variables	Description	Participant (133)		Non-participant (71)		χ^2	P-Value
			No	Per%	No	Per%		
Total HH (204)	**Credit Use**	Yes	3	1.47	2	0.98	0.61	0.805
		No	130	63.37	69	33.82		
	Market Information	Yes	76	37.25	1	0.50	61.192	0.000***
		No	57	27.94	70	34.31		
Achua (N=114)	**Credit Use**	Yes	1	0.88	0	0	3.246	0.192
		No	69	60.52	44	38.59		
	Market Information	Yes	43	37.71	1	0.88	0.056	0.971
		No	27	23.68	43	37.71		
Pulkod (N=57)	**Credit Use**	Yes	0	0	2	3.51	2.162	0.0112**
		No	41	71.92	14	24.56		
	Market Information	Yes	20	35.08	0	0	3.1526	0.0145**
		No	21	36.84	16	28.07		
Waar (N=33)	**Credit Use**	Yes	1	3.03	0	0	0.4521	0.12
		No	20	60.60	11	33.33		
	Market Information	Yes	13	39.39	0	0	0.3621	0.6512
		No	9	27.27	11	33.33		

*Where *** p<0.01, ** p<0.05, and * p<0.1implied the probability level of significance at 1%, 5%, and 10%, respectively.*
Source: survey result, 2021

Measure of market concentration ratio

The market concentration ratio of milk dealers was calculated using the four processors/retailers (hotel and café) that handled the most milk. The four milk processors/retailers in Itang town have a market concentration ratio (C4) of 33%, indicating a weak oligopoly market type. Table 5 from Kohls and Uhl (1985) supports this conclusion. This suggests that the town of Itang has a large number of dairy farmers.

Table 5: Milk traders' concentration ratio (C_4) in Itang Special Woreda

No. of trader (A)	Cumulative freq. of traders (B)	Per% of trader $\boldsymbol{D = \frac{A}{20}}$	Cumulative per% of traders (E)	Quantity purchased in liter (F)	Quantity purchased in liter (**G**) = **A** ∗ **F**	Per% share of purchase $\boldsymbol{Si = \frac{G}{n}}$	Per% Cumulative purchase $\boldsymbol{C = \sum_{1=i}^{r} Si}$
1	1	5	5	3850	3950	11	11
1	2	5	10	3520	3300	9	20
1	3	5	15	2756	2606	7	27
1	4	5	20	2109	2109	6	33***

10	14	50	70	1650	16,500	47	80
4	18	20	90	1180	4720	13	93
2	20	10	100	1046	2092	6	100
20		**100**		**16,311**	**35,277**	**100**	

*Where *** is the market type indicator which significant at 1% level*

Marketing Costs

Table 6 lists various marketing and production expenses associated with milk transactions by farmers, dairy cooperatives, and retailers (cafés and hotels) in the research area: The production cost structure shows that while the producers' labor marketing expenditures were greatest across all channels, veterinarian costs were comparatively high across all channels. Additionally, it was found that cooperatives and retailers had greater transportation marketing costs in channels (V) and (VI). Conversely, the cafe and hotel in channels III and VI had the largest sugar marketing costs.

Table 6: Market cost of dairy production and milk marketing

Actors	Channel (I)		Channel (II)		Channel (III)		Channel (IV)		Channel (V)		Channel (VI)	
Producers	Cost	Per%	Cost	Per %	Cost	Per%	Cost	Per%	Cost	Per%	Cost	Per%
Operating cost												
Veterinary	0.210	20.1	0.210	20.1	0.210	20.1	0.210	20.1	0.21	20.1	0.210	20.1
Feeds	0	0	0	0	0	0	0	0	0	0	0	0
Labor cost	0.501	50.10	0.501	53.10	0.502	53.2	0.501	50.1	0.501	50.1	0.501	50.1
Material cost	0.257	25.7	0.257	25.7	0.267	26.70	0.257	25.70	0.257	25.7	0.257	25.7
Transport cost	0	0	0.0493	4.93	0.0493	4.93	0	0	0.049	4.93	0.049	4.93
Total operating cost	0.97		1.02		1.02		0.97		1.02		10.2	
Selling price	13		15		13		15		15		15	
Net profit	12.03		13.98		12.03		13.98		13.98		13.98	
Dairy cooperative	**Cost**	**Per%**	**Cost**	**Per%**	**Cost**	**Per%**	**Cost**	**Per%**	**Cost**	**Per%**	**Cost**	**Per%**
Buying price							13		13		13	
Operating cost												
Labor cost							0.50	64.50	0.50	39.53	0.50	39.53
Materials cost							0.25	32.47	0.50	39.53	0.25	19.10
Transportation cost							0.05	2.03	0.25	19.76	0.50	19.53
Others									0.015	1.90	0.015	1.90
Total operating cost							0.80		1.27		1.27	
Total production cost							13.80		14.27		14.27	

