Colegio de Postgraduados

Cost-benefit of implementing a vaccination and deworming program in dual-purpose production units in Veracruz tropics

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ABSTRACT

Objective: To evaluate the cost-benefit of implementing a Vaccination and Deworming Program (PdVyD) in commercial farms in the central region of Veracruz, Mexico.

Design/Methodology/Approach: Based on a survey, information on livestock health problems and practices was collected from eight farms located in six municipalities in this region.

Results: No farmer has an adequate program for controlling livestock diseases, so it would be useful to rely on a PdVyD. Cattle deaths were recorded in all farms. Average cost per head in Mexican pesos (MXN/head) of medicines was grouped in four categories: A) Vaccines for reproductive diseases, $49.85; B) Bovine rabies vaccine, $22.27; C) Clostridiasis vaccines, $22.63; and D) Dewormers, $21.22. The total cost of a PdVyD for a medium size farm (70 head) was $8,655 a year; in this, the Vaccination Program (PV, groups A, B, and C) accounts for $6,633 (76.6%) a year, and the Deworming Program (PD) (group D) for $2,022 (23.4%) a year. For a small size farm (25 head), the total cost of PdVyD was $3,128 a year, broken down into $2369 (75.7%) for PV, and $759 (24.3%) for PD.

Study Limitations/Implications: The analysis is focused on the last year of operations and only considers eight production units.

Findings/Conclusions: Practices for preventing diseases among the participants lacks regularity. The cost of a PdVyD is lower than livestock losses, even without considering losses in productive efficiency due to diseases. The implementation of a PdVyD requires to improve farms management and promotion among producers by the technicians.

Key words: animal health, bovine cattle, planning, prevention, profitability.

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INTRODUCTION

Among the main limitations of bovine production in the tropics are health-related problems, due to ignorance (or poor knowledge) of both producers and technicians in some aspects of disease prevention and control (Díaz *et al.*, 2018). Proper management

should include disease control in pregnant cows, heifers, bulls, and calves. In all stages and conditions, it is essential to implement a preventive medicine management plan. Certainly, mass-vaccination campaigns have lowered the incidence of diseases but wider eradication and prevention campaigns are required (Younger, 2017). In this context, deworming and vaccination against high incidence and/or very aggressive diseases plays a fundamental role. These actions must be carried out through a calendar that considers the periodic application of biologicals for those diseases that require it, considering the time of year and the composition of the herd (Abad *et al.*, 2016).

Kappes *et al.*, 2023 points out to the existence of a gap in knowledge related to the global burdens of animal diseases and their impacts on safe and efficient production systems. There are studies that estimate the annual cost of preventive measures and the annual cost of some diseases, such as brucellosis in cattle in Colorado (Salman *et al.*, 1990) and in Chile and Argentina (Gallacher, 2010); in turn, Solórzano Thompson *et al.* (2020) calculated the social economic benefit of disease prevention in animals and their effect on public health in Costa Rica. In Mexico, previous studies on benefit-cost analysis of animal health programs are scarce (Xolalpa *et al.*, 1993; Guerrero *et al.*, 1995; Xolalpa *et al.*, 2004; Hernández-Hernández *et al.*, 2013) and completely absent regarding vaccination and deworming programs for dual-purpose livestock. Consequently, as Rodríguez-Vivas *et al.* (2017) mention, when talking on livestock health problems, the first challenge is precisely how to estimate the economic loss in productivity due to this cause, particularly at the herd-level. Due to the aforementioned, this document evaluates the cost of implementing a vaccination and deworming program in commercial farms in the central region of Veracruz, Mexico.

MATERIAL Y METHODS

Location

The field work stage of this study was carried out from January to June 2023 in the Sotavento region, which is located on the coastal plain of the central region of the state of Veracruz Mexico (17° 03', 22° 27' N and 93° 36', 98° 36' W).

