R. Bras. Zootec., 49:e20190250, 2020
https://doi.org/10.37496/rbz4920190250

Biometeorology and animal welfare
Full-length research article

Revista Brasileira de Zootecnia

Brazilian Journal of Animal Science
e-ISSN 1806-9290
www.rbz.org.br

Producers' knowledge and perception about environmental enrichment and materials used in pig farms

Carlos Rodolfo Pierozan[1*], Luciana Foppa[1], Edilson Dias Caldas[1], Andre Michelon[1], Gabriela Ruiz[1], José Vitor Silva Duarte[1], Camilo Cazetta Rodrigues Silva[1], Caio Abércio da Silva[1]

[1] Universidade Estadual de Londrina, Departamento de Zootecnia, Londrina, PR, Brasil.

ABSTRACT - This study investigated the knowledge and perception of Brazilian pig producers in terms of environmental enrichment (EE) for pigs, the materials used, and the forms of presentation, identifying the single conditions that can improve their application on pig farms. A questionnaire was applied to 1340 farms – representing 7.4% of the farms and 12% of the sows in the country. The questions included descriptions of farms and respondents, their knowledge, judgments and level of interest in the use of EE, and frequency of use of the materials. Enrichment was used in 89.1% of farms, but half of the respondents admitted to using it without knowing what was involved. The producers presented an optimistic view (92.3%) about the application of this tool and were interested in receiving more knowledge and guidance on the subject (97.8%). The materials were used mainly to avoid fights (46.3%) and to prevent tail biting (23.3%); on the other hand, the increase in production costs (39.6%) and lack of knowledge about the subject (31.3%) were the main reasons for not using enrichment; concerns about increased management on farms were sporadic (7.1%). Metal chains were the main artifacts used, followed by plastic containers and pieces of wood; the same breeding farm used up to five types of materials. The fact that the respondents stated that they knew what EE was and that they had a good perspective on its use were significant conditions for the use of some kind of enrichment on the farms. Younger farm owners were more likely to use enrichment materials than more experienced ones. The results suggested that Brazilian pig producers use EE even with limited knowledge about the subject and that there is an argument to improve the use of this animal welfare strategy.

Keywords: animal behavior, animal welfare, environment, swine, tail biting

***Corresponding author:**
carlos.pierozan@ifsudestemg.edu.br

Received: December 1, 2019
Accepted: August 25, 2020

How to cite: Pierozan, C. R.; Foppa, L.; Caldas, E. D.; Michelon, A.; Ruiz, G.; Duarte, J. V. S.; Silva, C. C. R. and Silva, C. A. 2020. Producers' knowledge and perception about environmental enrichment and materials used in pig farms. Revista Brasileira de Zootecnia 49:e20190250. https://doi.org/10.37496/rbz4920190250

1. Introduction

In industrial pig farming, there have been recurrent changes in favor of animal welfare, imposed legally or by the demand of the sector. In this sense, among the proposed actions to improve the welfare of animals, the search for solutions that mitigate the negative affective state provided by the confined environments is important. In view of this, the European Union states that all pigs must have access to sufficient quantities of environmental enrichment (EE) material that promote the expression of innate behaviors (EC, 2008). Such requirements, although intended for member states of this trade block, may be reflected in other producer countries.

Environmental enrichment can be defined as changes in the animal's environment that increase the expression of normal behavior, provide cognitive stimulation, and reduce the expression of abnormal behavior (OIE, 2019). In its popular sense, the term refers to the provision of organic substrates and

other synthetic objects for animals. However, according to the European Commission, enrichment for pigs must be safe, edible, chewable, searchable, manipulable, capable of promoting sustainable interest, accessible to handling, be supplied in sufficient quantities, and be kept clean (EC, 2016).

Environmental enrichment can be categorized as optimal, suboptimal, or of marginal interest. Optimal materials present all the characteristics listed above and can be provided alone. On the other hand, suboptimal materials possess almost all the characteristics considered optimal. Finally, objects of marginal interest provide distraction, but they are not sufficient for the animal's needs. Both suboptimal objects and those of marginal interest should be used together with optimal and other suboptimal materials that include all the properties ideal for animals (EC, 2016).

In Brazil, the most popular herd maintenance system for reproduction, weaned piglets, and finishing pigs is the conventional system with indoor production on concrete flooring. The majority of barns are open to the sides (i.e., have curtains) and have solid or partially slatted floors. In particular, nursery pigs are housed on partially or fully slatted plastic floors. Farms that house gestating sows in pens only or in crates and pens are predominant (Callegari et al., 2020). It is considered that Brazilian pig farms use objects (Hötzel et al., 2009; Pierozan et al., 2017), even empirically and arbitrarily, without considering the scientific precepts of the subject, and therefore, the characteristics described above may not be present, and the benefits of enriching the environment may not be attained.

Considering that pig producers, both owners and employees, are the persons mainly responsible for implementing actions favorable to animal welfare, it is essential that they possess the knowledge, perceptions, and attitudes favorable to the subject. According to Hothersall et al. (2016), a training package had a significant positive influence on improving the people's understanding of the EE requirements in Europe. However, Brazilian studies on the subject or on the prevalence of the enrichment materials used in pig farms are scarce. Such information would provide the scientific community and the production chain with a basis for the improvement of this methodology.

The objective of this study was to investigate the knowledge and perception of the producers about the use of EE, the materials used, and forms of presentation as well as identify single factors that may contribute to their use on commercial pig farms.

2. Material and Methods

A cross-sectional study was carried out involving a sample of 1340 commercial pig farms in Brazil. The number of farms evaluated represented 7.4% of the total number of farms in the country (18100), and the number of sows housed in breeding farms represented 12% of the national total, considering the latest data available in 2016 (Neves, 2016).

