Cost of producing a replacement heifer in family dairy system

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ABSTRACT

Objective: To estimate the production cost of a replacement heifer in the family dairy system of the Los Altos Region of Jalisco, Mexico, providing economic evidence to support ranchers' decision-making in the region.

Design/methodology/approach: Information was obtained from three dairy farmers in the family farming system located in Tepatitlán, Jalisco, from May 2019 to May 2022, through the design and implementation of monthly tracking forms for technical and economic information. The unit of analysis was the heifer, with information obtained from 297 animals. These data were integrated into a database to analyze the activities and technologies implemented in the zootechnical areas and to estimate the unit cost of production of a heifer (CUPV). The CUPV was calculated by summing the quantity of each input used multiplied by its respective price in each production unit and dividing the result by the number of heifers produced.

Results: Eleven of the 17 activities and technologies analyzed were implemented by all three production units during the study period. None of the units had calving facilities or hired staff exclusively dedicated to calf care. The only activity that improved during the study period was the implementation of the progressive weaning method. The average CUPV was $37,789, with feed representing 96%, labor 1.4%, reproduction-related costs 1.3%, and health-related costs 0.6%.

Limitations on study/implications: Estimating the CUPV is essential to support milk producers' decision-making in generating their own replacement heifers.

Findings/conclusions: Producing a replacement heifer costs on average $37,789.00 from month 0 to first calving, with more than 90% of the total cost allocated to feed.

Keywords: Livestock economics, bovine milk, technology.

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INTRODUCTION

Bovine milk production in Mexico in 2024 was 13,553,069.380 thousand liters, with 2,713,534 cows in milk. Jalisco ranks first both in production and in number of breeding cows, with 2,845,110.294 thousand liters and 402,347 cows in milk, with 26,213 production units out of the 231,448 existing in Mexico (SIACON, 2024), which places it in second position nationwide in this category. It is estimated that milk production units in the state of Jalisco have an average of 15 breeding cows, with a production of 19.1 liters per cow per day (INEGI, 2022). These data show the importance of dairy activity in the state of Jalisco, but the number of breeding cows per production unit and the productivity per

cow indicate that the family or small-scale production system predominates. Within the state of Jalisco, the Los Altos region is one of the most important dairy regions, not only in the state but in the country; however, productivity levels and the use of technology are not optimal. A study conducted by Mariscal *et al.* (2017) mentions that the main problems faced by dairy producers in the region are related to high input costs, marketing problems, and other contextual threats, but it does not mention problems whose solution focuses on making the production process more efficient.

In studies reviewed on the problems of milk production in the Los Altos Region of Jalisco, the production of replacement heifers is not mentioned, which coincides with what was expressed by Barrón *et al.* (2025) regarding the limited research on heifer development and their productive and economic performance, which presents a dilemma in management and decision-making by ranchers, especially those in small-scale family systems where their priority is often to obtain an "immediate" income from milk sales and heifers are usually considered an extra economic burden (Barrón *et al.*, 2025). They also lack financial knowledge to decide what is more convenient, producing or buying their replacements, impacting their costs, as is done in other countries such as the United States, Canada, or the United Kingdom, where there are studies on the production costs of replacement heifers under different conditions, mentioning the advantages for dairy enterprises of buying or producing these replacements (Laflamme-Michaud *et al.*, 2025; Boulton *et al.*, 2017; Hawkins *et al.*, 2019). However, the lack of information in most production units also makes real cost calculation difficult, as it is not possible to separate the inputs used in raising replacement heifers from other livestock and agricultural activities.

Raising heifers from birth to first calving is a costly investment that requires at least two years to be integrated into milk production and begin to recover this investment (Hawkins *et al.*, 2019; Boulton *et al.*, 2017; and Laflamme-Michaud *et al.*, 2025). Heifer rearing is considered a significant cost, and it has been shown that the total cost of raising heifers ranks second in the annual operating cost of dairy production units (Heinrichs *et al.*, 2013; and Boulton *et al.*, 2015), accounting for up to 20% of production costs (Laflamme-Michaud *et al.*, 2025). However, milk producers in many important milk-producing countries, and dairy producers in Los Altos de Jalisco, Mexico, can undoubtedly be included, raise their replacement heifers aware that this is a costly activity, keeping (almost) all their newborn female calves with the aim of ensuring the availability of enough young females to replace cows that are eventually expected to be culled (Mohd *et al.*, 2015). Being aware that this is a high cost does not mean that producers know exactly "how costly" it is, as they often lack sufficient information to calculate it, since costs are rarely evaluated (Laflamme-Michaud *et al.*, 2025). Based on the above, the production costs of a replacement heifer in the family dairy system were estimated to provide economic elements to support ranchers' decision-making.

