AGRO PRODUCTIVIDAD

Colegio de Postgraduados

Cow milk production cost in a semi-specialized system in the mountainous region of Veracruz, Mexico

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ABSTRACT

Objective: To analyze cow milk production cost in farm production units (UPPs), in a semi-specialized system, in the mountainous region of Veracruz, Mexico.

Design/Methodology/Approach: A questionnaire was applied to milk producers; additionally, the production units were visited.

Results: The main elements of the variable cost of milk production included: feeding, animal health, and fuel (86% of the total). The workforce accounted for 35 to 60% of the fixed costs. The production cost per liter fluctuated between USD$0.26 and USD$0.352 and the selling price ranged from USD$0.28 to USD$0.30; consequently, the profit margin is low. The profit per liter of milk fluctuated between USD$0.02 and USD$-0.04. The improvement in milk quality can increase profitability.

Study Limitations/Implications: The analysis focuses in the last year of operations and only takes into account six production units; therefore, the conclusions are only valid in that context.

Findings/Conclusions: Some UPPs have a positive profit; however, the combination of production factors must be reviewed. Additionally, in order to guarantee that more producers obtain a profit, some adjustments must be made.

Key words: Economic analysis, dairy cattle, milk quality, profitability.

Citation: Gudiño-Escandón, R. S., Loyo-Soberano, N. M., & Villagómez-Cortés, J. A. (2022). Cow milk production cost in a semi-specialized system in the mountainous region of Veracruz, Mexico. *Agro Productividad*. https://doi.org/10.32854/agrop.v14i6.2213

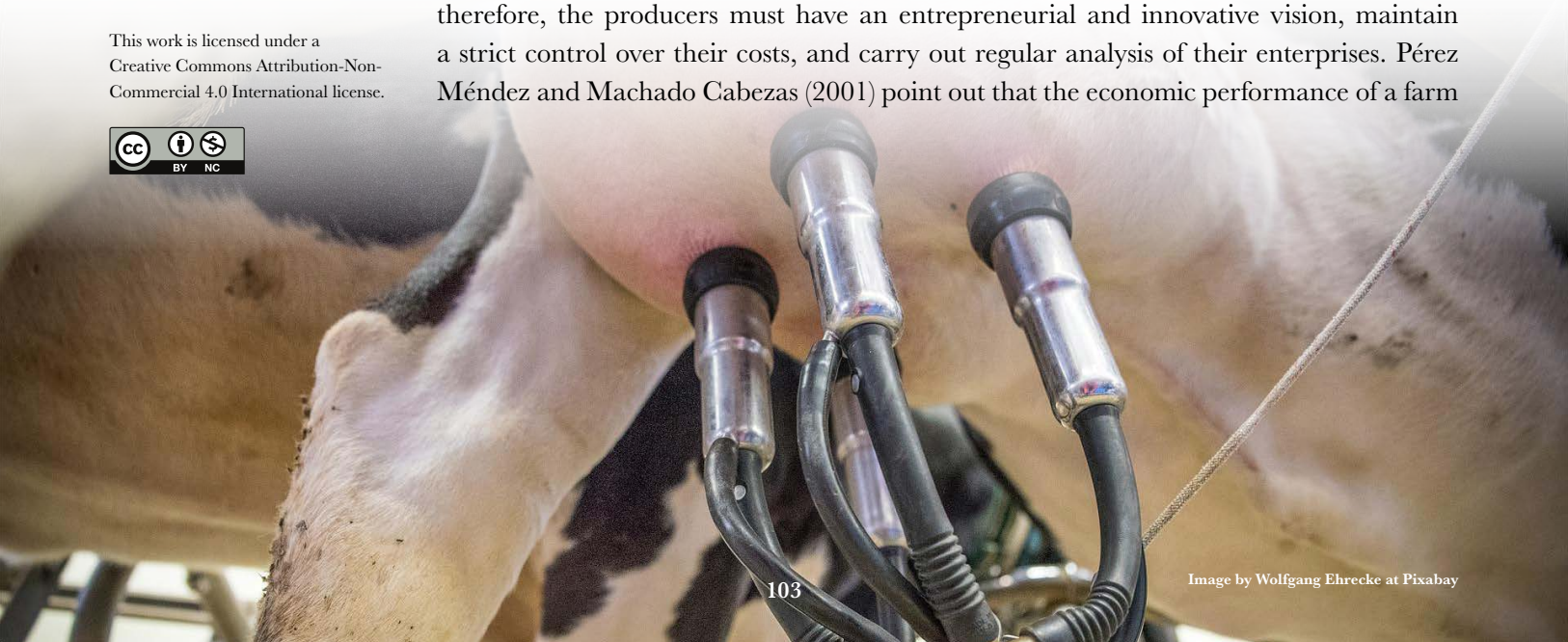
Academic Editors: Jorge Cadena Iñiguez and Libia Iris Trejo Téllez

