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Economic and Productive Impact of Porcine Epidemic Diarrhea during Three Post-Infection Reproductive Cycles

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ABSTRACT

Objective: To evaluate the long-term productive and reproductive performance of a naïve group of sows infected with the Porcine Epidemic Diarrhea virus (PEDv) and to calculate the cost per weaned piglet.

Design/Methodology/Approach: A repeated-measurement design was used to compare productive performance over a farrowing horizon. The analysis included five reproductive cycles: a) farrowing prior to the PEDv outbreak; b) farrowing during the PEDv; c) first post-PEDv farrowing; d) second post-PEDv farrowing; and e) third post-PEDv. farrowing A general cost formula was used to estimate the cost per weaned piglet.

Results: Significant differences were recorded between the number of weaned piglets and the non-productive days during the outbreak ($P<0.05$). Prior to the PEDv, sows weaned an average of 10.55 piglets. This figure dropped to 3.49 during the outbreak. Over the next three post-PEDv farrowings, the average remained below 9.60 piglets. The first post-outbreak farrowing recorded a 0.62 increase in stillborn piglets. The cost per piglet before the outbreak reached USD $22.03; however, during the three subsequent farrowings the price per piglet after the outbreak was USD $23.82, USD $23.64, and USD $23.66, respectively.

Study Limitations/Implications: Understanding the production costs of PEDv enables the development of strategies to lessen its financial impact on farms. It also provides an effective guide for sow management that reduces the impact of this disease on productivity.

Findings/Conclusions: The analysis of the productivity and economic impact —which included a review of sow productivity— showed that the cost per weaned piglet remained high for at least three subsequent farrowings after the outbreak was controlled. As a result of the emergence of highly virulent strains in Asia and North America, PEDv remains a significant pathogen in pork production.

Keywords: Swine coronavirus; pig diseases; productivity; weaned piglets; long-term disease.

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INTRODUCTION

Currently, the Porcine Epidemic Diarrhea virus (PEDv) is one of the four main emerging coronaviruses that impact swine production (Wang *et al.*, 2019). In China (2010) and in the USA (2013), large-scale outbreaks of highly virulent strains caused significant economic losses and forced farmers to design or strengthen biosafety protocols (Russell *et*

al., 2019; Jarvis *et al.*, 2016). During this period, PEDv spread at a fast pace in North and Central America. In addition, the concomitant circulation of the Porcine Deltacoronavirus (PDCoV) was confirmed (Perez *et al.*, 2019 Niederwerder and Hesse, 2018; Trujillo *et al.*, 2016).

Porcine Epidemic Diarrhea (PED) is particularly hard on neonatal piglets of sows that were not previous exposed to the virus. Mortality rates range from 50 to 100%, as a consequence of diarrhea, vomit, and dehydration. The third effect, along with the increase of the production costs —due to the control measures adopted by producers— are the main cause of the high economic impact of this disease (Ji *et al.*, 2020).

In 2017, the USA reported 2,754 positive pig farms. In countries such as Colombia, PEDv still impacts farms (Qi *et al.*, 2020; Ajayi *et al.*, 2019). The emergence of new strains and the potential synergy with other infectious agents —such as porcine circovirus type 2 and 3 (PCV2/PCV3) and PDCoV— could aggravate the infection (Zhang *et al.*, 2021; Guo *et al.*, 2020; Jung *et al.*, 2020). In Mexico, García-González *et al.* (2023) analyzed 1,054 serums collected in eight states of the country during 2019-2021 and detected 61.66% of PEDv positive cases. According to these authors, Jalisco was the state with the highest percentage of positive samples (256; 21.44%). In addition, the circulation of emerging PEDv strains with amino acid insertions in protein S has been recorded. These insertions can produce new antigenic variants (Reveles-Félix *et al.*, 2020).