The data were obtained between March and May 2018 through a questionnaire applied in person by professionals providing technical assistance to the farms, who were previously instructed to standardize the data collection. Prior to the start of data collection on each farm, these professionals provided a brief explanation to the respondents about the purpose of the study and requested their participation. The choice of interviewees was random and performed by the technicians who visited the units, without the knowledge of the study proponents. All the owners/employees approached joined the survey.

The structure of the questionnaires included 21 closed or semi-closed questions, including descriptions of respondents and farms (gender, age, time of activity, type of farm, number of animals housed in each phase), knowledge of and perceptions about the use of EE, the level of interest in this tool, the point-source objects used, and the frequency of use on their farms. To assist the questionnaire, a brief definition of EE was provided shortly after the question concerning knowledge of the subject.

The farms visited were reproduction units, nursery only, reproduction and nursery, and wean-to-finish systems. The answers obtained were transcribed to digital spreadsheets and submitted to a process of corrections of typing and transcription errors. Initially, 1412 questionnaires were obtained; however, 72 were excluded because they contained contradictory answers, many unanswered

questions, or because they did not identify the type of farm or category of animals housed. In total, 1340 questionnaires were used in the study.

The profile of the farms evaluated included 81.1% growing-finishing units, 10.2% reproduction, 5.4% reproduction and nursery, 3.2% nursery and 0.1% wean-to finish farms. Most of the interviewees were male (92.5%), with an average age of 47.5 (±12.5) years, ranging from 17 to 89 years. Of these, 75.1% were farm owners and 24.9% were employees, with an average time spent in pig farming of 14.8 (±9.7) years, ranging from 0 to 55 years. The sizes of the herds at the time of data collection are shown in Table 1.

The farm was considered the experimental unit for all statistical analyses using SAS software (Statistical Analysis System, University Edition). For the categorical variables, the frequencies within each category (Proc Freq) were calculated, and for the numerical variables, the central tendency (mean and median) and dispersion (standard deviation, quartiles, and amplitude; Proc Means Univariate Boxplot) were determined. The variables "interviewee's age", "time in activity", "total of sows", and "total of piglets" and "total of finishing pigs" were grouped into four categories according to the values of their lower and upper quartiles and the minimum and maximum values (Proc Rank Sort). The χ^2 test (Proc Freq) was applied to evaluate associations between single variables and the use of enrichment in the farms, including "interviewee type" (owner or employee) as a "strata variable" to group the responses according to these classes. To maintain the validity of the χ^2 test, which requires that no more than 25% of the cells have an expected count below five, the responses in the categories that had a low absolute frequency for the variables "why no EE is used" and "main reason to use enrichment" were excluded. A significance level for the χ^2 test, α, was determined to be 0.05. For the significant variables, the odds ratio (Proc Logistic) was calculated.

Table 1 - Size of herds on farms evaluated[1] according to the animal category in the production stages

Category	n	Mean ± SD	Minimum	1st quartile	Median	3rd quartile	Maximum
Sows	198	1,045±956	150	450	630	1,200	4,400
Nursery piglets	72	4,457±4,352	450	1,425	2,605	5,950	16,500
Finishing pigs	858	1,674±1,855	100	522	1,000	2,000	13,300

SD - standard deviation.
[1] Not all questionnaires answered provided the size of the herd housed. The total number of farms with sows was 209, that of farms with nursery piglets was 115, and that of finishing farms was 1,088.

3. Results

Among the respondents who used EE (n = 1155), almost half claimed to use it without knowing what it was, while for those who did not use enrichment (n = 154), almost two-thirds said they did not know about this tool (Table 2).

With few exceptions, the producers showed an optimistic view (92.3%) on the use of this methodology and believed that its application provided some benefits to the animals and/or the management

Table 2 - Knowledge about and use of environmental enrichment by interviewees on commercial pig farms

Respondents	Frequency (%)
Those who used farm enrichment (n = 1155)	
Those who knew what enrichment is	53.7
Those who did not know what enrichment is	46.3
Those who did not use enrichment (n = 144)	
Those who knew what enrichment is	35.4
Those who did not know what enrichment is	64.6

performed on farms (98.8%) and were interested in gaining more knowledge and receiving guidance on this subject (97.8%; Table 3).

The main reasons reported by the interviewees for the use of enrichment included avoiding fights (46.3%) and preventing/reducing tail and ear biting (23.3%), followed by preventing the animals from defecating/urinating in the clean area (16.2%) and providing entertainment to the pigs (12.3%). On the other hand, respondents who did not use EE provided the following main reasons: increased production costs (39.6%) and lack of knowledge (31.3%), followed by the difficulties in obtaining materials (21.3%). Concerns about increased management on farms were not frequent and were indicated by only 7.1% of the respondents. When asked whether they would use this resource even if there were an increase in management on the farm, 63.5% said that they certainly would, and 33.8% probably would use it.

Metal chains were the main artifacts used as enrichment, followed by plastic containers and pieces of wood. Additionally, tires were preferred in growing-finishing farms (Figure 1) and music in breeding farms (Figure 2). In the breeding units, the diversity of materials used, among farms and within the same farm, was smaller compared with that in growing-finishing farms, where most producers who claimed to know what enrichment was used only one (15.7%) or two (17.4%) types of material. When the respondents did not know what enrichment was, there was a higher variety, with five or more different materials being used on 9.6% of the farms. The maximum number of materials used in the same breeding farm was five, while in the same growing-finishing farm, it was 11.