Received: January 31, 2022.
Accepted: May 19, 2022.
Published on-line: July 01, 2022.

Agro Productividad, 15(6). June. 2022. pp: 103-109.

INTRODUCTION

Agricultural businesses have the same complexity than any other economic sector; therefore, the producers must have an entrepreneurial and innovative vision, maintain a strict control over their costs, and carry out regular analysis of their enterprises. Pérez Méndez and Machado Cabezas (2001) point out that the economic performance of a farm



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depends on the ability of the managers to guide the farm production unit (UPP) towards the optimization of its profits, using economic techniques that can help them during the decision-making process. Profits must be planned, it is not just something that producers can expect to obtain at the end of the year (Makeham and Malcom, 1986).

Additionally, during the last years, the livestock sector has changed at an unprecedented pace. As a result of the innovative technologies and the structural changes in the sector, livestock production has experienced a significative increase (FAO, 2019). Nevertheless, millions of people in rural areas still use traditional cattle production systems, which are their livelihood and guarantee the food security of their families (FAO, 2021). In Mexico, milk production is carried out in different ecological regions and producers utilize different production systems (Loera and Banda, 2017). In Veracruz, the semi-specialized system is mainly used in the mountainous region (Pérez *et al.*, 2004). However, the number of studies about the semi-specialized system is very small; therefore, the objective of this study was to evaluate the economic situation of farm production units (UPPs) that carry out their production activities using the semi-specialized system and to offer recommendations aimed to achieve a higher economic efficiency.

MATERIALS AND METHODS

The work field stage of this study was carried out from January 2021 to May 2021, in Xico, Ixhuacán de los Reyes, and Jilotepec, in the mountainous region of Veracruz, Mexico. A survey was exclusively carried out with cattle farmers who use a semi-specialized dairy system. The producers took part in the survey voluntarily. The milk production cost was calculated using the FIRA (Trust Funds for Rural Development) methodology proposed by Trejo-González and Floriuk-González (2010).

The six farm production units (UPPs) that were studied developed their livestock activities with a milk production semi-specialized system, using *Bos taurus* genotypes (Holstein and Brown Swiss). All the UPPs use mechanical milking, twice a day. Animals graze mainly on rye grass (*Lolium hybridum*), kikuyo grass (*Pennisetum clandestinum*), and white clover (*Trifolium repens*); they also have unlimited access to water and mineral salts. Cattle is fed twice a day (during the morning and the afternoon), in a field rotation system. During the milking, they also receive a concentrate supplement —18% protein: 1 kg per every three liters of milk produced by the cow—, divided into two portions (morning and afternoon). The six UPPs developed a health program that includes de-worming, vitamins, and vaccination (bovine rabies, clostridial disease, and pasteurellosis). The six UPPs use artificial insemination, with reproductive status diagnosis.