MATERIALS AND METHODS

Selection of production units

The participation of three conventional producers, convinced of the importance of providing information through the implementation of specific technical and economic

records for heifer production, was obtained in the municipality of Tepatitlán de Morelos, Jalisco, Mexico. The municipality is among those with the highest milk production at the state level, with a predominance of family or small-scale and semi-technified production systems (Ríos *et al.*, 2015). It is located in the Altos Sur region of Jalisco (Figure 1), Mexico, 80 km from the state capital (Guadalajara) (20° 48' 54" N, 102° 45' 31" W at 1880 m above sea level). It is part of the Bajío macro-region with a semi-warm semi-humid climate (type C(w1) according to Köppen-García), with average annual temperatures around 18-19 °C, rainy summers (June-August), and an average precipitation close to 870 mm (IIEG, 2021).

Integration of information

Monthly technical and economic monitoring formats were designed in the Excel® program and implemented from May 2019 to May 2022 in the three cooperating and representative production units of the family or small-scale dairy system. The technical monitoring formats included activities/technologies in the areas of feeding with six activities, four in management, three in pre-production, and three in health (Table 1). The record was made by marking the number 1 when the activity/technology was carried out and 0 when it was not.

The unit of analysis was the heifer, obtaining average information from 297 animals. The information was collected by a technician and subsequently compiled and analyzed.

Estimation of the cost of a replacement heifer

The estimation of the total cost was obtained by applying the following algebraic expression.

Source: Taken from IIEG, Statistical and Geographic Information Institute of the State of Jalisco, "General Map of Jalisco, 2012", and INEGI, 2025.

Figure 1. Geographic location of the municipality of Tepatitlán de Morelos, Jalisco, Mexico.

Table 1. Activities/technologies related to heifer rearing carried out from 2019 to 2022.

Area	Activities/Technologies
Feeding	Provide colostrum within the first 24 h
	Receives colostrum from the dam
	Feed the calf individually during the milk-feeding period
	Provide starter feed or concentrate prior to weaning
	Provide milk replacer
	First forage offering, days
Management	Apply a weaning method
	Daily cleaning of the calf hutch or pen
	Daily cleaning of utensils
	Exclusive staff for calf care
	Protection against prevailing winds
Reproduction	Apply a gradual weaning method
	Separate the calf from the dam
	Has a calving pen
Health	Navel disinfection
	Deworming of replacement heifers
	Vaccination of replacement heifers

Source: Author's own elaboration.

$$TC = VC + FC = Pr_{i...n} * Q_{i...n} = \left(Pr_{milk} * Q_{milk} + Pr_{milk\ replacer} * Q_{milk\ replacer} + Pr_{forage} * Q_{forage} + Pr_{concentrate} * Q_{concentrate} + Pr_{vaccines,\ dewormers\ and\ medications} * Q_{vaccines,\ dewormers\ and\ medications}\right) + Reproduction\ cost\left(18\ months - first\ calving\right) + FC$$

Where: TC=Total cost; VC=Variable cost; FC=Fixed cost; $Pr_{i...n} * Q_{i...n}$ =Price of input i to n multiplied by the quantity of input i to n.

The inputs considered in the variable feeding cost were the cost of milk, commercial milk replacer, forage (corn stover), and commercial concentrate; vaccines, dewormers, medications, and, in the 18 months-first calving stage, a reproduction cost. The labor cost was calculated based on the hours dedicated to heifers by permanent workers in relation to an eight-hour workday.

As a fixed cost in the short term, the proportional fraction of the depreciation of breeding cows was considered. Average production costs were obtained by growth stage, divided into: a) lactation from 0 to 60 days, b) post-lactation to 6 months, c) from 12 to 18 months, and d) from 18 months to first calving. The costs obtained were updated to 2024 using the annual inflation rate reported by INEGI (2025b). With the total costs obtained for each growth stage, unit costs were calculated by dividing the total cost per stage by the quantity produced.