Table 3 - Perceptions of interviewees regarding environmental enrichment in commercial pig farming

Variable	Frequency (%)
Usage overview (n = 1,308)	
Good	92.3
Indifference	7.7
Bad	0
Do you believe that enrichment benefits the animal/management? (n = 1,323)	
Yes	98.8
No	1.2
Would you like to have more knowledge on the subject? (n = 1,285)	
Yes	97.8
No	2.2
Main reason for using environmental enrichment (n = 1,175)	
Avoid fights	46.3
Avoid tail or ear biting	23.3
Prevent defecating or urinating on the clean area	16.2
Provide entertainment to the animal	12.3
Requirement	0.7
Personal interest	0.7
Ambience	0.4
Others	0.1
Reason why they do not use environmental enrichment (n = 450)[1]	
Increased production costs	39.6
Lack of knowledge about environmental enrichment	31.3
Difficulty in finding materials	21.3
Environmental enrichment difficult in daily handling	7.1
Worsening sanity	0.7
Would you use enrichment to improve animal welfare even by increasing handling? (n = 1,314)	
Yes, sure	63.5
Yes, probably	33.8
No, sure	0.5
No, probably	2.2

[1] Some interviewees pointed out this issue even using some kind of enrichment on their farms at the time of data collection.

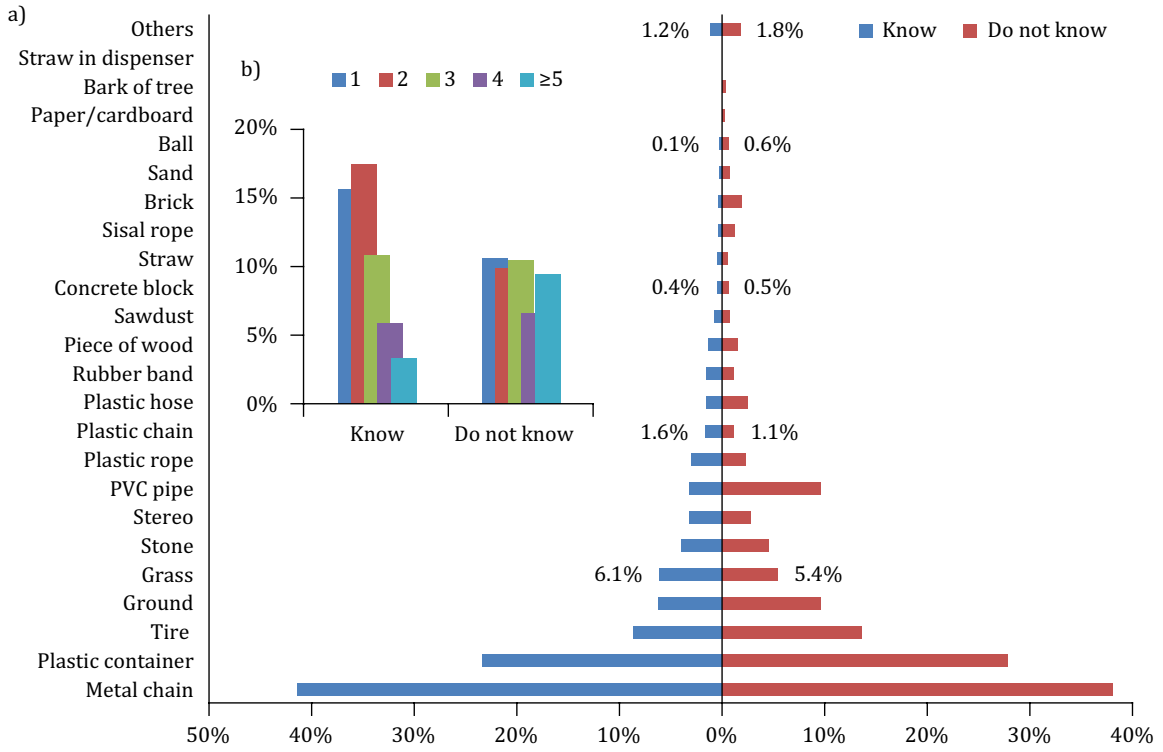

Figure 1 - Enrichment materials used (a) and diversity of materials present (b) on growing-finishing pig farms (n = 995) according to respondents who said they knew (n = 527) or did not know (n = 468) what environmental enrichment is.