The United States Department of Agriculture (USDA) stopped monitoring the disease in 2018, when the number and intensity of the cases diminished. Nevertheless, some authors pointed out that the emergency of less virulent PEDv strains —able to persist in young animals— could results in an endemic disease (Lin *et al.*, 2019; Chen *et al.*, 2016; Crawford *et al.*, 2016; Langel *et al.*, 2016). There are several inactivated vaccines available in the market; however, herd immunity through a controlled exposition to the virus in the field (feedback) is the most common method to stimulate the production of the secretory immunoglobin A (S-IgA) (Hsueh *et al.*, 2020; Chang *et al.*, 2018). The feedback method stimulates the passive immunity of the sows against circulating strains; however, the lack of a standardized inoculum preparation method can modify the results or even worsen the health situation of the farms. Although research is currently focused on designing first-generation vaccines for the different strains (Yu *et al.*, 2020), several studies agree that the PED impact on the (re)productive performance of the herd depends on the physiological stage in which sows are exposed to the virus, but that it, at least, includes the subsequent farrowing (Furutani *et al.*, 2018; Sasaki *et al.*, 2017). Olanratmanee *et al.* (2010) reported that this effect is more severe on gilts and sows during early gestation stages.

Langel *et al.* (2020) emphasized that the gestation stage in which immunity protocols are executed is significant for the improvement of the protection of the herd against PEDv, ultimately leading to an optimization of the control measures. Several strategies have been simulated to evaluate the PED impact on the future productivity of the farms; however, post-outbreak data are still limited.

As a consequence of the persistent importance of this disease for pork production in Mexico, the objectives of this study were: (1) to evaluate the long-term effects of PEDv on the (re)productive performance of infected sows; and (2) to estimate the cost per weaned piglet in the three subsequent farrowings once the initial outbreak had been controlled.

MATERIALS AND METHODS

Pig farm and PEDv outbreak description

The study was carried out in a full cycle pig farm (from farrow-to-finish), located at 1,670 m.a.s.l. in the plateau of the State of Mexico. The average stock included 170 Landrace-Yorkshire hybrid sows, and a reproductive cycle target of 116 gestation days, 21 lactation days, and 7 days until the first post-weaning. Productive and financial data were directly obtained from the database of the pig farm, from October 2013 to June 2015.

Before the outbreak, the farm recorded an average of 2.36 farrowings per sow per year and an 84% fertility average. The initial outbreak was confirmed during the last week of March 2014. A polymerase chain reaction (PCR) was applied to the feces, diarrhea, and small intestines (jejunum and ileum) during the necropsies of recent diseased piglets. The results of the tests were positive and helped to rule out the presence of the transmissible gastroenteritis virus (TGEV) and rotavirus (Hernández *et al.*, 2018).

In order to determine the PEDv long-term effect, 61 sows that initially contracted the disease were evaluated and monitored during three subsequent farrowings. A week after the symptoms appeared, a herd immunity process was conducted using the exposition method (feedback). The intestines of infected piglets were collected, crushed, and mixed to prepare an approximately 10-ml oral solution that was administered to pregnant, lactating, and weaned sows, as well as replacement gilts once a day for 13 days.

Statistical analysis

In order to determine the long-term (re)productive performance of the group of sows infected with PEDv, the following variables were analyzed: total number of born piglets, total number of liveborn piglets, total number of stillbirths, total number of mummified piglets, total number of weaned piglets, lactation duration, non-productive days, and interval between farrowings.

A repeated measure analysis (Park *et al.*, 2009) used time as a classification variable and (re)productive performance as a dependable variable. The best covariance structure (heterogeneous-autoregressive (HAR) model) was determined. In addition, an adjusted Tukey's test was conducted to establish significance (Kramer, 1956). Five periods were established: 1) before the PEDv outbreak; 2) during the PEDv outbreak; 3) first post-PEDv farrowing; 4) second post-PEDv farrowing; and 5) third post-PEDv farrowing. The analyses were carried out using SAS OnDemand for Academics (SAS Institute, Cary, NC, USA; License: u58666318).

Cost analysis per weaned piglet

The total cost formulas proposed by Muñoz and Rouco (1995) and Amador *et al.* (2022) were used to analyze the costs, focusing on the cost per weaned piglet (Table 1). The costs were calculated using the USD \$1=MXN \$14.7414 exchange rate published by the Banco de México in August 2014.

Table 1. Formulas used to calculate the cost per weaned piglet.