A convenience selection process was used to choose the cattle farmers that took part in the study. For this purpose, the profile of the research subject was defined. Cattle farmers who own semi-specialized milk production enterprises were chosen. Additionally, they should be enrolled in the programs developed by the Secretaría de Agricultura y Desarrollo Rural (SADER) (national level) and the Secretaría de Desarrollo Agropecuario, Rural y Pesca (SEDARPA) (state level). Producers must also have production and economic records and they should be willing to share their information and take part in the study.

The producers that met the selection criteria and agreed to take part in the research were subjected to a survey that covered the following points: their production units, the identification data of the enterprises, the available resources, the production volume, the technologies they use, the list of their assets, and their cost and sales strategies. During the visits to the production units, we checked the facilities, the animals, and the logbooks. All the field data for each production unit were input into a Microsoft Excel spreadsheet. The data were subjected to a descriptive statistical analysis. All the values were converted to US dollars.

RESULTS AND DISCUSSION

Characteristics of the chosen UPPs

Just like other UPPs, milk producers have a limited control of the technical-administrative information (Parra-Cortés and Magaña-Magaña, 2019); consequently, only six enterprises with records agreed to take part in the study. The average size of the properties is 18.33±7.45 ha (8-30 ha), with a herd of 63.17±38.31 heads (37-139 heads), and an animal stock average of 4.07±3.38 AU ha^{-1} (2.1-10.7 AU ha^{-1}). Most of the herds have similar characteristics.

Technology use and productive indicators

Overall, there is a high use of technology. All the UPPs carry out health (vaccination, de-worming, and other) and mineral supplementation practices. Cows receive concentrate supplement, stubble, and fodder. All UPPs carry out only artificial insemination. The differences in size, management, and use of technology in the UPPs determines differences in the production; consequently, calving rate fluctuates between 60 and 85%, the production per cow varies from 6 to 16 kg d^{-1}, and milk production per lactation per cow ranges from 3,000 to 7,560 kg. The average calving rate of the UPPs in the study was 74.16±11.58%. The average milk production per lactation was 4,785±1,511.21 kg. In fact, only UPP1 had a milk production per lactation of 7,560 kg. Five UPPs sell calves five days after they are born, with an average weight of 38.5 kg; however, one UPP sells 200-kg breeding bulls, at twice the price per meat kg.

Income

In this production system, the income comes from selling different products and each product contributes a different rate of the said income. Milk production accounts for the highest percentage of the income and, to a lesser degree, fattened male calves and heifers, as well as cull cows, also contribute to the income. The selling price per unit fluctuated between USD$0.28 and USD$0.30 per liter of milk. The annual amount of milk sold per UPP ranged from 40,000 to 219,000 L, accounting for 77.33-97.44% of their total income. The total annual average of income per UPP was USD$29,830.51±19,085.78 (USD$13,532.53-$66,043.37). The average income of milk sales was USD$27,224.10±18,750.85 (USD$12,144.58-$62,269.88) (Table 1). Osorio (2001) pointed out that a low production level is characterized by a negative economic margin per liter; consequently, producers lose money and must sell other products.

Table 1. Income and sales rate of milk, calves, cull cows, and breeding bulls of six farm production units in the mountainous region of Veracruz, Mexico.

Farm	Total income (US$)	Income from milk sales (US$)	Income from milk sales (%)	Income from calves sales, (US$)	Income from calves sales (%)	Income from culling cows, (US$)	Income from culling cows (%)
1	33,850.60	32,983.13	97.44	867.47	2.56	-	-
2	24,053.01	22,361.45	92.97	650.60	2.70	1,040.96	4.33
3	16,881.93	13,055.42	77.33	2,342.17	13.87	1,484.34	8.79
4	24,621.59	20,530.12	83.38	3,513.25	14.27	578.22	2.35
5	66,043.37	62,269.88	94.29	650.60	0.99	3,122.89	4.72
6	13,532.53	12,144.58	89.74	867.47	6.41	520.48	3.85

