https://doi.org/10.22319/rmcp.v12i3.5178

Technical note

Evaluation of disease-predisposing conditions in small-scale swine farms in an urban environment in northwestern Mexico City

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Abstract:

The objective of the work was to develop and apply an instrument to identify the predisposing conditions to the occurrence of diseases in 12 small-scale swine farms in an urban environment. The percentage of negative points obtained in general and by type of farm was analyzed according to its production, fattening (T1) or full cycle (T2), where the highest percentage was for T1 (50 %) and for T2 (66.0 %). Likewise, the data were analyzed to compare the farms T1 and T2 in relation to the percentages of each section that makes up the survey, where only a difference in the "health state" section (P<0.0001) was found. The relationship between the population density per m^2 with respect to the maximum percentage of points reached by farms showed no difference (R^2, 0.03; P=0.854). No correlation was found between the percentage of points obtained with the number of animals (R^2, 0.13; P=0.722). In relation to the average percentage per section by population size, only a difference in the "feeding" section (P<0.0006) was detected, indicating that farms with 10 to 40 swine obtained fewer points in this section. It is concluded that the methodology for the evaluation of conditions predisposing to diseases in this type of farms proved to be applicable. It was determined that farm size and population density are not a predisposing factor in these farms, but the predisposing conditions to the occurrence of diseases differ between full-cycle and fattening farms.

Key words: Swine, Diseases, Urban swine farming.

Received: 04/12/2018

Accepted: 22/10/2020

By way of introduction, it can be mentioned that urban and peri-urban animal production exists in different countries of the world[1,2], it is a source of occupation in which interrelations between social, cultural, economic, religious and health factors are established[3], within it swine farming is a strategy to mitigate poverty[4], since the swine is an ideal animal for urban environments with minimum space requirements, versatility in food consumption and easy commercialization.

Many of the swine producers located in urban environments are considered small-scale swine producers, that is, those who own up to 575 animals or up to 50 sows[4]. These small-scale farms (SSF) in urban conditions are associated with disease transmission, environmental pollution, lack of animal welfare and causing negative effects on public health[5]. Although there are several factors that may predispose these types of farms to the occurrence of diseases[6], little is known regarding the biosafety factors to prevent them from the presence of diseases[7]. This determines the importance of having a correct diagnosis of the situation in these farms, especially in health and environmental impact aspects, since, to guarantee the production of these farms, it is necessary to know the potential impact on animal health.

In the northwest area of Mexico City, there are SSFs that have been immersed in urbanization, a specific example are 14 swine producers located in the borough of Azcapotzalco, who years ago began raising their animals in a rural environment but are currently in a critical situation regarding the impact of their activity on neighbors and the authorities, who assume negative aspects in health, animal welfare and environmental impact. As an objective of this work, it is considered basic to establish a guide to carry out the process of quantitative evaluation of zootechnical, biosafety and preventive medicine practices that may be a health risk for this type of farms, in order to subsequently establish palliative measures or administrative decision-making[2]. The instrument has been modified for use on small-scale urban farms and is the first exercise of its kind.

The work was carried out in 12 small-scale swine farms (SSF) located in the borough Azcapotzalco of Mexico City, which represent 85 % of the total number of farms registered with the local association of swine producers. The farms selected were those where producers assumed the status of cooperators, upon request and interview, and which are registered in the International Livestock Individual Identification System (SINIIGA, for its acronym in Spanish). The units evaluated had a minimum of 10 animals and a maximum of 299 and represent a percentage of the swine population consistent with what was indicated by other authors[1,8].

Initially, the information obtained was that regarding the time of operation of the farm, the space of the farm, if it adjoins houses, who cares for the farm and if it has veterinary advisory. Subsequently, one or more visits were made to each farm accompanied by the application of an *in situ* evaluation instrument, carried out by a single evaluator according to the methodology used in similar studies(9,10). The farms were classified into fattening (T1) or full cycle (Type 2). In addition, they were classified into three groups based on the number of animals: A those with 1 to 40 animals, B from 41 to 100 and C from 101 to 300 animals(10).

The instrument was applied on a farm as a test to determine its operability but was not previously validated. This was designed with seven sections with a total of 55 questions; each item was confirmed by the evaluator in the physical inspection he made on the farm; each item had a value of 0 when the response indicated a high health risk, 1 when it was intermediate and 2 low; some items, due to their characteristics, only had the options of 0 and 2. The maximum value of points obtained for each section was: biosafety (B) 12 points, preventive medicine (PM) 20, facilities (F) 12, feeding (Fe) 14, management (M) 12, health state of swine (H) 16 and environment (E) 14 points, giving a total of 100 points for T1 and 92 for T2. During the visit, the inventory of animals was checked and the population density in each farm was calculated.