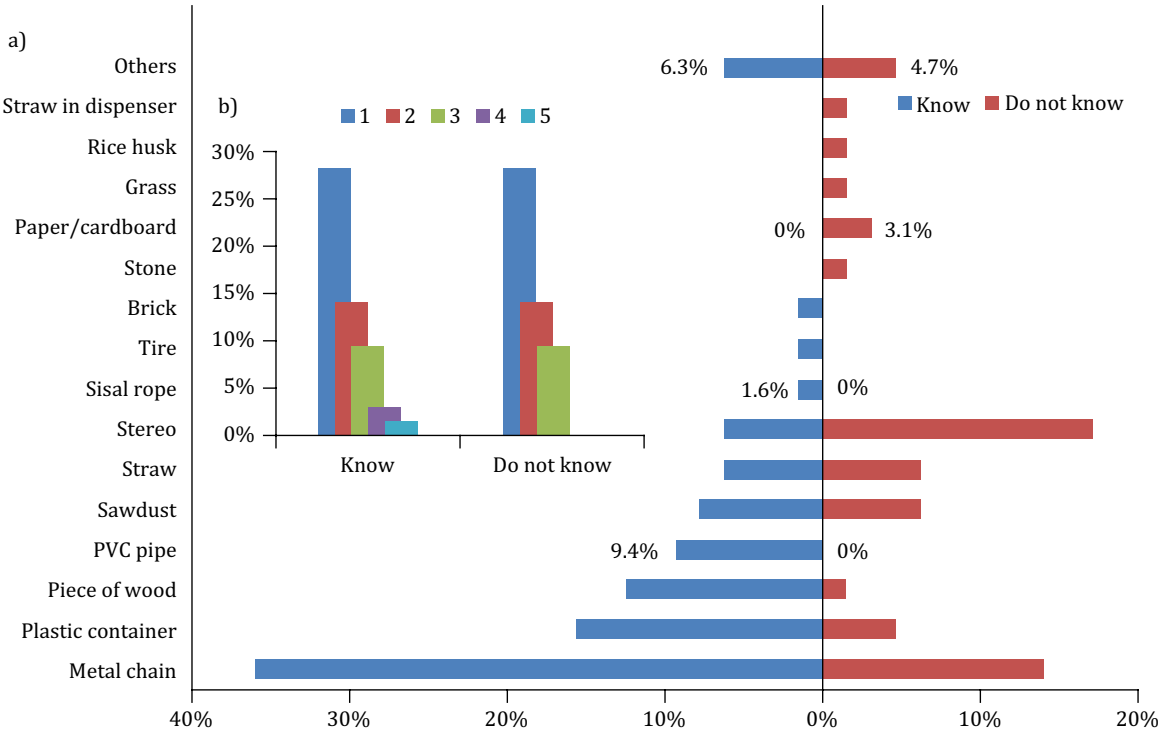

Figure 2 - Enrichment materials used (a) and diversity of materials present (b) on reproduction pig farms (n = 64) according to respondents who said they knew (n = 36) or did not know (n = 28) what environmental enrichment is.

Regarding the frequency of use of materials, 48.8% of the respondents used enrichment in all batches (Table 4). However, 50.1% used it sporadically, only on the occurrence of fights, tail biting, or soiling of the clean area of the pen or if there were materials available to be used. In cases where the material was consumed or became unusable, 60.9% of the respondents stated that they had to replace it for the same batch and 25.8% would replace it only for the next batch. Concerning the form of availability, 23.5% of the respondents stated that they offered the enrichment directly on the floor and 58.7% offered some materials on the floor and others suspended.

Environmental enrichment was more likely to be used by producers who already knew the meaning of the term (Table 5). In addition, there was a greater possibility of the use of enrichment on the farms where the respondents professed a good perspective on its use in comparison with those indifferent to the tool, whether the respondent was the farm owner (OR 5.9; 3.3-10.6) or when statistical analysis included both owner and employee (OR 7.8; 4.9-12.3). There was also a greater likelihood of use by respondents who, even in the case of increased management, were more convinced to use enrichment ("would certainly use") compared with being less convinced ("likely to use"), whether the respondent was the farm owner (OR 1.6; 1.1-2.5) or when statistical analysis included both owner and employee (OR 1.8; 1.3-2.6).

Greater chances of using enrichment were observed for farms where respondents used such strategies mainly to avoid defecation or urination in the clean area of the pen (OR 17.1; 2.2-132.7) or to avoid tail biting (OR 2.7; 1.1-6.5) compared with those that used it to offer a form of entertainment to the animals.

There was no distinction in the use of enrichment between male and female respondents or among the different age groups. However, an intermediate time spent in swine farming was associated with a higher frequency of enrichment use (OR 2.1; 1.1-3.7) and with respondents in the industry in general between nine and 13 years (OR 1.8; 1.1-2.9) and between 14 and 20 years (OR 2.1; 1.3-3.5), compared with the respondents with the most time in the activity (21-55 years).

Large-scale breeding farms (1201-4400 sows) were more likely to use enrichment (OR 2.7; 1.2-6.4) compared with farms with small to medium herds (150-450 sows). Regarding the growing-finishing farms, greater chances of using enrichment were observed in herds between 1001 and 2000 pigs (OR 4.4; 1.2-15.4), considering owner respondents, and between 523 and 1000 (OR 2; 1-4.2) and between 1001 and 2000 pigs (OR 4.9; 1.6–14.4), considering all the respondents, compared with smaller herds (between 100 and 522 pigs).

Table 4 - Methods of using environmental enrichment on commercial pig farms

Respondents	Frequency (%)
Frequency of use of enrichment (n = 1,296)	
All batches	48.8
Sporadically: fights, tail biting, or waste in an inappropriate place	41.5
Sporadically: according to material availability	8.6
First time using enrichment	1.1
Enrichment replacement (n = 1,157)	
Replace in the same batch after being consumed or rendered unusable	60.9
Replace in next batch after being consumed or unusable	25.8
Do not reset after being consumed or unusable	13.3
Use enrichment on the pen floor (n = 1,189)	
Yes, all of them	23.5
No, none	17.8
Some on the floor and others suspended	58.7

Table 5 - Univariate logistic regression[1] showing the factors associated with the use of environmental enrichment on pig farms according to the interviewee