Study design

Eight cooperating farmers residing in Manlio Fabio Altamirano, Jamapa, Soledad de Doblado, Camarón de Tejada, Zentla, and Comapa were identified, all raising cattle in a dual-purpose system. Farms were classified according to the methodology proposed by Trejo and Floriuk (2010), namely small (<60 cows), medium (61-200 cows), and large (>200 cows). A survey on social and economic aspects of the farm was applied to them, focused on the costs of animal health (vaccines and dewormers), type of livestock feeding, reproduction management, level of integration/development, and livestock inventory. In addition to herd size, the number of livestock deaths was recorded, and indirectly the cost of a vaccination and deworming program (PdVyD) was estimated. A second survey was applied to 10 suppliers of veterinary products and services, and to providers of animal production services, to know the commercial price for the different products used, and thus to carry out the cost analysis of the proposal for a PdVyD program.

Cabinet phase

The information collected was captured in an electronic Microsoft Excel™ spreadsheet and analyzed using descriptive statistics. A qualitative analysis of the responses to livestock management practices in each farm was developed, especially in relation to vaccination and deworming practices, as well as the number of livestock deaths.

PdVyD costs computation

Based on each drug cost, the cost for each group was calculated, taking into account the doses and the number of times per year in which vaccines and dewormers are administered. First, the unit cost of the dose was calculated according to each drug. Vaccines against reproductive diseases are made from active or modified virus, and applied according to the reproductive stage of the females, following the recommendation of the laboratories. The other vaccines are administered at identical doses, regardless of the size and age of the animal, therefore, the cost is identical in all stages. In the case of dewormers, the dose depends on the weight of the animal. Three sizes of animals were considered: calf = 40 kg, yearling = 200 kg, and adult = 500 kg. To estimate the cost of the PdVyD for a small and medium farm, the average values of calf, yearling, and cow were taken as a basis. Two examples of farms were selected. A medium farm with a 70 heads herd (farm 7 in Soledad de Doblado) and a small one, with 25 heads (farm 3 in Camarón de Tejeda). In order not to underestimate the cost per program, in each case the average commercial value was assigned for each production stage. The PdV cost was obtained by multiplying the number of heads in each category by the corresponding unit cost per head of each program. The sum of both programs resulted in the total cost of the PdVyD by type of producer.

RESULTS AND DISCUSSION

Farms management

The sample size is small, but this is a consequence of the fact that it is not common in the region to routinely implement a disease control program. A high proportion of producers carry out sanitary practices very sporadically, without programming. In the farms under study, crosses of *Bos taurus* cattle (Swiss, Holstein, and Angus) with *Bos indicus* (Indubrasil, Brahman, Gyr) in different proportions are the most common view, as well as *Bos indicus* of various breeds. Two of the farms are medium-sized (61 to 200 heads) and the rest are small (≤60 heads). All of them use Bull's Front (*Paspalum notatum*), Pangola (*Digitaria decumbens*), Insurgente (*Brachiaria brizantha*) and Paral (*Brachiaria mutica*) for grazing. Only one farm utilizes electric fencing and the rest resorts to extensive grazing with fixed fences. They all provide food supplement during the dry season and have their own breeding stock. In seven farms they use bulls, only in one case does artificial insemination and bull is employed. Most hire technical assistance service for each event that occurs, and only one uses veterinary services periodically. The farms place their products in domestic markets, but only part of the production of one of them is exported.

Animal health status

Livestock deaths occurred in all farms, with this problem concentrating on calves and some cows, being the main cause infectious diseases. In all farms, cattle are vaccinated and dewormed, although not based on a PdVy; even though all participants see the advantage of having a defined vaccination and deworming program. In this sense, Luna *et al*. (2007), in a study in Costa Rica, found that endoparasiticides are frequently used inappropriately, since producers usually select the drugs based on their own criteria and without a veterinarian's advice. Table 1 presents drug categories considered in the Vaccination and Deworming program (PdVyD) grouped according to the disease to be prevented. The first group include vaccines that protect against: infectious bovine rhinotracheitis (IBR), bovine viral diarrhea virus (BVD) (Types 1 and 2), parainfluenza virus 3 (PI3), bovine respiratory syncytial virus (BRSV), and some strains of *Leptospira* spp. Bovine rabies vaccines are highly effective (Yakobson *et al*., 2015), and even short-term antibody response produce titers over one year later, although antibody response to rabies vaccination was influenced by vaccine brand (Gilbert *et al*., 2015). Group C includes biologics used for the prevention of symptomatic charcoal, malignant edema, infectious necrotic hepatitis, enterotoxemias, myositis, pasteurellosis, *Mannheimia haemolytica* and *Histophilus somni* infections. The dewormers used basically belong to three chemical families: imidazothiazoles, benzimidazoles, and macrocyclic lactones (Riviere and Papich, 2018)