Information analysis

The technical activity data and the economic data were validated with the technician; subsequently, labor calculations were performed, and average costs were estimated and updated. With the updated data, relative frequencies and averages were obtained.

RESULTS AND DISCUSSION

Activities and technologies for the production of replacement heifers

The three production units studied, located in the municipality of Tepatitlán, Jalisco, had a total of 743 confined Holstein cows, of which 402 were considered by the producers as high producers, 141 as medium producers, 105 as low producers, and 95 as dry cows. On average, the productive herd size was 248 animals, and the units had facilities for milk production such as roofed pens, drinkers and feeders, mechanized milking parlors, handling chutes, and areas assigned for calves and heifers, as well as land for grain and forage production and silos for silage production, all intended for milk production.

These producers are representative of the system, but also in their attitude toward carrying out specific activities/technologies to ensure proper development of the calves and heifers that will become part of production and of the producers' assets in the medium and long term. The activities/technologies were 16, grouped into feeding, management, reproduction, and animal health (Figure 2), of which 75%, 88%, and 63% were implemented in 2019 by Production Unit (PU) 1, PU2, and PU3, respectively.

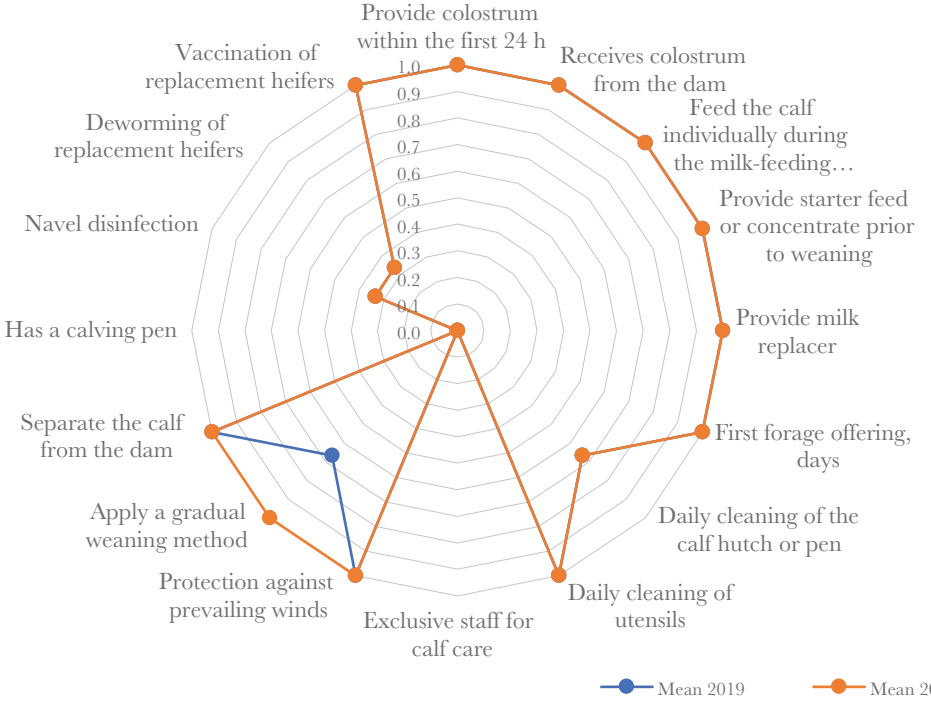

Figure 2. Average activities carried out for heifer production in the production units from 2019 to 2022. Source: Authors' own elaboration based on monitoring form data.