Factor	Use of enrichment								
	Farm owner			Employee			Overall		
	OR	CI	P-value	OR	CI	P-value	OR	CI	P-value
Enrichment									
Those who know	1	-	-	1	-	-	1	-	-
Those who do not know	1.8	1.2-2.8	0.006	2.7	1.1-6.9	0.027	2.1	1.5-3	<0.001
Enrichment overview									
Indifferent	1	-	-				1	-	-
Good	5.9	3.3-10.6	<0.001				7.8	4.9-12.3	<0.001
AW versus management[2]									
Yes, probably	1	-	-				1	-	-
Yes, sure	1.6	1.1-2.5	0.032				1.8	1.3-2.6	0.001
No, sure	4.5	0.6-33.6	0.148				1.9	0.6-6.4	0.301
Main reason to use									
Entertainment							1	-	-
Avoid feces in the clean area							17.1	2.2-132.7	0.007
Avoid tail/ear biting							2.7	1.1-6.5	0.031
Avoid fights							1.3	0.7-2.7	0.436
Categories									
Female	1	-	-				1	-	-
Male	0.6	0.2-1.7	0.309				0.7	0.3-1.5	0.377
Interviewee's age									
17-38 years old	1	-	-				1	-	-
39-48 years old	1.2	0.7-2.4	0.511				1.3	0.8-2	0.375
49-56 years old	1.4	0.7-2.7	0.254				1.4	0.9-2.3	0.176
57-89 years old	1.7	0.8-3.2	0.129				1.4	0.8-2.4	0.195
Time in swine farming									
21-55 years	1	-	-	1	-	-	1	-	-
14-20 years	2.1	1.1-3.7	0.017	2.3	0.6-9.6	0.238	2.1	1.3-3.5	0.003
9-13 years	1.8	1-3.1	0.058	1.2	0.4-3.8	0.8	1.8	1.1-2.9	0.021
0-8 years	1.4	0.8-2.6	0.276	2.1	0.7-6.3	0.208	1.6	1-2.5	0.054
Total of sows									
150-450							1	-	-
451-630							1.8	0.8-4	0.149
631-1,200							1.6	0.7-3.5	0.239
1,201-4,400							2.7	1.2-6.4	0.019
Total of finishing pigs									
100-522	1	-	-				1	-	-
523-1,000	1.8	0.8-4.1	0.178				2	1-4.2	0.049
1,001-2,000	4.4	1.2-15.4	0.022				4.9	1.6-14.4	0.004
2,001-13,300	0.8	0.3-2.1	0.599				2	0.9-4.2	0.074

OR - odds ratios; CI - confidence interval at 95%; AW - animal welfare.
[1] The $\chi 2$ analyses with 25% or more cells with expected counts less than 5 are not shown.
[2] Would you use environmental enrichment to improve animal welfare even if management increased?

4. Discussion

The results of this study show that producers have an optimistic view on the use of EE and that the adoption of this resource is influenced by their level of knowledge. This set of results corroborates those reported by de Te Velde et al. (2002), who evaluated Dutch producers and pointed out that their perceptions of animal welfare were based on collective traditions, convictions, values, norms, shared interests, and knowledge derived from daily farm experience and their discussions on the topic. In turn, these perceptions about the welfare of animals were likely to influence their actions within the farm, among them, the adoption or not of enrichment.

The economic concern of producers in implementing animal welfare practices is pre-eminent, especially when consumers are not willing to pay more for the products (Bock and van Huik, 2007). In practice, it is generally difficult to reconcile the needs of animals with those of the owner, since effective enrichment materials generally imply higher costs or extra work compared with less effective solutions (Vanheukelom et al., 2012). However, our results point out that issues related to the management of enrichment are secondary to those related to their costs and the lack of knowledge about this subject shown by those in charge of the farms. In addition, the data reinforce the idea that Brazilian pig farmers are receptive and optimistic about EE and believe that the observed benefits outweigh the increased care required in daily management.

There was also a greater likelihood of use by respondents who, even in the case of increased management, were more convinced to use EE. Furthermore, this may prove once again that the adherence to enrichment is more associated with the practical perceptions of producers, especially those related to the visual identification of problems (e.g., fights, feces, and tail biting), as pointed by the results of our study. It can be inferred, therefore, that although in the present work many farms used some enrichment materials, these may only be present in some of the pens, mainly in those where these problems occurred.

Our results show the importance of governmental actions related to EE that serve as a theoretical and practical basis for the correct use of the tool, as well as its continuous improvement. Furthermore, knowledge about EE could be disseminated via booklets, lectures, field days, and online training and be taught by professionals during technical assistance visits. In addition, government institutions and companies could promote local events on the topic, including practical demonstrations and periodic follow-ups to verify the effectiveness of the measures. The authors also suggest that knowledge be reinforced over time and updated according to innovations in the field. In a study by Hothersall et al. (2016), the authors showed that online training helped participants to improve their perception of the need to modify enrichment objects.

Among the materials listed as the most used, few fulfill the requirements recommended by the European Union. Materials considered optimal, such as straw, or suboptimal, such as sisal ropes (EC, 2016), were poorly used on breeding farms and even less on growing-finishing farms. The provision of substrates considered optimal is not always feasible for farmers (Nannoni et al., 2016). The lack of national regulations on the use of EE also helps producers to opt for more economical and practical materials, which, however, do not always fulfil the behavioral needs of the pigs (von Keyserlingk and Hötzel, 2015; Horback et al., 2016; Cecchin et al., 2018).

The high occurrence of metal chains and tires has previously been verified in a smaller sample of Brazilian farms (Pierozan et al., 2017), and the low prevalence of straw and other substrates confirms that these materials have low acceptance among Brazilian producers, mainly because they are considered impractical (Hötzel et al., 2009). In Europe, a similar study in 2008 found that Dutch farms also used numerous metal chains as well as more sophisticated objects such as rubber or plastic balls (either suspended or placed on the floor), plastic or rubber pet toys, and organic materials such as wood, straw, and sawdust (Bracke, 2017). The wide use of metal chains was expected, since this type of object is widespread as a way to enrich the environment, is easy to implement, and has high durability (van de Weerd and Day, 2009; Guy et al., 2013; Fábrega et al., 2019). Recent studies suggest that metal

chains can be considered an effective enrichment if made available vertically with one end in contact with the floor of the stall and extra links along its length, allowing the pig to interact with the object on the ground and at snout height (Bracke, 2017). This strategy foresees animal welfare benefits combined with good durability and reduced financial expense of the material (Bracke and Koene, 2019).