Cost of the vaccination and deworming program

Table 2 shows the costs by type of medication for vaccinating and deworming. The products shown are only an example, and in no way represent an endorsement for any particular brand or product. The estimated prices are the prices of the products offered to the consumer in veterinary pharmacies in the study area.

Based only on PdVyD averages, the vaccine for reproductive health represented the largest investment. the other two vaccines groups had very similar values (Table 3). In this regard, Gudiño (2019) mentions that reproductive diseases receive the least attention, when the opposite should be the case, since without cows in optimal conditions the long-term viability of livestock farming is put at risk. The vaccination program was 4.46 times more expensive than the deworming program, since the average cost per vaccinated animal was $94.75 MXN (81.75%) *versus* $21.22 MXN (18.25%) per dewormed animal.

Table 1. Products in the Vaccination and Deworming Program (PdVyD) of farmers in central Veracruz, Mexico grouped according to type of products used.

Category	Description	Group
1	Vaccines for diseases affecting reproduction	A
2	Vaccine against bovine rabies	B
3	Vaccines for Clostridium diseases in cattle	C
4	Dewormers for bovine cattle	D

Source: Table developed by authors based on information provided by farmers.

Table 2. Unit costs of products considered for bovine cattle PdVyD in the central region of Veracruz, Mexico. Amounts in Mexican pesos (MXN).

Group	Product	Id	Calf $MX	Yearling $MX	Cow $MX
A	Bovilis vista once SQ	1a	47.92	47.92	47.92
	Bovilis vista 5 l5 SQ	1b	44.50	44.50	44.50
	Bovi-Shield Gold FP5L5	1c	47.40	47.40	47.40
	Bovimune Protector L5	Id	59.40	59.40	59.40
	Average cost		49.85	49.85	49.85
B	Vacuna Biozoo	2a	27.93	27.93	27.93
	Derrisan Sanfer	2b	18.93	18.93	18.93
	Vac-Rabat-Bovis_Virbac	2c	19.94	19.94	19.94
	Average cost		22.27	22.27	22.27
C	Biovac 11v_Biozoo	3a	19.36	19.36	19.36
	Once vías_Gortie	3b	28.95	28.95	28.95
	Adbac_Adler	3c	19.94	19.94	19.94
	Average cost		22.63	22.63	22.63
D	Cydectin_Zoetis	4a	3.01	15.04	37.60
	Valbazen 10% _Zoetis	4b	7.40	37.00	92.50
	Virbamec_Virbac	4c	1.27	6.36	15.90
	L-vermizol vit_aranda	4d	3.33	16.63	41.58
	Iverfull-Macrovit ADE_Aranda	4e	2.20	11.01	27.53
	Average cost		3.44	17.21	43.02

Source: Table developed by authors based on information provided by farmers.

Table 3. Average cost by product group and cattle size. Amounts in Mexican pesos ($MXN).

Item	Average Cost, $MXN	Calf, $MXN	Yearling, $MXN	Cow, $MXN
Reproduction	49.85	49.85	49.85	49.85
Bovine rabies	22.27	22.27	22.27	22.27
11 ways	22.63	22.63	22.63	22.63
Dewormers	21.22	3.44	17.21	43.02
		98.19	111.96	137.77

Source: Table developed by authors based on information provided by farmers.