In 2022, the same number of activities/technologies was carried out, reflected in the same percentage obtained for PU1 and PU2; in the case of PU3, it increased to 69% with the implementation of the progressive weaning method (Figure 2). Within each area in the three production units analyzed, the six feeding-related activities were carried out at 100% both at the beginning in 2019 and at the end in 2022. Newborn females received colostrum from the mother within the first 24 hours after birth, approximately four hours after being born; they also received milk replacer to complement feeding since they were separated from their mothers. Calves were fed individually during the lactation stage. In the forage category, corn stover and silage were included, which were offered at approximately 60 days of age. In management, the cleaning of utensils and protection from prevailing winds stand out, activities carried out at 100% in the three units, unlike the daily cleaning of calf pens or corrals, which was only carried out in PU1 and PU2. In reproduction, the implementation of the progressive weaning method was the only activity not carried out in 2019 in PU3 and that had been incorporated by 2022. Umbilical disinfection and deworming of replacements were only carried out in PU2 (Figure 2).

Based on these data, more than 70% and up to 88% of the activities/technologies aimed at obtaining replacement heifers in good condition to be integrated into the productive herd were carried out in the production units. Considering that not all listed items are technologies and some remain only at the level of activities, this can still be explained as a high technological level, given that dairy producers in the state of Guanajuato under the same production system used technology within a range of 66% to 100% (Vélez *et al.*, 2013), and in dual-purpose small-scale production units the use of technology in general is higher than 50% (Espinosa *et al.*, 2018). However, these producers use more technology and carry out more activities in the areas of feeding and reproduction and genetics than reported by Vélez *et al.* (2013), with percentages of 64% and 69%, respectively, and they coincide in progress in animal health with more than 50%. On average, the producers had 99 animals for heifer replacement and a total of 297 (Table 2).

Cost of producing a replacement heifer in family or small-scale production units

The production cost of a replacement heifer in these units, considering the activities/technologies carried out during the production process by growth stage, averaged

Table 2. Animals intended for heifer replacement in 2022 by production unit.

Month and year	Calves in the milk-feeding period	Rearing from 3 to 6 months	Rearing from 6 to 12 months	Rearing from 12 to 18 months	Rearing from 18 months to first calving	Total
PU 1_May 2022	15	15	12	29	22	93
PU 2_May 2022	5	26	27	28	25	111
PU 3_May 2022	3	17	31	18	24	93
Total	23	58	70	75	71	297
Mean	8	19	23	25	24	99

Source: Authors' own elaboration based on monitoring form data.

$2,198.00 during the lactation stage, and the cost for the animal to enter as a productive cow at first calving increased on average to $35,592.00 Mexican pesos at approximately 24 months of age. The average cost of obtaining a replacement heifer at first calving, at 2024 prices, was $37,789, and consistency is observed in the increase in costs according to the physiological growth of the animals over time (Table 3).

Table 3. Production costs of replacement heifers by growth stage in the state of Jalisco.

Stage	Production Unit			Mean
	1	2	3	
Lactation	2,303	2,300	1,990	2,198
Post-weaning to 6 months	5,006	2,844	5,012	4,287
6 a 12 months	7,418	6,955	8,345	7,573
12 a 18 months	11,074	7,617	9,766	9,486
18 months-first calving	17,985	11,357	13,396	14,246
Total	43,786	31,073	38,509	37,789

Source: Authors' own elaboration based on monitoring form data.

The average total cost of producing a replacement heifer coincided with that reported by Takeaways (2024), which reported an average value of $38,797 ($2,904 Canadian dollars, with an exchange rate of $13.36 in 2024), based on data from 63 farms. Another study, with information from 1,972 farms located in Minnesota, United States, reported by Dairy Heifer Cost Variation from PennState Extension, Beck (2025), based on data from 2016 to 2021, mentions an average cost of a replacement heifer of $35,684 ($1,709 US dollars, at an exchange rate of $20.88 in December 2024).

Although production systems differ from those existing in Mexico, and specifically from the family or small-scale dairy system, these studies serve as references given the scarcity of national information.