It is important that, in addition to being suitable for pig entertainment, objects must be practical and affordable. When assessing different types of enrichment materials, Fábrega et al. (2019) pointed out that straw in a rack proved to be the best option from an animal welfare point of view, but at the same time it was the option with the higher labor cost and management expense.

Research suggests that pigs rapidly lose interest in the available object (Trickett et al., 2009) and, therefore, using objects with different characteristics at the same time or changing them periodically can be an alternative to extend the time of acceptance (EC, 2016). On the other hand, a recent study conducted by Godyń et al. (2019) indicated that materials of marginal interest, even when provided alone, can bring about the desired effect on pigs, promoting more active behaviors. In this sense, some studies have focused on strategies to prolong the animals' interest in EE, and aromatized environmental enrichment seems to be the most promising. Nowicki et al. (2015) pointed out that aromatized environmental enrichment can increase the animals' interaction with EE objects and also that pigs prefer natural fragrances such as moist soil and grass. Also, a novelty factor has been reported as an important attribute to increase the effectiveness of EE materials (Courboulay, 2014).

In the present study, many respondents offered enrichment to all batches and used more than one type of material. However, it is necessary to consider that it is most likely that the diversity of materials offered on the same farm is due to their availability in different pens, that is, without changing the type of material in the same pen, so not allowing the extension of the interest of the pigs in the enrichment.

It is worth considering the form of presentation of the EE. The results indicate that a significant number of producers provide them direct on the floor, which may not be beneficial for the interactions. Hanging objects tend to provide greater distraction for finishing pigs than the same objects provided on the floor (Scott et al., 2009). In addition, objects on the pen floor tend to become dirty and lose their attractiveness more quickly compared with those suspended at the eye level of the pigs (Blackshaw et al., 1997; EC, 2016). Studies have suggested that it is not the enrichment itself, but its properties and management that stimulate and maintain the interest of the animal (Greenwood et al., 2014). Its continuous use by the pigs is one of the objectives when using an enrichment strategy (van de Weerd and Day, 2009).

The results (Table 5) reiterate that the adherence of pig farmers to animal welfare measures seems to be related to their degree of knowledge and receptivity to change (Austin et al., 2005; Vanhonacker et al., 2008). Research suggests that farmers' views on animal welfare issues are influenced by the professionals who provide technical assistance, their experience, the pressure of society and consumer market, and the impacts on the productivity of their farms (Kauppinen et al., 2012; Kılıç and Bozkurt, 2013). It is worth considering that in Europe, as opposed to what is currently occurring in Brazil, there is legislation that advocates for the use of EE for pigs in all production categories (Directive 2008/120/EC); for this reason, the government, businesses, and entities are committed to promoting the propagation of knowledge and guidance to producers.

When assessing developed countries, Cornish et al. (2016) concluded that highlighting the benefits for performance and animal welfare in adopting a particular practice may encourage producers to improve production methods. For example, the use of enrichment may contribute to reducing the incidence of tail biting (Valros et al., 2016; Wallgren et al., 2016) and improve some variables of performance and meat quality for pigs with access to substrates and objects (Beattie et al., 2000; Melotti et al., 2011; Oliveira et al., 2016). Nevertheless, it is important to emphasize to those involved that just the offering of enrichment material does not guarantee the achievement of such benefits. Similarly, research conducted in the Netherlands found that 95% of respondents were optimistic about the use of EE and that 72% considered EE an opportunity to improve the welfare levels of pigs (Bracke, 2017).

Larger farms are highly specialized and, consequently, use more techniques and strategies to improve animal management and welfare. According to Bock and van Huik (2007), smaller-scale producers tend to associate welfare with only the basic needs of the animals, such as sufficient and good-quality feed, while more specialized producers, besides the basic health requirements and good nutrition, include behavioral aspects in their definitions of animal welfare. Moreover, it is natural that farms with larger herds have more pens, making it more likely that at least one stall would present reasons for the producer to make use of enrichment, such as tail biting or stools in the clean area. In the European Union, there is constant work to elucidate and make feasible the implementation of animal welfare improvement actions foreseen in its legislation (EC, 2012). However, this is a challenge, especially in the case of small producers, since there is a lack of technical and scientific guidance and awareness of the economic benefits of changes in favor of animal welfare (Temple et al., 2015).

5. Conclusions

Brazilian pig farmers demonstrate a good receptivity for improvements in the use of environmental enrichment. There is a wide range of materials used within and among farms, and those most employed are simple metal chains and plastic containers, frequently supplied at floor level. The results highlight that improving farmers' knowledge levels about environmental enrichment can increase the correct use of this tool on farms.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Conceptualization: C.R. Pierozan, L. Foppa, E.D. Caldas, A. Michelon and C.A. Silva. Data curation: C.R. Pierozan, L. Foppa, E.D. Caldas, A. Michelon, G. Ruiz, J.V.S. Duarte and C.C.R. Silva. Formal analysis: C.R. Pierozan. Methodology: C.R. Pierozan, L. Foppa, E.D. Caldas and A. Michelon. Supervision: C.R. Pierozan, L. Foppa, E.D. Caldas, A. Michelon and C.A. Silva. Writing-original draft: C.R. Pierozan and L. Foppa. Writing-review & editing: C.R. Pierozan, L. Foppa, E.D. Caldas, A. Michelon, G. Ruiz, J.V.S. Duarte, C.C.R. Silva and C.A. Silva.

Acknowledgments

The authors wish to thank the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) and the partnership CAPES/Fundação Araucária for supporting scholarships to the first and second authors. We also thank all the professionals who collected the information and the producers who took part in the survey.