Formula		
General	$C = F + V$	C=Cost per weaned piglet. F=Fixed cost. V=Variable cost.
Fixed cost	$F = L + S + Co + R + A + Fi + COf + Ot$	L=Labour costs. S=Inputs costs. Co=Energy and fuel costs. R=Cost of repairs and maintenance. A=Amortization of fixed assets. COf=Fixed opportunity costs. Ot=other costs.
Variable cost	$V = ((SA + SF + AI + PF + M + T + COv) / (TOOSOW \times W)) \times z$	SA=Sow amortization SF=Sow feeding cost. AI=Artificial insemination. PF=Piglet-feeding cost. M=Medicines. T=Transport. COv=Variable opportunity cost. $TOTSOW$=Total number of sows. W=Piglet-weighting factor. z=Number of weaned piglets.
Sow amortization	$AR = (PS - (PC - (1 - MORR))) / (AFPS / AFSY) - REP$	PS=price per sow. CS=price per culled sow. $MORR$=% of sow mortality. $AFPS$=total average number of farrowings per sow. $AFSY$=average number of farrowings per sow per year. REP=sow replacements.
Number of farrowings (Regardless of sows' productive stage).	$PARM = \sum (CER \times n) / TOTSOW$	CER=Number of sows. n=Number of farrowings. $TOTSOW$=Total number of sows.
Number of farrowings per sow per year.	$PAR = 365 / (116 + LAC + INT) \times (1 - NAB + VAC / CUB)$	LAC=Lenght of lactation. INT=Weaned-to-fertile service interval. NAB=Number of abortions. VAC=Non-productive shows. CUB=Number of reproductive services.
Piglet weighting factor	$w = PAR \times VIV \times (1 - MOR)$	VIV=Number of live-born piglets per farrow. MOR=Piglet mortality

The cost per weaned piglet was estimated for the periods previously established in the repeated measure design. The following combined costs were calculated to determine the long-term economic impact of PEDv: a) a weaned piglet, including the cost during the outbreak and the first post-PED farrowing (Goede and Morrison, 2016); b) a weaned piglet, including the cost during the outbreak and the first and second post-PED farrowings ; and c) a weaned piglet, including the cost during the outbreak and the first, second, and third post-PED farrowings.

RESULTS AND DISCUSSION

Productive and reproductive performance

PEDv did not have an impact on the total number of born piglets, liveborn piglets, mummified piglets, or the lactation duration (Table 2). Nevertheless, a 0.62 increase of stillbirths during the first farrowing post-outbreak was recorded (P<0.05). The number of weaned piglets and the non-productive days were different during the outbreak (P<0.05).

Before the PED outbreak, the group of sows weaned an average of 10.55 piglets, but during the outbreak they only weaned 3.49 piglets. During the subsequent three post-PEDv cycles, the average did not exceed 9.60 piglets. The non-productive days variable had an erratic behavior; however, a significant effect on farrowings (P<0.05) was clearly identified during rather than before the outbreak (16.16±2.07 days). No differences were recorded when the farrowing cycles during the outbreak were compared with the two subsequent post-PEDv farrowing cycles.

Analysis of the cost per weaned piglet

The lower cost per weaned piglet was recorded before the PEDv outbreak (USD $22.30). The highest cost was registered during the outbreak farrowing (USD $32.50), followed by the cost of the third post-PED farrowing (USD $23.98) (Table 3). Combining the costs before and during the outbreak farrowing cycles, the estimated cost per weaned piglet was USD $24.43. The following formula was used to determine the combined cost per farrowing cycle: before the outbreak + during the outbreak + first post-PEDv farrowing + second post-PEDv farrowing + third post-PEDv farrowing. Likewise, the combined costs per farrowing cycle were higher than the costs recorded before the outbreak (Table 3).

Regarding the variable cost structure, the total feed for sows (FSTOT) heading did not show a significant variation between reproduction cycles. The feed during lactation (FL) and feed for weaned piglets (FWP) headings diminished during the outbreak, while the feed after the weaning (FW) increased (Table 3). The FL and FWP costs were lower during the two subsequent farrowings. The FW cost was higher during the first subsequent farrowing than before the outbreak.

Table 2. Productive and reproductive performance of the farrowings of a group of sows infected with PEDv during the last gestation or lactation stages: before the outbreak, during the outbreak, and first, second, and third post-PED farrowings.