Selling price							15		16		17	
Gross margin							2.0		3.0		4	
Net margin/profit							**1.20**		**1.73**		**2.73**	
Café/ Hotel	**Cost**	**Per%**	**Cost**	**Per%**	**Cost**	**Per%**	**Cost**	**Per%**	**Cost**	**Per%**	**Cost**	**Per%**
Buying price					13						15	
Operating cost												
Labor cost					0.05	1.86					0.05	1.68
House rent					0.25	15.32					0.25	15.32
Electric power					0.08	4.04					0.08	4.04
Water					0.25	15.32					0.25	15.32
Sugar					0.50	30.64					0.50	30.64
Materials					0.40	25.20					0.40	25.20
Others					0.15	7.62					0.15	7.62
Total operating cost					1.68						1.68	
Total production cost					14.68						16.68	
Selling price					30						31	
Gross margin/profit					17						16	
Net margin/profit					**15.32**						**14.32**	

Where selling and buying price determined here in ETB and 1 USD was equivalent to 43.64 ETB in survey time

Marketing Margin

The marketing margin is a metric used to quantify the expense of providing marketing services. It is defined as a function of the price differential between the farm and retail prices of a specific farm product. Price changes for marketing inputs, farm supply, and retail demand are the main factors affecting the margin (Fig. 3).