Because farms could obtain a different number of points depending on their type (T1 or T2), the percentage of points obtained in general and by section was calculated for each farm. To establish the difference between the percentage of points of T1 and T2 in general and for each section, the transformation of the percentages was made obtaining the square root of the arcsine; the data thus obtained were analyzed by means of a Wilcoxon test. Similarly, the differences in percentage of points for the three population levels (A, B, C) were analyzed using the Kruskall-Wallis test, and in case of finding statistical differences, a mean difference test was performed using the honest Tukey test(11). Correlations between the percentage and total points obtained with the number for each farm, as well as between the population density with the percentage of points and the total points obtained, were made by means of the Spearman correlation coefficient(10). Data were analyzed using the JMP.8 statistical package(12).

As results, the general conditions of the farms are initially presented, which are detailed in Table 1, where it is summarized that the farms have been operating for a minimum of 18 yr, with a variable space below 600 m^2, only one has workers hired, 90 % are surrounded by houses and 40 % of them do not receive any type of technical advisory.

Table 1: General conditions of farms

Farm	Years*	Space / farm m^2	Houses	Type	Cared for	Veterinary advisory
1	50	49.2	Yes	T1	Owner	No
2	70	200	Yes	T2	Family	No
3	40	315	Yes	T2	Family	Yes
4	30	63	Yes	T2	Family	Yes
5	18	100	Yes	T2	Family	No
6	20	11.25	No	T1	Family	Yes
7	44	600	Yes	T1	Family	Yes
8	42	400	Yes	T1	Employees	Yes
9	38	80	Yes	T1	Family	No
10	40	300	Yes	T2	Family	Yes
11	70	150	Yes	T2	Family	No
12	20	200	No	T2	Family	Yes

*Age of the farm.

Data from five farms T1 and seven farms T2 were obtained. Table 2 presents the total points and the percentage of points obtained in general in each farm, as well as the type of farm according to its production, where it is observed that the lowest percentage of points obtained occurred in farm 6 with 31.52 and the highest in farm 12 with 66.00. By type of farm, the highest percentage of points for T1 was 50 % and for T2 66.0 %. The percentage of points obtained by each farm is shown in Table 3.

Table 2: Number of animals, points obtained and percentage of points in general by farm

Farm	Type	Animals	Points	% Points
1	1	19	37	37.00
2	2	50	61	66.00
3	2	45	48	48.00
4	2	53	56	56.00
5	2	33	45	45.00
6	1	10	29	31.52
7	1	299	46	50.00
8	1	188	39	42.39
9	1	28	46	50.00
10	2	113	58	58.00
11	2	86	44	44.00
12	2	73	66	66.00

Table 3: Percentage of points obtained by farm and section of the instrument

Farm	Type	B	PM	F	Fe	M	H	E
1	1	15.34	57.50	46.01	18.40	46.01	51.72	13.14
2	2	41.67	80.00	66.67	57.14	50.00	87.50	28.57
3	2	58.33	60.00	41.67	42.86	33.33	75.00	14.29
4	2	41.67	40.00	66.67	71.43	41.67	87.50	42.86
5	2	66.67	65.00	25.00	21.43	16.67	87.50	14.29
6	1	23.01	28.75	15.34	9.20	46.01	57.47	13.14
7	1	30.67	57.50	53.68	46.00	61.35	57.47	13.14
8	1	7.67	51.75	53.68	46.00	38.34	45.98	26.28
9	1	38.34	40.25	61.35	27.60	38.34	68.97	39.42
10	2	33.33	80.00	66.67	57.14	16.67	87.50	42.86
11	2	41.67	30.00	25.00	50.00	41.67	87.50	28.57
12	2	41.67	90.00	66.67	50.00	50.00	87.50	57.14

B= biosafety; PM= preventive medicine; F= facilities; Fe= feeding; M= management; H= health; E= environment.

No differences were found between farms T1 and T2 in terms of B, PM, F, Fe, M and E; however, a difference (*P*= 0.002) was found between farms T1 and T2 in the section focused on health state (H) (Table 4).

Table 4: Average and standard deviation of the percentages of each section of the instrument by type of farm

Section	Type 1 (5 farms)	Type 2 (7 farms)	*P*
B	23.01 ± 12.12	46.43 ± 11.65	0.116
PM	47.15 ± 12.47	63.57 ± 22.12	0.121
F	46.01 ± 17.9	51.19 ± 20.0	0.361
Fe	29.44 ± 16.46	50.00 ± 14.46	0.369
M	46.01 ± 7.39	35.71 ± 19.68	0.367
H	56.32 ± 8.53	85.71 ± 17.18	0.002
E	21.03 ± 11.75	32.65 ± 28.11	0.058

B= biosafety; PM= preventive medicine; F= facilities; Fe= feeding; M= management; H= health; E= environment.