Variable	Before	After	1st post-PED	2nd post-PED	3rd post-PED
n	52	61	51	46	32
Total piglets born	12.18±0.47	12.44±0.43	12.90±0.50	12.16±0.50	11.92±0.66
Live-born piglets	11.29±0.43	11.48±0.39	10.93±0.44	11.22±0.45	10.80±0.61
Stillborn piglets	0.43±0.14[a]	0.61±0.13[a]	1.23±0.14[b]	0.56±0.15[a]	0.48±0.20[a]
Mummified piglets	0.45±0.12	0.36±0.11	0.73±0.13	0.38±0.13	0.64±0.17
Weaned piglets	10.55±0.44[a]	3.49±0.40[b]	9.60±0.45[a]	9.20±0.46[a]	9.48±0.62[a]
Length of lactation	18.90±1.09	15.03±0.03	17.40±1.13	19.35±1.16	21.08±1.56
Number of unproductive days	7.59±2.11[a]	16.16±2.07[b]	11.00±2.13[ab]	8.00±2.40[ab]	5.37±3.02[a]
Farrowing interval	144.81±4.40	144.06±3.17	148.49±3.20	146.28±3.37	148.88±4.04

[a,b] Values with different letters in the same column are statistically different (P<0.05).

Table 3. Structure of the cost of the farrowings for the group of sows infected during the last gestation or lactation stages: before the outbreak, during the outbreak, during the subsequent first, second, and third post-PEDv farrowings.

Item	Before	During	+ 1	+ 2	+ 3
Fixed cost					
Total fixed cost	25,689.87	25,689.87	25,689.87	25,689.87	25,689.87
Variable cost					
SA (Sow amortization)	1,425.84	1,425.84	1,425.84	1,425.84	1,425.84
FG (Feed for gestation stage)	33,694.80	33,870.22	32,859.75	31,584.63	32,773.67
FL (Feed for lactation stage)	20,766.25	16,600.09	18,644.33	19,906.50	22,528.34
FW (Feed for sow at weaning stage)	2,117.96	4,532.86	2,993.43	2,090.18	1,457.51
FSTOT (Sow total feed)	56,579.01	55,003.17	54,517.51	53,581.31	56,759.52
FB (Feed for boar)	2,123.19	2,123.19	2,123.19	2,123.19	2,123.19
FWP (Feed for weaned piglets)	1,003.54	333.71	890.55	819.39	877.11
AI (Artificial insemination)	2,028.30	2,028.30	2,028.30	2,028.30	2,028.30
M (Medicines)	6,375.91	6,492.38	6,064.82	5,941.22	5,993.80
VO (Variable opportunity)	3,665.65	3,550.44	3,527.68	3,462.37	3,645.72
Total variable cost	73,201.44	71,007.03	70,577.89	69,381.62	72,853.48
Total variable cost*	73,897.91	23,285.64	66,843.92	61,247.85	69,038.25
Total cost	99,587.78	48,975.51	92,533.79	86,937.72	94,728.12
Cost per weaned piglet	22.03	32.58	23.07	23.55	23.98

*Including: / (TOTSOW * W) *z. +1=1st post-PED farrowing, +2=2nd post-PED farrowing, +3=3rd post-PED farrowing.

Based on the analysis of the combined cost structure of the farrowing cycles —before and during the outbreak and during the three subsequent farrowings—, the cost of feed during lactation (FL) and feed for piglets (FP) was lower than the costs recorded before the outbreak (Table 4). Meanwhile, the cost of feed for weaned sows (FW) increased when farrowings during the outbreak and the three post-PED farrowings were included in the analysis. The inclusion of the productive performance of the PEDv infected sows in the estimated cost per weaned piglet resulted in a higher value than the farrowing cost before the outbreak (Table 4).

Productive and reproductive performance

PEDv does not change the total number of born piglets, liveborn piglets, mummified piglets, or lactation duration (Furutani *et al.*, 2018; Sasaki et al., 2017); however, it can increase non-productive days and the number of stillbirths during the first post-outbreak farrowing (Olanratmanee et al., 2010), as a consequence of the premature loss of litters (Lin et al., 2016). In the evaluated pig farm, the number of stillbirths increased during the first post-PED farrowing, possibly as a result of the reduction of daily feed consumption by sows and the inefficient use of nutrients, which led to a delayed estrus and a lower milk production.

Tsukahara et al. (2018) and Gao et al. (2021) reported that the PED infections can take place even after the application of immunity protocols. For their part, Murai et al. (2018) concluded that the mortality increase in complete cycle pig farms could be the consequence

Table 4. Structure of the combined cost of farrowing cycles for the group of sows infected during the last gestation or lactation stages: before and during the outbreak, and during the first, second, and third post-PEDv farrowings.