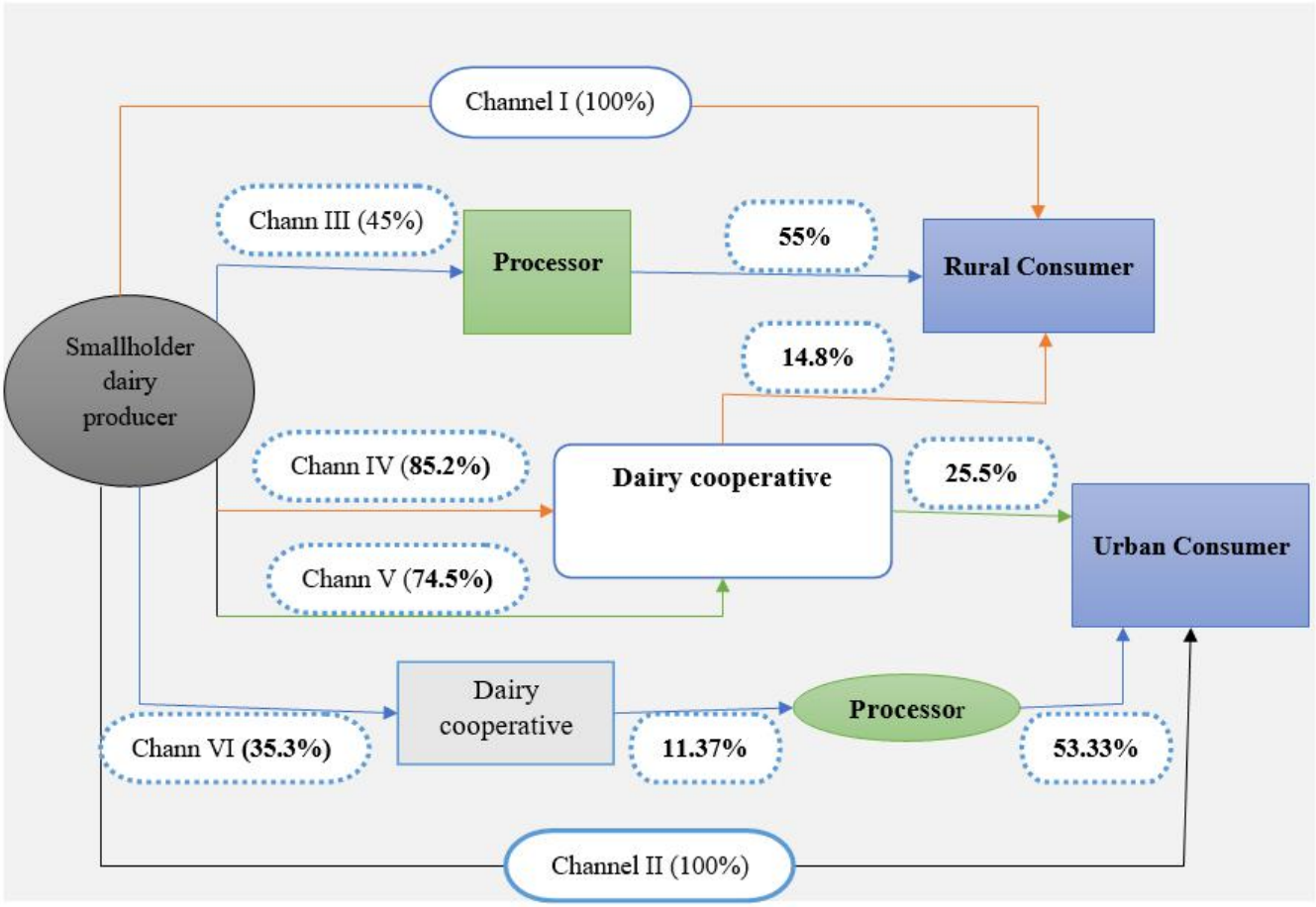

Fig. 3: Actors' market price shares from the end user

A summary of the marketing margin between various participants in various channels is shown in Table 7. Channel VI has the largest total gross marketing margin (TGMM), with channel III coming in second with TGMMs of 55% and 48.38% of the consumer price, respectively. On the other hand, the producers, hotels, cafés, and dairy cooperatives that deal in milk have the highest gross marketing margins, accounting for 100% of the consumer price in channels I and II, 55% in channels III, and 25.5% in channels V.

Table 7: Summary of marketing margins for milk traders in different marketing channels

Marketing Margin	**Milk Marketing Channels**					
	I	II	III	IV	V	VI
TGMM	0	0	55	14.8	25.5	48.38
GMMP	100	100	45	85.2	74.5	35.3
GMMCO				14.8	25.5	13.3
GMMCH			55			53.3
NMMCO				6.43	13.35	9.11
NMMCH			53.33			46.73
FCP	13	15	30	15	16	31

Where FCP is final consumer price stated in ETB and 1 dollar was equivalent to 43.64 in survey time

The producer's share (GMMp) is highest (100%) in consumer prices in Channel I and II, but lowest (35.3% and 45%) in consumer prices in Channel VI and III. TGMM is lowest, accounting for 0% of the consumer price. This is due to the fact that those channels were longer than other marketing channels in comparison. The hotel and café in channels III and VII have the largest NMM, accounting for 46.73% and 53.3% of the total. The highest consumer price in both marketing channels (over 30 ETB/liter) is the cause (Table 7).

Determinants of Milk Market Participation Decision

Table 8 presents a summary of the binary Probit (participation) equation results. Households make the decision to sell or not in the first step. The Probit Maximum Likelihood technique was used to estimate the decision to engage in the binary market. In order to examine the sample of smallholder dairy producer households, it was found that 65.2% of them participated in the milk market, while 34.8% did not.

Six (6) variables were identified from a set of thirteen explanatory variables to be used in the Probit/participation equation to calculate the probability of cow milk market participation. The following factors are included in the Table 8: the number of children under five (NUNDF5), the number of owned milking cows (TTLMLKCOW), the income from non-dairy sources (INCNONDS), the frequency of interaction with extension services (EXTSSFREQ), the volume of milk yield per day (MLKTLD), and the milk market information (MKTINFO).

Table 8: First-stage probit estimation results of probability of milk market participation decision

Variables	Coefficient	St. Err	z-value	P>|z|	Marginal Effect
MMP					
HHEX	-0.1689	0.446	-0.38	0.705	0.662
AGE	0.01310	0.028	-0.46	0.648	4.338
FSZ	0.35453	0.247	1.44	0.151	5.230
NUNDF5	-1.11567	0.437	-2.55	0.011**	1.559
EDUCLVL	0.079024	0.126	0.62	0.533	1.191
LAHLSZ	-0.81678	1.106	-0.72	0.460	0.373
TTLMLKCOW	1.424167	0.646	2.20	0.028**	1.824
CRUSE	-2.67134	38.498	-0.07	0.945	-0.025
DTWM	-0.07340	0.0756	-0.97	0.332	4.240
INCNONDS	0.00370	0.000	2.08	0.037**	5.765
EXTSSFREQ	-1.21772	0.311	-3.91	0.000***	2.980
MLKTLD	1.25004	0.382	3.27	0.001***	3.346
MKTINFO	1.84255	0.991	1.86	0.063*	0.377
Constant	-3.2354	2.884	-0.66	0.292	
Dependent Variable = Household Milk Market Participation				Predicted Success = 73	
Number of observation = 204				Chi-Square = 202.36	
Censored observation = 133				Prob> χ^2 =*0.000*	
Uncensored observation= 71					

