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Approach to a classification of construction typologies of pig facilities: case study Antioquia – Colombia

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Abstract. Pig facilities foro confined production in tropical countries such as Colombia does not specify, in the present moment a typological classification that allows researchers to carry out evaluations related to animal comfort and environmental impacts according to the type of accommodation. To achieve the objective of this research were developed a survey to a panel of experts, a decision sensitivity analysis and the hierarchical analytical method AHP. Parameters that allowed to describe the concept of a technified pig farm were obteined, where the most relevant were: biosecurity measures, measurement of zootechnical parameters, training for workers and legal fulfilment. Additionally, ranges were defined to establish the production size in small, medium and large according to the number of animals. The results obtained per group were: 1) breeding small (50–200), medium (201–1,000) and large (1,001–5,000); 2) growth small (60–200), medium (201–800) and large (801–5000); and 3) finishing stage small (50–500), medium (501–1,000) and large (2,001–5,000). A total of 948 typological combinations were initially determined. Finally, the construction characteristics with the greatest technical and operational feasibility were prioritized for each group achieving 36 typologies that can represent the typological pig facilities not only in the state of Antioquia but also in many others states in Colombia.

Key words: tropical country, natural ventilation, swine production, animal comfort.

INTRODUCTION

Pork is the second most consumed meat in the world, representing 43% of the world's meat production for human consumption (OCDE/FAO, 2013), the worldwide distribution is mainly concentrated in Asia 59%, Europe 22% and North and Central America with 11%. China, the European Union and the United States produce more than 86% of pig cattle (USDA, 2011). In America, the highest production occurs in countries such as the United States, Canada, Brazil and Mexico. Colombia only produces 1% of the meat in the American continent (Porkcolombia & PigCHAMP, 2015) with 14,000 pig farms (Departamento Administrativo Nacional de Estadística (DANE), 2016). The steady growth of the productive sector has aroused keen interest worldwide on issues of animal welfare and environmental impact assessment, both widely studied for pig production systems, to find better management practices at commercial level (Rhodes et al., 2005).

Most of the production systems of northern and southern countries are developed in closed buildings (Reimert et al., 2014). In a multidisciplinary review developed by CIGR (2006) regarding the differences in constructive characteristics of greater relevance for animal comfort between zones with very marked seasons and subtropical or tropical countries, it was found that for countries with seasons is easy to find climate control systems to maintain the interior temperature and relative humidity, however, for hot summer days, the acclimatization problems are identical to the problems in equatorial areas (Jackson et al., 2018), where the main cause of thermal discomfort is due to the amount of heat, from solar energy, absorbed by the facilities. This is the reason why most of the facilities are equipped with natural ventilation and open systems in side walls and ceilings, and in few cases hybrid systems that combine natural and mechanical ventilation, searching lower operating costs and less greenhouse gas emissions (Reckmann et al., 2013 and Osorio et al., 2017). Due to the above, thermal stress should be the first attribute to take into account in a bioclimatic design, together with the gas emission (Pietrosemoli & Tang, 2020).

Regarding environmental impacts, those associated with manure management have been extensively studied. Contamination of soil, water and generation of atmospheric emissions were mainly evaluated. The latter in relation to toxicity in the biotic environment and contribution of gases with global warming potential GWP (Castrillón et al., 2020). However, there are other sources of impact related to accommodation. The most relevant of which are water management, feeding, energy consumption, management of liquid and solid manure, management of other waste, infrastructure design and thermal comfort characteristics (Reckmann et al., 2013).

The advantage that climate control systems have for research and legal policy management is that they have detailed definitions and defined typological classifications allowing efficient comparisons between the different systems. (Jackson et al., 2018). On the contrary, in tropical countries, the confined production of pigs does not have a specific classification in terms of its construction type, farm size, or a specific definition that allows identifying when a farm is technified.