The relationship between the population density per m^2 with respect to the total maximum points reached by the 12 farms was analyzed, without finding an effect (R^2, 0.03; P=0.854). In the correlation between the percentage of points obtained and the number of animals existing on the farm, no effect was found both generally and by sections (R^2, 0.13; P=0.722). In relation to the average percentage per section for each classification of population size, only a difference in section A was detected (Table 5).

Table 5: Average and standard deviation of the percentage of points in each section of the instrument in relation to the number of animals by farm size

	A (n= 5)	B (n= 4)	C (n= 3)	*P*
B	35.84 ± 3.03	45.00 ± 0.78	23.89 ± 11.8	0.228
PM	47.88 ± 22.06	60.00 ± 25.5	63.09 ± 13.06	0.584
F	36.92 ± 15.23	53.33 ± 18.0	58.01 ± 7.9	0.286
Fe	19.16[a] ± 18.06	54.29[b] ±8.75	49.71[b] ± 7.33	0.0006
M	36.76 ± 12.51	43.33 ±4.17	38.79 ± 18.7	0.777
H	66.42 ± 12.3	85.00 ± 0.13	63.65 ± 15.2	0.106
E	20.00 ± 14.2	34.29 ±11.8	27.43 ± 13.46	0.399

B= biosafety; PM= preventive medicine; F= facilities; Fe= feeding; M= management; H= health; E= environment.

The items that obtained a score of 0 and 1 were considered as deficiencies in the production process of the farm, they may indicate a risk for the occurrence of diseases and are areas of opportunity for work on the farm. Table 6 shows the number of producers who have weaknesses based on each of the questions of the instrument.

Table 6: Items of the instrument by section and number of farms that presented deficiencies (1 or zero points) in each question of the instrument

Section	Question	2 points	1 point	0 points
B	Location with respect to other farms	2	3	7
	Origin of animals	8	2	2
	Quarantine area	0		12
	Farm visits	5	3	4
	Use of work clothes	2	6	4
	There is a bathroom/dressing room		6	6
PM	Washing and disinfection	6	5	1
	Breeding stock vaccination	5		2
	Vaccination in weaning	4	3	5
	Vaccination in fattening		4	8
	Breeding stock deworming	6	1	
	Deworming in weaning	6	6	
	Deworming in fattening	6	4	2
	Preventive medications	2	10	
	Pest control	7	1	4
	Presence of other animals on the farm		10	2
F	Proper farm design	8	4	
	Space per animal	11	1	
	Suitable feeders	1	5	6
	Suitable drinkers		5	7
	Ventilation control	5	1	6
	Characteristics of the floor		8	4

Fe	Type of feed (balanced, alternative)	3	9	
	Storage conditions	1	6	5
	Alternative feeding treatment is used		1	11
	Adequate feed supply for piglets	3	2	2
	Food supply in maternity/females		2	5
	Feed supply in weaning	7	1	4
	Feed supply in fattening	7	2	3
	Management system in general		1	11
M	Swine are regrouped	10		2
	Grouping by size/weight	10		2
	There is an infirmary area	1		11
	Treatment is given to the sick	1		11
	Records are used		3	9
H	General morbidity on the farm in the last month	9	1	2
	General mortality on the farm in the last month	11		1
	Presence of diarrhea	6		6
	Presence of respiratory signs	2		10
	Presence of systemic signs	11		1
	Presence of nervous signs	12		
	Presence of locomotor or skin disorders	10		2
	Presence of reproductive problems	11		1
E	Liquid excreta are treated			12
	Solid excreta are treated	4		8
	Presence of odors	6		6
	Noise level on the farm	10		2
	How is the disposal of biological waste			12
	How is the disposal of inorganic waste	3		9
	How is the disposal of chemical waste			12

B= biosafety; PM= preventive medicine; F= facilities; Fe= feeding; M= management; H= health; E= environment.

When analyzing the items that obtained a score of 0 or 1 in B, no farm has quarantine and half of the producers do not have a bathroom or dressing room. In PM, the fact that in all farms there is the presence of other domestic species stands out. In Fe, the design, installation, quality of feeders and drinkers was considered as a planning deficiency, since only one producer has suitable feeders, and none of the farms had suitable drinkers. On no farm were the floors dry and with a finish suitable for the comfort of the animals found.

In Fe, only two farms use a combination of alternative and balanced feed for the breeders, while the rest only supply alternative feed and no producer performs a treatment of this type of feed. In M, only in a farm there is an "all-in all-out system" and an infirmary area. In H, it is a risk factor that 83 % of the farms presented respiratory signs in various areas of production and in 50 % diarrhea was observed. Finally, in E, it was observed as the main deficiency that none of the producers treats excreta and does not have an adequate disposal of biological and chemical waste. As for inorganic waste, only a quarter gives treatment, the rest is disposed of as urban garbage.