Structure of cost production

In average, the total cost was USD$31,550.26±22,691.54, resulting from the addition of variable costs (USD$23,664±17,614.31) and fixed costs (USD$7,886.18±5,312.34) (Table 2). Out of the variable costs, the headings in which the UPPs had the highest average expenditurewere:feeding(USD$15,964.28±12,378.96),health(USD$2,144.59±1,901.29), fuel (USD$2,006.10±938.03), mineral supplement (USD$1,318.38±1,370.46), technical support (USD$1,028.12±141.87), insemination (USD$734.94±557.41), grassland maintenance (USD$630.52±563.89), and NLIS (National Livestock Identification System) ear tags (USD$56.87±29.13). The average values for fixed costs were: regular workforce (USD$5,833.90±4,445.63); opportunity costs (USD$1,444.25±765.74); depreciation (USD$318.87±184.94); and management (USD$289.16).

Variable costs accounted for 63.20 and 83.26% (73.81%±7.54) of the total cost, while fixed costs ranged from 16.74 to 36.8% (26.20%±7.54). These results do not match those reported by Sánchez-Medina *et al.* (2018), who conducted research in 24 family farms in the State of Mexico and recorded variable costs that accounted for a 90.7% average. The main elements of variable production costs were feeding, health, and fuel. These components accounted for 86% of the total cost. The average values were: feeding (67.46%), health (9.06%), fuel (8.48%), mineral supplement (4.64%), technical support (4.34%), artificial insemination (3.11%), grassland maintenance (2.66%), and NLIS ear tags (0.24%). According to Moran (2009) more than half of the costs of small dairy enterprises are related to feeding; consequently, Moran recommends growing forage instead of buying it. Additionally, Moran suggests using the milk sales income minus the feeding cost as a profitability indicator, because it is simple and easy to measure. The average percentages of each fixed cost heading were: regular workforce (73.98%), opportunity costs (18.31%), depreciation (4.04%), and management (3.67%). Given that fixed costs are not impacted in the short term by the production volume and are independent of the production activity of the UPP, they must always be kept at a minimum (Novaes *et al.*, 2001).

Livestock products are the sole source of financial resources for the production system. Three UPPs surpassed the break-even point and entered the profit stage. The net margin fluctuated between −19.15 (UPP6) and 11.28 (UPP5).

Table 2. Income and production costs of six farm production units in the mountainous region of Veracruz (US$).

Item	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Farm 6
Feeding	21,227.23	9,700.96	4,915.66	12,243.37	38,664.82	9,033.64
Drugs and vaccines	2,438.55	1,132.53	608.67	1,903.61	5,783.13	1,001.06
Fuel	2,313.25	1,610.60	1,132.53	1,610.60	3,759.04	1,610.60
Mineral supplement	667.90	699.57	554.12	6,07.52	3,759.04	911.28
Technical asistence	1,204.82	963.86	963.86	867.47	1,204.82	963.86
A.I.	722.89	578.31	265.06	530.12	1,831.33	481.93
Pasture management	867.47	307.23	307.23	307.23	1,686.75	307.23
NLIS eartags	28.92	49.16	31.81	52.05	106.99	72.29
Total, variable costs	29,471.03	15,042.22	8,778.94	17,514.45	56,795.92	14,381.89
Variable costs, %	79.18	66.80	63.20	74.57	75.82	83.26
Labor	6,265.06	5,397.59	3,759.04	4,096.39	14,216.87	1,268.43
Opportunity cost	952.53	1,546.80	819.28	1,343.33	2,912.00	1,091.57
Depreciation	243.37	243.37	243.37	243.37	696.39	243.37
Administration	289.16	289.16	289.16	289.16	289.16	289.16
Total, fixed costs	7,750.12	7,476.92	5,110.84	5,972.24	18,114.41	2,892.53
Fixed costs, %	20.82	33.20	36.80	25.43	24.18	16.74
Total Costs	37,221.15	22,519.14	13,889.79	23,486.70	74,910.34	17,274.42
Total Income	33,850.60	24,053.01	16,881.93	24,621.59	66,043.37	13,532.53
Gross Margin, USD$	−3,371	1,534	2,992	1,135	−8,867	−3,742
Gross Margin, %	−9.96	6.38	17.72	4.61	−13.43	−27.65