Where, ***, ** and * indicated that statistically significant level at 1%, 5% and 10% respectively

Determinants of milk market supply

Seven (7) explanatory variables—including inverse Mill's ratio (LMBDA)—out of the thirteen hypothesized explanatory variables in the selection equation of the model were found to be significant determinants of the level of cow milk volume marketed surplus. These explanatory variables affected milk market supply in Heckman's two-stage model's second stage. They included the number of children under five (NUNDF5), the education level of the household head (EDUCLVL), the number of milking cows owned (TTLMLKCOW), the frequency of extension services contact frequency (EXTSSFREQ), the volume of milk yield per day (MLKTLD), and Inverse Mill Ratio (/Mill Ratio) (Table 9).

Table 9: Estimation result of Cow milk supply equation model

Heckman Selection Model –two-step estimates			Number observation =204		
(Regression model with sample selection)			Censored observation =133		
Dependent variable = Milk Market Volume			Uncensored observation =71		
			Wald χ^2 (13) = 572.31		
			Prob> χ^2 = 0.000		
MMV	**Coef.**	**St.Err**	**z-value**	**p>|z|**	**Sig**
HHSEX	-0.078	0.126	-0.62	0.533	
AGE	0.011	0.009	1.23	0.219	
FSZ	0.041	0.056	0.72	0.471	
NUNDF5	-0.320	0.090	-3.56	0.000	***
EDUCLVL	0.096	0.039	2.48	0.013	**
LAHLSZ	-0.449	0.315	-1.43	0.154	
TTLMLKCOW	0.123	0.066	1.85	0.044	**
CRUSE	-0.136	0.385	-0.35	0.723	
DTWM	0.018	0.016	1.11	0.269	
INCNONDS	0.000	0.000	-0.27	0.791	
EXTSSFREQ	-0.132	0.056	-2.37	0.018	**
MLKYLD	0.538	0.035	15.23	0.000	***
MKTINFO	0.191	0.133	1.44	0.151	
/Mill Ratio	0.507	0.181	2.81	0.005	***
_cons	-1.156	0.679	-1.70	0.089	*
rho	0.2825				
sigma	0.0822				
lambda	0.0232		2.81	0.387	

Where, ***, ** and * indicated that statistically significant level at 1%, 5% and 10% respectively.

Dairy Production and Marketing Constraints

In the discussion section, a number of obstacles that prevent the cow milk value chain from thriving and hinder dairy productivity are discussed. Table 10 provides a brief overview of the main obstacles. The current limitations were recognized and articulated at the Woreda and Kebeles levels that were chosen, and the Likert rating result showed that the importance of the issues (constraints) varied

throughout Kebeles. As a result, although one constraint can cause issues for one Kebeles, another might not necessarily do so for the other. The respondents ranked various obstacles and chokepoints in the dairy production and marketing system, ranging from the first (ranked first) to the eleventh (ranked eleventh).

Nonetheless, the top five obstacles noted by stallholders are prevalent issues in the chosen Kebeles and pose serious challenges to dairy production. According to the Likert rank analysis, the top five restrictions were diseases, market issues, predators, a lack of veterinary care, and issues with thieves. This is consistent with the findings of Sharo (2015) and Nardos (2010), they reported that seasonality in milk demand, a lack of formal marketing systems, land constraints for sustainable dairy development, high costs and shortages of animal drugs, a lack of knowledge regarding improved dairying, and difficulty obtaining credit for business expansion all contribute to lower productivity levels for dairy cow milk (Tsegay and Gebreegziabher, 2015, Tegegne, 2017).

Dairy Cattle Health

The majority of responders from the chosen Kebeles reported having udder infections in their dairy herds, with Achua, Pulkod, and Waar having the highest rates. While all the farmers in the Woreda region utilized traditional treatments to treat their sick animals, only a small percentage of the sampled HHs used veterinary drugs. A small yield rate was the productivity that the remaining responders were pushing, with over half discarding the milk produced from sick udders. While half of the household heads in Pulkod and Waar reported both lumpy skin disease (LSD) and foot and mouth disease (FMD), mastitis was the other most common dairy cattle condition.