References

Austin, E. J.; Deary, I. J.; Edwards-Jones, G. and Arey, D. 2005. Attitudes to farm animal welfare: Factor structure and personality correlates in farmers and agriculture students. Journal of Individual Differences 26:107-120. https://doi.org/10.1027/1614-0001.26.3.107

Beattie, V. E.; O'Connell, N. E. and Moss, B. W. 2000. Influence of environmental enrichment on the behaviour, performance and meat quality of domestic pigs. Livestock Production Science 65:71-79. https://doi.org/10.1016/S0301-6226(99)00179-7

Blackshaw, J. K.; Thomas, F. J. and Lee, J. A. 1997. The effect of a fixed or free toy on the growth rate and aggressive behaviour of weaned pigs and the influence of hierarchy on initial investigation of the toys. Applied Animal Behaviour Science 53:203-212. https://doi.org/10.1016/S0168-1591(96)01087-8

Bock, B. B. and van Huik, M. M. 2007. Animal welfare: the attitudes and behaviour of European pig farmers. British Food Journal 109:931-944. https://doi.org/10.1108/00070700710835732

Bracke, M. B. M. and Koene, P. 2019 Expert opinion on metal chains and other indestructible objects as proper enrichment for intensively-farmed pigs. PLoS One 14:e0212610. https://doi.org/10.1371/journal.pone.0212610

Bracke, M. B. M. 2017. Chains as proper enrichment for intensively-farmed pigs? p.167-197. In: Advances in pig welfare. 1st ed. Špinka, M., ed. Woodhead Publishing, Duxford.

Callegari, M. A.; Pierozan, C. R.; Dias, C. P.; Souza, K. L.; Foppa, L.; Gasa, J. and Silva, C. A. 2020. Brazilian panorama of pig breeding sector: a cross-sectional study about specific aspects of biosecurity, facilities, management, feeding, and performance. Semina: Ciências Agrárias 41:587-606. https://doi.org/10.5433/1679-0359.2020v41n2p587

Cecchin, D.; Sousa, F. A.; Amaral, P. I. S.; Castro, J. O.; Carmo, D. F.; Ferraz, P. F. P.; Campos, A. T. and Cruz, V. M. F. 2018. Welfare in pig housing – Brazilian and Portuguese legislation. Journal of Animal Behaviour Biometeorology 6:77-83.

Cornish, A.; Raubenheimer, D. and McGreevy, P. 2016. What we know about the public's level of concern for farm animal welfare in food production in developed countries. Animals 6:74-89. https://doi.org/10.3390/ani6110074

Courboulay V. 2014. Enrichment materials for fattening pigs: Summary of IFIP trials. Les Cahiers de l'IFIP 1:47-56.

EC - European Commission. 2008. Directiva 2008/120/CE do Conselho de 18 de dezembro de 2008 relativa às normas mínimas de proteção de suíno. Available at: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:047:0005:0013:PT:PDF>. Accessed on: Mar. 13, 2019.

EC - European Commission. 2012. Communication from the commission to the European Parliament, the council and the European economic and social committee on the European Union strategy for the protection and welfare of animals 2012–2015. Available at: <https://eur-lex.europa.eu/resource.html?uri=cellar:57576a43-59e3-4e99-aa3a-517b34804bc2.0003.03/DOC_1&format=PDF>. Accessed on: Mar. 5, 2019.

EC - European Commission. 2016. Commission Recommendation (EU) 2016/336 of 8 March 2016 on the application of Council Directive 2008/120/EC laying down minimum standards for the protection of pigs as regards measures to reduce the need for tail-docking. Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016H0336&from=GA>. Accessed on: Mar. 5, 2019.

Fábrega, E.; Marcet-Rius, M.; Vidal, R.; Escribano, D.; Cerón, J. J.; Manteca, X. and Velarde, A. 2019. The effects of environmental enrichment on the physiology, behaviour, productivity and meat quality of pigs raised in a hot climate. Animals 9:235. https://doi.org/10.3390/ani9050235

Godyń, D.; Nowicki, J. and Herbut, P. 2019. Effects of environmental enrichment on pig welfare - A review. Animals 9:383. https://doi.org/10.3390/ani9060383

Greenwood, E. C.; Plush, K. J.; van Wettere, W. H. E. J. and Hughes, P. E. 2014. Hierarchy formation in newly mixed, group housed sows and management strategies aimed at reducing its impact. Applied Animal Behaviour Science 160:1-11. https://doi.org/10.1016/j.applanim.2014.09.011

Guy, J. H.; Meads, Z. A.; Shiel, R. S. and Edwards, S. A. 2013. The effect of combining different environmental enrichment materials on enrichment use by growing pigs. Applied Animal Behaviour Science 144:102-107. https://doi.org/10.1016/j.applanim.2013.01.006

Horback, K. M.; Pierdon, M. K. and Parsons, T. D. 2016. Behavioral preference for different enrichment objects in a commercial sow herd. Applied Animal Behaviour Science 184:7-15. https://doi.org/10.1016/j.applanim.2016.09.002

Hothersall, B.; Whistance, L.; Zedlacher, H.; Algers, B.; Andersson, E.; Bracke, M.; Courboulay, V.; Ferrari, P.; Leeb, C.; Mullan, S.; Nowicki, J.; Meunier-Salaün, M.-C.; Schwarz, T.; Stadig, L. and Main, D. 2016. Standardising the assessment of environmental enrichment and tail-docking legal requirements for finishing pigs in Europe. Animal Welfare 25:499-509. https://doi.org/10.7120/09627286.25.4.499

Hötzel, M. J.; Lopes, E. J. C.; Oliveira, P. A. V. and Guidoni, A. L. 2009. Behaviour and performance of pigs finished on deep bedding with wood shavings or rice husks in summer. Animal Welfare 18:65-71.