In the structure of variable production costs on average, feeding represented 96%, labor 1.4%, reproduction-related costs 1.3% considered in the 18 months-first calving stage, and health 0.6%, with recurrent problems of diarrhea and umbilical infections (Table 4). The percentage of feeding is double that reported by Hawkins *et al.* (2019), who analyzed the costs associated with pre-weaning management strategies for raising heifers on dairy farms in the United States, estimating that 46% of the total cost was allocated to feeding. A similar situation was reported by Boulton *et al.* (2017) in 101 farms in the United Kingdom, with 46.4% from birth to weaning and 36.8% from birth to calving, and by Laflamme-Michaud *et al.* (2025) in Canada, with 87 conventional Holstein dairy farms in Quebec reporting 46%, as well as 73% in the study reported by Heinrichs *et al.* (2013) based on 44 farms in Pennsylvania, United States. However, in a study conducted on the dairy operation of the Alfredo Volio Mata Experimental Station of the University of Costa Rica by Elizondo and Solís (2018), the percentage of feeding cost was 86.19% from 3 to 16 months and 77.56% from 16 months to the age at first

calving. The percentage of feeding cost was high compared to other studies, and it is possible that the feeding plan for the animals exceeds the recommended percentages for newborn calves, with milk quantities ranging from 8% to 10% of body weight according to González *et al.* (2022), as well as the amount of concentrate supplied, which increased the average feeding cost.

By production unit, the highest feeding cost was observed in PU3 and, therefore, the percentages in the remaining categories were lower. The forage cost was included from the 3-6 months stage to first calving and included corn stover and silage. The labor percentage was lower than 1.5%, which can be considered low when compared with the results obtained by Hawkins *et al.* (2019), who reported 33% of the total cost allocated to labor, and 22.3% reported by Boulton *et al.* (2017) based on information from 101 farms in the United Kingdom; in the case of a study conducted in Canada by Laflamme-Michaud *et al.* (2025), labor represented 16% in 80 farms and 23% in 44 farms in Pennsylvania, United States. What is confirmed is the limited time that permanent staff working in the production units dedicate to heifer care, which averaged 2 hours per day, with payment at the minimum wage and without personnel exclusively assigned to calf care.

Table 4. Structure of production costs of replacement heifers in percentage terms.

Item	Feeding	Health	Reproduction	Labor
UP1	96.3	0.5	1.7	1.4
UP2	94.8	0.8	1.5	1.4
UP3	97.4	0.4	0.6	1.3
Mean	96.2	0.6	1.3	1.4

Source: Authors' own elaboration based on monitoring form data.

Feeding cost in the production of replacement heifers in family or small-scale production units

During the lactation stage, the calves were fed with cow's milk (produced at the PUs), commercial milk replacer, and concentrate. In PU3, milk accounted for 55% of the total feeding cost during lactation stage, with a total cost of $1,940, of which 11% was for milk replacer and 34% for concentrate. In PU1 and PU2, commercial concentrate represented 69% and 72%, respectively. During the following four stages, they were fed with forage and commercial concentrate. Forage represented 24%, 37%, and 32% of the total feeding cost in PU1, PU2, and PU3, respectively, while commercial concentrate accounted for 77%, 63%, and 68%. The total feeding cost was lowest in PU2, as its diet offered a smaller amount of concentrate and a larger amount of forage compared to the other two Pus, even though its lactation stage cost was higher than in PU3 and $88.00 lower than in PU1 (Table 5).

Table 5. Average feeding cost of producing replacement heifers by growth stage in the state of Jalisco at 2024 values in Mexican pesos.

Stage	UP1	UP2	UP3	Average
Lactation	2,251	2,163	1,940	2,118
Post-weaning to 6 months	4,843	2,663	4,853	4,120
6 to 12 months	7,224	6,747	8,203	7,391
12 to 18 months	10,879	6,896	9,298	9,024
18 months-first calving	16,976	11,000	13,229	13,735
Total	42,172	29,469	37,521	36,387

Source: Authors' own elaboration based on monitoring form data.

CONCLUSIONS

The use of technologies/activities by producers reflects the importance they place on using technologies and carrying out specific activities aimed at obtaining replacement heifers to be incorporated into the dairy herd, with more than 80% of activities/technologies implemented.

The production of heifers, whether for replacement or for sale to other producers, is an activity present in all milk production units and production systems, and it requires resources of all kinds for its development; therefore, estimating the cost of producing them becomes of utmost importance to support milk producers' decision-making. In this study, the average cost was $37,789.00 from month 0 to first calving, with more than 90% of the cost corresponding to feeding, which can serve as a reference to support decisions related to feeding programs, the acquisition of inputs at better prices, the review of labor activities and the number of hours dedicated to this activity, and the necessary and sufficient number of replacements to be generated and incorporated considering the average total and unit production costs.

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