Previous research conducted in several regions of Ethiopia revealed that the most common health issues affecting dairy cattle were FMD, mastitis, anthrax, pasteurollosis, blackleg, and LSD, according to (Andualem, 2015). This suggests that one of the main illnesses that result in significant financial loss is mastitis. Thus, for dairy production to be viable over the long term, farm earnings are greatly impacted by the health of the cows (Asrat, et al. 2016).

Market Challenges:

According to this research, the main issue dairy farmers and other market participants (hotels, cafés, dairy cooperatives, and consumers) in Itang Woreda were facing was a lack of a milk market. The low milk productivity, seasonality of the product, the society's religion, the lack of information about the milk market, the lack of transportation, the long travel distance to the woreda market, and the perishable nature of the fluid milk are the reasons why it is difficult to access the market for an extended period of time.

Thus, this study agrees with (Felleke, 2010 and Deng, 2014), who found that the farmers in Itang district cited low milk quantity (37.5%), long distance to market (31.7%), spoiling (17.5%), and cultural limitation (13.3%) as the main barriers to milk marketing. Among the respondents, the most common constraints on the pastoral production system were the distance to markets (48.3%), spoilage (21.7%), inadequate milk (15%), and cultural limitations (15%).

Predator Challenges

Predation is a totally natural process in which the primary means of obtaining food is through the killing and consumption of other animals. However, it can become problematic when the predator becomes overly abundant or when it is seen inappropriate for humans to share individuals of a specific type of prey. It is likely that predation has been an issue since domestication and that it still is, necessitating current solutions. In contrast to previous research, the peculiarities discovered in this report were limited to the lowland regions and were not seen in many other parts of the nation (Hansson & Tranvik, 1996).

Ultimately, the biggest loss resulting from predation was that many dairy farmers chose not to raise a herd of cattle because they thought the losses from predation might not be profitable. This leads to the loss of rangeland improvement that can come from mixed-species grazing, as well as the loss of potential revenue for the producer and the community to which they contribute. As a result, instead of being dairy producers, the producers decided to focus

more on crops, which should have resulted in lower milk output (Misganaw et.al, 2017).

Thieves

A total of 54% of respondents from the tested dairy households mentioned having to deal with nighttime raids in the forest or at home. Similar to predators, thieves bring the farmer complete financial losses since they quickly deplete a significant amount of their assets due to outside human and environmental variables.

Lack of veterinary service

According to the Likert Rank Analysis of this study, the fourth-most common complaint was veterinary services. Nearly all of the respondents from the sampled household heads reported having trouble accessing veterinary care due to two factors: (1) extension service agents' inaccessibility to some remote areas of Pulkod and Waar; and (2) the high cost of the medications they charge, which forces the producers to resort to conventional methods in an attempt to save their dairy cattle. Other issues faced by dairy farmers in the research areas were a lack of expertise in various facets of dairy activity and the scarcity of government veterinary services, which further restricted the provision of animal health services (Table 10).

Table 10: Likert Rank Analysis of dairy producers' constraints in selected Kebele, Itang Woreda

Constraints/Challenges	Selected Kebele						Woreda level	
	Achua Kebele		Pulkod Kebele		Waar Kebele			
	Index	Rank	Index	Rank	Index	Rank	Index	Rank
Shortage of grassland	-----	-----	----		-----		-----	**----**
Health/disease problem	0.1450	1	0.1311	2	0.1445	1	0.1402	**(1)**
Scarcity of labor	0.1124	8	0.0214	9	0.1378	4	0.0905	**(8)**
Predators	0.1311	5	0.1200	5	0.1402	3	0.1304	**(3)**
Water scarcity	-------	-----	-----	-----	0.0124	9	0.0124	**(11)**
Lack of supplementary feed	-------	-----	-----	-----	-----	-----	-----	**----**
Market problem	0.1354	3	0.1331	1	0.1432	2	0.1372	**(2)**
Drought/problem	0.1202	7	0.1154	6	0.1121	8	0.1159	**(7)**
Lack of shelter	-----	-----	0.0351	8	-----	-----	0.0351	**(9)**
Lack of veterinary service	0.1302	6	0.1256	4	0.1215	5	0.1258	**(4)**
Mastitis	0.1361	2	0.1153	7	0.1123	7	0.1212	**(6)**
Abortion	0.0245	9	------	----	-----	----	0.0245	**(10)**
Thieves	0.1325	4	0.1302	3	0.1132	6	0.1253	**(5)**

Where (-----) indicated the factors NOT considered as constraint at the selected areas and strength of importance increase from deep pink to light yellow.