Kauppinen, T.; Vesala, K. M. and Valros, A. 2012. Farmer attitude toward improvement of animal welfare is correlated with piglet production parameters. Livestock Science 143:142-150. https://doi.org/10.1016/j.livsci.2011.09.011

Kılıç, I. and Bozkurt, Z. 2013. The relationship between farmers' perceptions and animal welfare standards in sheep farms. Asian-Australasian Journal of Animal Sciences 26:1329-1338. https://doi.org/10.5713/ajas.2013.13124

Melotti, L.; Oostindjer, M.; Bolhuis, J. E.; Held, S. and Mendl, M. 2011. Coping personality type and environmental enrichment affect aggression at weaning in pigs. Applied Animal Behaviour Science 133:144-153. https://doi.org/10.1016/j.applanim.2011.05.018

Nannoni, E.; Sardi, L.; Vitali, M.; Trevisi, E.; Ferrari, A.; Barone, F.; Bacci, M. L.; Barbieri, S. and Martelli, G. 2016. Effects of different enrichment devices on some welfare indicators of post-weaned undocked piglets. Applied Animal Behaviour Science 184:25-34. https://doi.org/10.1016/j.applanim.2016.08.004

Neves, M. F.; Lima Júnior, J. C.; Sá, N. C.; Pinto, M. J. A.; Kalaki, R. B.; Gerbasi, T.; Galli, R. M. and Vriesekoop, F. 2016. Mapeamento da suinocultura brasileira. SEBRAE, ABCS, Brasília.

Nowicki, J.; Swierkosz, S.; Tuz, R. and Schwarz, T. 2015. The influence of aromatized environmental enrichment objects with changeable aromas on the behaviour of weaned piglets. Veterinarski Arhiv 85:425-435.

OIE - World Organisation for Animal Health. 2019. Animal welfare and pig production systems. In: Terrestrial Animal Health Code. Available at: <https://www.oie.int/fileadmin/Home/eng/Health_standards/tahc/current/chapitre_aw_pigs.pdf>. Accessed on: Jan. 11, 2019.

Oliveira, R. F.; Soares, R. T. R. N.; Molino, J. P.; Costa, R. L.; Bonaparte, T. P.; Silva Júnior, E. T.; Pizzutto, C. S. and Santos, I. P. 2016. Environmental enrichment improves the performance and behavior of piglets in the nursery phase. Arquivo Brasileiro de Medicina Veterinária e Zootecnia 68:415-421. https://doi.org/10.1590/1678-4162-8253

Pierozan, C. R.; Dias, C. P. and Silva, C. A. 2017. Environment, facilities, and management of hospital pens in growing and finishing pig farms: a descriptive study. Revista Brasileira de Zootecnia 46:831-838. https://doi.org/10.1590/s1806-92902017001100001

Scott, K.; Taylor, L.; Gill, B. P. and Edwards, S. A. 2009. Influence of different types of environmental enrichment on the behaviour of finishing pigs in two different housing systems 3. Hanging toy versus rootable toy of the same material. Applied Animal Behaviour Science 116:186-190. https://doi.org/10.1016/j.applanim.2008.07.002

Temple, D.; Vermeer, H. M.; Mainau, E. and Manteca, X. 2015. Opinion paper: implementing pig welfare legislation. Animal 9:1747-1748. https://doi.org/10.1017/s1751731115001068

Te Velde, H.; Aarts, N. and Van Woerkum, C. 2002. Dealing with ambivalence: farmers' and consumers' perceptions of animal welfare in livestock breeding. Journal of Agricultural and Environmental Ethics 15:203-219. https://doi.org/10.1023/A:1015012403331

Trickett, S. L.; Guy, J. H. and Edwards, S. A. 2009. The role of novelty in environmental enrichment for the weaned pig. Applied Animal Behaviour Science 116:45-51. https://doi.org/10.1016/j.applanim.2008.07.007

Valros, A.; Munsterhjelm, C.; Hänninen, L.; Kauppinen, T. and Heinonen, M. 2016. Managing undocked pigs – on-farm prevention of tail biting and attitudes towards tail biting and docking. Porcine Health Management 2:2. https://doi.org/10.1186/s40813-016-0020-7

van de Weerd, H. A. and Day, J. E. L. 2009. A review of environmental enrichment for pigs housed in intensive housing systems. Applied Animal Behaviour Science 116:1-20. https://doi.org/10.1016/j.applanim.2008.08.001

Vanheukelom, V.; Driessen, B. and Geers, R. 2012. The effects of environmental enrichment on the behaviour of suckling piglets and lactating sows: A review. Livestock Science 143:116-131. https://doi.org/10.1016/j.livsci.2011.10.002

Vanhonacker, F.; Verbeke, W.; Van Pouckeb, E. and Tuyttens, F. A. M. 2008. Do citizens and farmers interpret the concept of farm animal welfare differently? Livestock Science 116:126-136. https://doi.org/10.1016/j.livsci.2007.09.017

von Keyserlingk, M. A. G. and Hötzel, M. J. 2015. The ticking clock: Addressing farm animal welfare in emerging countries. Journal of Agricultural and Environmental Ethics 28:179-195. https://doi.org/10.1007/s10806-014-9518-7

Wallgren, T.; Westin, R. and Gunnarsson, S. 2016. A survey of straw use and tail biting in Swedish pig farms rearing undocked pigs. Acta Veterinaria Scandinavica 58:84. https://doi.org/10.1186/s13028-016-0266-8