Item	Before	Before + During	Before + During + 1	Before + During + 1 + 2	Before + During + 1 + 2 + 3
Fixed cost					
Total fixed cost	25,689.87	25,689.87	25,689.87	25,689.87	25,689.87
Variable cost					
SA (Sow amortization)	1,425.84	1,425.84	1,425.84	1,425.84	1,425.84
FG (Feed for gestation stage)	33,694.80	33,782.28	33,469.07	33,440.78	33,305.19
FL (Feed for lactation stage)	20,766.25	18,688.58	18,673.56	19,268.43	19,930.99
FW (Feed for weaning stage)	2,117.96	3,322.27	3,210.63	2,959.82	2,654.49
FSTOT (Sow total feed)	56,579.01	55,003.17	55,353.26	55,669.03	55,890.67
FB (Feed for boar)	2,123.19	2,123.19	2,123.19	2,123.19	2,123.19
FWP (Feed for weaned piglets)	1,003.54	669.50	744.55	775.07	795.81
AI (Artificial insemination)	2,028.30	2,028.30	2,028.30	2,028.30	2,028.30
M (Medicines)	6,375.91	6,433.99	6,308.65	6,293.22	6,293.26
VO (Variable opportunity)	3,665.65	3,608.20	3,580.86	3,598.76	3,608.68
Total variable cost	73,201.44	71,292.19	71,564.65	71,913.41	72,165.55
Total variable cost*	73,897.91	47,997.28	54,190.98	56,860.76	59,129.60
Total cost	99,587.78	73,687.15	79,880.85	82,550.63	84,819.47
Cost per weaned piglet (USD)	22.03	24.43	23.82	23.64	23.66

*Including: / (TOTSOW * W) *z. 1=1st post-PED farrowing, 2=2nd post-PED farrowing, 3=3rd post-PED farrowing.

of the long persistence of the virus during the finish line, where swines can be infected and spread the virus without showing any symptom. Meanwhile, García-González *et al.* (2023) highlighted that PEDv is still present in key swine regions of Mexico and that its impact on the domestic production could be higher than expected, suggesting a long persistence of the virus. The serums analyzed by these authors belonged to 6-month-old piglets from slaughterhouses and backyard farms. Reveles-Félix *et al.* (2019) recorded the circulation of non-Indel-S emerging strains with insertions of protein S in 15 Mexican states (2016-2018), suggesting that the virus still circulated and persisted in the population. According to Saif *et al.* (2019), the virus can be found in circulation for more than 200 days.

The sows of the impacted farm weaned less piglets during the outbreak and the three subsequent farrowing cycles than they did before the outbreak. Furutani *et al.* (2020) reported that the PED-impacted farms that applied herd immunity processes right after the first symptoms appeared recorded an increase in the number of piglets that died during lactation (5.9 per litter during the first month) and a reduction (2.5 per litter during the third month post-outbreak). This study shows that neither the number of stillbirths nor the number of weaned piglets returned to the pre-outbreak levels. This situation could be the consequence of the short duration of the protection granted by the immunity process (Langel *et al.*, 2020), the diversity of the strains with different virulence levels found in the field, the synergy with other infectious agents (Zhang *et al.*, 2021); the use of nonstandardized oral inoculums for the feedback process; or the lack of biosafety measures in the handling of the feed.

Jung *et al.* (2020) argue that immunity achieves better results if applied during the middle of the gestation period. Meanwhile, the number of stillbirths per littler increase and the sows have less neutralizing antibody titers if the treatment is applied during early or later stages. Regarding the long-term effects of PED, Perri *et al.* (2019) reported that eliminating the virus from an infected pig farm takes approximately 43 weeks, while Jang *et al.* (2021) pointed out that its full eradication may take up to 24 months. García-Cano *et al.* (2023) mentioned that the seroconversion changes throughout time, depending on the inoculum amount and mean.

The remedial strategies to tackle PEDv in the field must be coordinated to strengthen biosafety in room and during transportation —through standardized cleaning and disinfection, a drying processes, and the application of heat, whenever possible— (Baker *et al.*, 2017) and feed biosafety —through origin and storage control and the application of pelletized heat treatments (Trudeau *et al.*, 2017; Cochrane *et al.*, 2017). In addition, prioritizing lactogenic immunity with mother immunization and gilt handling must be aligned to the gestation stage to maximize S-IgA content in calostrum and milk (Wei *et al.*, 2024).