Milk production cost

The unit cost of production is an excellent indicator of competitiveness (Muñoz-Luna and Rouco Yañez, 1997; Lobos *et al.*, 2001). The sold milk volume fluctuated between 40,000 L (UPP 6) and 219,000 L (UPP 5), the cost production ranged from USD$0.268 (UPP2) to USD$0.386 (UPP6), and the selling price varied from USD$0.29 (UPP2) to USD$0.315 (UPP3 and UPP6); therefore, the production cost in UPP2, UPP3, and UPP5 was lower than the selling price, unlike UPP1, UPP4, and UPP6. The production cost varies vastly between UPPs. It is the result of the decisions that each producer makes regarding the investment and the management of available resources. The cost per liter does not depend on a higher milk production, but on an efficient management and the reduction of variable costs (particularly, feeding).

Holmann (1998) pointed out that the most intensive milk production system does not generate an increase that is proportional to the investment levels required to achieve profitability. This situation must be evaluated in the livestock production context and under low economic resources conditions. Strategies and mechanisms must be identified to allow producers to achieve a better combination of production factors, aiming to create a financial fluctuation that will provide them cash throughout the year.

Vázquez-Selem *et al.* (2020) evaluated the economic efficiency of a dual-purpose system (SDP) and a dairy family enterprise with a semi-specialized system in Veracruz.

They pointed out that there is direct correlation between technology implementation and the financial profitability and the economic efficiency that the producers can achieve. Consequently, mechanisms and policies aimed at the technological upgrading of the milk production systems must be developed. Meanwhile, as part of their analysis about family milk production in the Valle del Mezquital, Espejel-García *et al.* (2016) interviewed 66 selected milk producers and identified five innovations that improved production: silage feeding, artificial insemination, mechanical milking, quality analysis, and integration into a collective tank.

Identification of improvement points

Overall, the improvement points that were identified have a direct relationship with milk quality and they impact the final price of milk. According to the survey results, the main problems that the UPPs face are sub-clinical mastitis (66%) and the presence of solids in the milk (50%). All the producers in this study sell their milk to Liconsa, Nestlé, or to a cheesemaker. The enterprises award quality bonuses to producers who comply with low levels of somatic cells and reductase; who do not use antibiotics; whose product has good protein and fat content; whose certificate of herd free of brucellosis and tuberculosis is in force; who produce up to 3,000 L; and who deliver the milk to the enterprise in an ongoing and permanent basis. For their part, cheesemakers do not buy milk based on its quality and they handle the payment according to the time of the year (USD$0.22-USD$0.31).

CONCLUSIONS

Feeding is the main concept that determines milk production cost in units that use semi-specialized systems, in the mountainous region of Veracruz. This aspect can be used as a good predictor for milk production cost, based on the current market prices in the study region.

In the case of producers who sell their product below its actual production cost, most of their income comes from selling milk and their variable costs account for 80% of the total cost. Consequently, they should carry out adjustments. Improving milk quality would help to obtain a higher sale price. However, producers must reduce the number of somatic cells and reductase, guarantee the continuity of the cooling chain, and make sure that there are no antibiotic residues in their milk production.

Keeping records and economic and production indicators will allow the UPPs to plan their improvement activities, making them more effective, optimizing their workforce, and looking for less expensive feeding alternatives. This type of study must be carried out periodically in order to determine profitability changes in the UPPs and to provide a wider and brief scope for the decision-making process. Finally, the transformation of UPPs into appropriate legal entities would help them to commercialize their products and would facilitate their access to new markets and diverse financial entities.

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