V. CONCLUSION AND RECOMMENDATION

The goal of the study was to examine the cow milk value chain in the setting of Itang Special Woreda in Gambella, Ethiopia. The results showed that the income of smallholder dairy producer households was positively/negatively and significantly impacted by the number of children under five, the number of milking cows owned income from non-dairy sources, the frequency of contact with extension services, the volume of milk yield per day, and the availability of milk market information.

According to the model's empirical results, "the probability of dairy producers participating in the milk market and providing volume to the market is significantly influenced by the number of children

under the age of five, the education level of the household head, the number of milking cows they own, the frequency of their interactions with extension services, and the volume of milk yield they produce each day." According to the aforementioned, the top five obstacles were, in that order, veterinarian extension services, predators, thieves, lack of market, and dairy health issues. Consequently, as a result of such factors, smallholders' milk yield has declined, which also causes producers to stop taking part in milk marketing.

The findings indicated above lead to the following recommendations:

- The market is the main issue in dairy production, and it makes it more difficult for small-scale dairy farmers to make a profit. The simplest way to address this issue and prevent producers from losing milk due to a lack of market is to establish processors close to collectors and producers. This will also make it easier for producers to obtain information about the milk market.
- The dairy cooperative should function as a formal marketing structure to change the mindset of farmers who wish to sell their fluid milk directly to consumers if it is renovated to a very active level. Other interested parties can accomplish this by setting up milk processors, but Gambella Agricultural Marketing and Promotion Agency (GAMPA) should operate here as the primary actor in obtaining information on the milk market.
- The absence of veterinary services was the other production issue. The majority of the families included in the sample required veterinary care to address widespread health issues with their dairy cattle; nevertheless, these households found it difficult to communicate with farmers, and the cost of medications was prohibitive for small-scale dairy farmers. A variety of stakeholders, including NGOs, traders, input suppliers, veterinarian service providers, researchers, and other interested parties, are needed to address these issues.
- The research area also has the issue of being hard to control when it comes to predators and thieves. Enough police should be deployed as part of the Woreda administration's security performance to prevent the former. To combat the latter, well-built barriers should be used to keep lions and hyenas from getting into the herd den. A variety of players, including dairy guarding farmers, material suppliers, traders, financial institutions, non-governmental organizations, the government, and other interested parties, are needed to address this issue.
- Finally, it was noted that the majority of Woreda's smallholder dairy farmers use traditional dairy production methods, which have a negative impact on milk output. One strategy to help dairy producers increase their revenue by operating their dairy farm expertly and fetching a good price in the market is to raise knowledge of the importance of quality milk production and to enhance their ability for it. NGOs and local extension agents are important collaborators in raising awareness of the significance of productivity and production.

ABBREVIATIONS

AGP: Agricultural Growth Program; AMA: Agriculture Marketing Agency; ASF: Animal Source Food; CSA: Central Statistics Agency; DCA: Danish Church Aid; FAOSTAT : Food for Agriculture Organization Statistics; FIAS :Faculty and Institute of Animal Science; FCP: Final Consumer Price; GAMPA: Gambella Agricultural Marketing and Promotion Agency; GARI: Gambella Agricultural Research Institute; GPNRS: Gambella People National Regional State; Ha: Hectare; ILRI: International Livestock Research Institute; INGOs: International Non-Governmental Organizations; KM : Kilometer; LDMP : Livestock Development Master Plan Study; LIVES: Livestock and Irrigation Value Chains of Ethiopia Smallholder; MNL : Multi Nominal Logistic ; NMP : Net Marketing Margin; OARD: Office Of Agriculture and Rural; Development; SNNP: Southern Nations Nationality People; TGMM : Total Gross Marketing Margin; TGPM : Total Gross Producer Margin; TOE :Total

Operating Expense; VCA: Value Chain Analysis; VSLA: Village Saving and Loan Association

ACKNOWLEDGMENTS

The authors would like to thank the Gambella Agricultural Research Institute for providing the data for this study. This study would not have been accomplished without the close assistance of the local community, the district agricultural offices, and development agents. Therefore, we thank all the people of the Gambella region.

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