By way of discussion and based on the results presented, it is suggested that the information obtained from the application of the evaluation instrument may present biases as it happens with this type of works and as reported by other authors(1,6,10). Similarly, the lack of validation of the instrument in urban and small-scale farms establishes limitations in the interpretation of the results.

Most of these farms are dedicated to the full cycle, contrary to expectations, since it is pointed out that the breeding of fattening swine requires a minimum of facilities and the cost of accommodation for the full cycle is the most expensive part of the system, since specific constructions are needed for all the biological stages of the swine(13). On the other hand, these results correspond to what was presented by authors who reported that full-cycle farms have better economic returns than piglet-producing and fattening farms(14).

The tasks of the farms evaluated coincide with other authors who point out that the work is carried out by family members and in most cases the breeding of animals is not the only economic activity(14,15), but it was found that they were elderly people, which contrasts with what was mentioned by the same authors in other non-urban farms in central Mexico, whose owners are of economically active age and have higher schooling(14).

Deficiencies in biosafety, facilities, vaccination and transport, among others, increase the risk of introduction of pathogens to the farm(10), so it is necessary to detect critical points on each farm to increase biosafety and reduce disease transmission(16).

The fact that no farm has quarantine increases the risk of disease transmission to the population and represents a fundamental failure in biosafety(17) and is the greatest risk for the introduction of pathogens to the farm. Similarly, the absence of dressing rooms represents a break in biosafety protocols(18). Although it is understood that the income of this type of farm limits investment in biosafety measures, it is important that each of them establishes practices that mitigate the risk of disease transmission; perhaps the most important thing is to raise awareness among producers to buy animals of the same origin and prevent the entry and exit of people to the farm without basic hygienic measures.

Deficiencies in the quantity and design of drinkers and feeders affect water consumption and the obtaining of nutrients, which can affect the health of animals(19). The conditions of high humidity and low temperature found in 50 % of farms predispose to pneumonia, skin diseases, presence of parasites, feed consumption and hoof injuries(20). Another condition that predisposes to the existence of diseases is the state of the floor, which can be a factor in the occurrence of diseases because a floor with cracks makes it difficult to wash and disinfect it(21).

Another aspect that can be associated with the existence and transmission of diseases is the almost widespread use of kitchen waste in swine feeding; this type of practice increases the appearance of zoonotic diseases, a risk that is run when animals are raised near houses, especially when used without treatment(22).

The low score in management aspects indicates that modern practices based on the physiology of the animals are not used in the SSFs in swine care, which is in agreement with various authors(6,23); this idea is reinforced in this study, since most of the producers do not have an infirmary and the sick swine are distributed among the population.

A point in favor of the farms evaluated is that not regrouping reduces the stress that this represents and therefore the immune status of the swine could be better, which reduces the possibility that they get sick and can transmit pathogens to other populations(24,25). The space required per animal in the farms evaluated was correct and does not represent a situation that predisposes to the occurrence of diseases(26).

The difference in the percentage of points obtained between fattening and full-cycle farms in the section “Health state" indicates that the purpose of the farm influences the occurrence of diseases, the main disadvantage of the fattening system lies in having animals of different age and origin(24), since the risks of buying from several suppliers of piglets(17) are known.

Based on the results of the study, it can be thought that SSFs are a risk for disease transmission, since the absence of protocols for biological, inorganic and chemical wastes and the lack of treatment of solid or liquid excreta represents a risk to public health and other swine populations(27,28). In addition, the management of waste in a small space and close to houses impacts the environment by dispersing or pouring uncontrollably(22).

Although the size of the farms did not influence the score obtained in Fe, a negative difference was found in farms with less than 40 animals; this is explained by the fact that producers with few animals use alternative feed without treatment, do not invest in feeders and feed in a rationed form, which decreases the health state(29).

It is concluded that the methodology for the evaluation of the conditions predisposing to diseases in SSF in an urban environment by means of a numerical score proved to be applicable to the farms. As advantages of the application of the instrument, the following can be cited: establishing an orderly structure to carry out the inspection of the farm and having basic information for the detection of areas of opportunity to mitigate these risks and implement more accurate diagnostic methods. The disadvantages of the instrument are that it can offer varying results from one farm to another and that the evaluation of the farms would have to be carried out in a higher number of farms and validate the information of the instrument. Preliminarily, it was observed that the type of production, the size of the farms and the population density are not a factor in terms of the numerical score that was obtained, but the health state differs if the farm is full cycle or fattening; it was identified that in farms with a smaller population, feeding aspects are a risk factor for the occurrence of diseases.

The authors declare that they have no conflict of interest.

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