Table 4 presents the unit cost per head of both programs for farms of different sizes. Erb (1988) points out the antagonism between the interests of the veterinarian and those of the livestock farmer. The veterinarian provides important data for economic decision-making, such as information on the probability of disease, its costs, and available control programs, and can help structure to formal cost-benefit analyses; in contrast, the livestock farmer has a certain degree of risk aversion and a variable willingness to sacrifice profits in favor of personal satisfaction. The conflict between these decisions influences the decisions of which products to use and at what stages the vaccines will be administered.

Table 4. Average unit cost of Vaccination and Deworming Programs for a medium and small cattle farm. Amounts in $MXN.

Cattle stage	Heads	Unit cost per head	PdV	Unit cost per head	PdD
Medium size farm					
Bulls	2	94.75	189.50	43.02	86.04
Steers	0	94.75	0.00	17.21	0.00
Bull calf	10	94.75	947.50	3.44	34.40
Female calf	15	94.75	1,421.75	3.44	51.60
Yearlings	11	94.75	1042.25	43.02	473.22
Heifers	0	94.75	0.00	43.02	0.00
Cows	32	94.75	3,032.00	43.02	1,376.64
Total	70		6,633.00		2,021.90
Grand Total					8,654.90
Small size farm					
Bulls	0	94.75	0.00	43.02	0.00
Steers	0	94.75	0.00	17.21	0.00
Bull calf	5	94.75	473.75	3.44	17.20
Female calf	3	94.75	284.25	3.44	10.32
Yearlings	0	94.75	0.00	43.02	0.00
Heifers	2	94.75	189.50	43.02	86.04
Cows	15	94.75	1,421.25	43.02	645.30
Total	25		2368.75		758.86
Grand Total					3,127.61

Source: Table developed by authors based on information provided by farmers.

In a small-scale farm, the total cost does not exceed $3,500 MXN a year, so this investment may be considered as good since the PdVyD implementation prevents the death of more than a single head. In the case of the medium-size farm, the annual investment of $8,500 MXN is comparable to selling a 180 kg calf. Of course, some considerations must be made regarding the aforementioned budgets. For instance, product prices may vary in a period of time as short as a month or less, and this may significantly modify the figures shown.

Vaccination and deworming schedule

Any vaccination and deworming schedule is an administrative tool to prevent and minimize the impact of the most common diseases, which is why it constitutes more of an investment than an expense. For developing a preventive calendar, Quiroz and Rodríguez (2012) propose including a series of basic measures that must be present in all farms in a region, as well as others that basically depend on the production system and the health history of each farm. Successful disease prevention is strongly associated with good management of quality food and water sources for livestock (Cruz and Romero, 2018). There are many health activities that can be carried out throughout a year. A schedule helps to organize and to prepare the yearly activities to serve as a base for future planning,

and also helps to remind the manager to perform the required tasks at specific times of the year and serve as a record. Basic yearly management activities and timing depend upon each particular farm goals, but the time in which management steps must be completed is important for cattle health and efficiency to ensure that all needed tasks are accomplished and avoid unfavored weather conditions that may induce illness and problems (Prewitt, 2015; Rodricks and Singh, 2024). Table 5 presents a proposed vaccination and deworming schedule that is recommended for cattle in the central region of the Veracruz tropics.

Table 5. Proposed vaccination and deworming schedule for cattle in the central region of the state of Veracruz, Mexico.

Activities	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Deworming, adults					X				X			
Deworming, calves					X				X			
Deworming, yearlings	X				X				X			
Vaccination, 11 ways		X	X							X		
Vaccination, IBR, DVB Leptospirosis										X		
Bovine rabies vaccination, adults					X							
Bovine rabies vaccination, calves	X				X					X		

Source: Table developed by authors based on information provided by farmers.

CONCLUSIONS

This study identified areas of opportunity related to the design and operation of a vaccination and deworming program and the demonstration of the benefit of estimating its cost and derived benefits. Producers are willing to carry out a vaccination and deworming programs in their farms, but they do not develop it due to lack of good planning and advice. The loss due to death of animals or delay in fertility is huge compared to the economic benefit of using dewormers and vaccines in a timely manner. The proposal of this program requires improvements in the comprehensive management of resources in the farm, and the ability of technicians to gain trust and convince cattle farmers.

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