Analysis of costs per weaned piglet

The estimation of the economic impact of PEDv can be inaccurate due to the variability in the outbreak severity and duration (Schulz and Tonsor, 2015). Goede and Morrison (2016) found significant productivity variations resulting from the effects of PED, as well as a 7-64-week recovery time (29.5 weeks in average). The authors agree that the main financial impact of PED lays in the reduction of the number of weaned piglets per litter, highlighting the importance of the analysis of the cost per weaned piglet.

This study focused on the average number of weaned piglets: 10.55 before the outbreak, 3.49 during the outbreak, and 9.60, 9.20, and 9.48 in the first, second and third subsequent farrowings, respectively. These fluctuations had important economic impacts.

Although no productive statistical difference was recorded between the number of weaned piglets before the outbreak and during the first, second, and third subsequent farrowings, the cost per weaned piglet increased by USD $1.04, USD $1.52, and USD $1.95, respectively. Amador *et al.* (2022) reported a production cost per weaned piglet of USD $114.50 and USD $133.94 during the first and second week of a PED outbreak in Mexican farms. They agreed that the production costs remained high for at least eight weeks after the initial outbreak.

This study determined that PED had a clear impact on the group of infected sows, particularly during the first post-outbreak farrowing, and that the cost per weaned piglet returned to its previous levels after at least three subsequent reproductive cycles. Jang *et al.* (2021) highlighted the importance of an appropriate handling of gilts in endemic farms, because they can be infected during the acclimatization process, without showing symptoms, consequently, spreading the virus in the farrowing units. Mai *et al.* (2020) pointed out that the persistent presence of the virus in slurries and in the fattening-finishing line increases the possibility of exposure and infection among gilts. Weng *et al.* (2016) proposed different intervention strategies, including the handling of gilts, which can significantly reduce the impact of PED.

The closure of the pig farm can impact production as a consequence of the lack of herd restocking, while adding new gilts after the outbreak could cause re-infections due to the introduction of susceptible non-immunized animals. Implementing strict biosafety protocols (feedback immunity) is fundamental, because this process involves a contamination risk. Nevertheless, Brown *et al.* (2019) and Won *et al.* (2020) agree that the exposition to field strains creates higher antibody titers. The reduction of losses associated with PED justifies the cost of applying this type of control measures (Weng *et al.*, 2016).

The few available reports about the economic impact of PED do not include its impact on consumption and feed conversion. Although the objective of this study was not to evaluate feed performance, the feed cost varied depending on the productive stage: the cost of feed for weaned sows increased and the cost of lactating and gestating sows decreased. Feed for piglets also recorded a lower cost during at least the three first post-outbreak farrowings, as a result of a lower number of weaned piglets.

Álvarez *et al.* (2016) reported higher mortality rates and lower weight gain among weaned piglets aftert a PED outbreak, as well as the persistence of the virus in the fattening line; consequently, taking into account the low post-PEDv yield of piglets is fundamental.

In financial terms, the review of the performance of sows showed variations in the cost per weaned piglets in the farrowings during the outbreak and the first, second, and third post-PED farrowings, recording USD \$2.40, USD \$1.79, USD \$1.69, and USD \$1.63 increases, respectively. Therefore, the herd produced an average increase of USD \$2,044.24 and USD \$1,539.43of the return on investment during the lactation and the weaning stage, respectively. The increase of the total variable cost reached USD \$429. At least three subsequent farrowings were required after the outbreak to recover the total losses associated with the disease. These losses were estimated for a herd of 170 sow, which resulted in 487 piglets, almost twice the 261 and 287 piglets reported by Amador *et al.* (2022) and Goede and Morrison (2016), respectively. The current study is one of the first scientific approaches that takes into account both long-term productive and economic indicators of sows impacted by PED.

CONCLUSIONS

The PEDv outbreak had a significant negative impact on the number of non-productive days and the weaned piglets during its duration. The number of stillbirths increased during the first post-outbreak farrowing. The evaluated group of sows only recovered its previous production levels after, at least, three subsequent reproductive cycles. Likewise, taking into account the productivity of the sows, the cost per weaned piglet was higher than the cost before the outbreak for at least three subsequent farrowings. Since the emergence of highly virulent strains in Asia and North America, PEDv remains a major pathogen for swine production.

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