Resolution 2640 of 2007 of the Colombian Agricultural Institute (ICA), is the only tool that provides criteria to evaluate production facilities at the national level. However, this standard does not have the necessary guidelines for the design and classification of accommodation with essential criteria such as animal welfare (Cecchin et al., 2019) and efficient management of natural resources (Reckmann et al., 2013). The foregoing leads to the need to generate a classification of these typologies based on their constructive characteristics, thermal floor, size and level of technification, which responds to the lack that researchers currently have to reference their work and determine the behaviour of different structures based on general welfare, animal comfort, impact on the environment, among others.

Given the above, this research is aimed to make a proposal for the classification of construction typologies for pig facilities of different age groups and according to the thermal floor. The research was developed in the department of Antioquia - Colombia and will serve for future research at the national level model.

MATERIALS AND METHODS

Data collection:

The methodology for collecting the primary information to perform the qualitative and quantitative analysis was divided into three stages. In the first stage, the concept of a technified pig farm was defined for a tropical country with productive levels such as Colombia. In the second, the farm size according to the age group and the most used construction characteristics in the department of Antioquia in relation to thermal comfort; generation, concentration and distribution of gases within the accommodation. And in the third, the criteria for categorizing the most feasible construction typologies of each age group were established, according to the thermal floor.

Determination of the panel of experts:

The panel of experts consulted for this work was constituted by an interdisciplinary group of 8 professionals from the branches of civil engineering, veterinary science, zootechnics, and agricultural engineering, among others, with experience in the construction, research, and management of pig housing in confined production, thermal comfort and animal welfare. The experts gave their concepts focused on developing typological classification guidelines according to the characteristics stated in each phase of production. The information was compiled and delivered again to the group of experts to carry out a first purge according to the criteria of age, thermal floor and degree of technification.

Finally, the expert panel were summoned to a group work to establish the construction and maintenance costs per square meter of each of the listed structures and define an evaluation relating to the effectiveness in keeping thermal comfort and animal welfare, in order to identify viable typological combinations. The construction characteristics used were: floor material (flat concrete, plastics and concrete slatteds, deep bed, mixed (flat and slatted)), manure storage or conveyance systems (flat floor, flooded pit, pit not flooded, pool or sump), lateral ventilation systems (100% open, low wall open between 50–80% and high wall with side windows openings between 30–50%), ventilation system on the roof (gable roof with or without laternim, gable roof with over-roof). Criteria such as the size of the facility were also taken into account based on the number of animals, age group and the respective thermal floors.

Determination of thermal floors:

To determine the thermal floors, the 2014 national agricultural survey developed by the ICA was used. It stated that Antioquia has 2,038 farms, located between 200 and 2,800 meters above sea level. Table 1 shows the classification of the facilities based on the height above sea level under the Caldas - Lang classification (Instituto Colombiano de Hidrología Meteorología y Estudios Ambientales - IDEAM, 2005, Gobernación de Antioquia, 2014). It was found that the largest number of farms in the department are located between 1,900 and 2,800 meters above sea level, represented by a cold, mild and warm thermal floor. No technified farms are registered over 2,800 meters above sea level.

Table 1. Location of the farms in Antioquia according to the thermal floor (Departamento Administrativo Nacional de Estadística (DANE), 2016, Gobernación de Antioquia, 2014)

Number of farms	Height above sea level	Thermal Floor
63	0–900	Warm
539	900–1,900	Mild
1,436	1,900–2,800	Cold
0	2,800–3,700	Very cold
0	3,700–4,700	Extremely cold
0	> 4,700	Nival

Definition of a technified farm:

Different descriptive factors were developed to establish the definition of a technified farm with the information obtained in the first panel of experts. They were valued according to the number of mentions made by each of the experts.

Determination of farm size:

With the ranges of each of the respondents and the use of descriptive statistics tools, the confidence intervals were determined to categorize the farms according to their size and age group between small, medium or large.

Determination of the total combinations of construction typologies:

The quantity of all possible existing facilities, age groups and thermal floors were subjected to a calculation of the possible number of combinations using the R statistical software. With the result, an initial filtration of the combinations that had mutually exclusive structures was carried out. Subsequently, the refined list of combinations was presented to the experts and they were asked to eliminate those combinations without feasibility according to the thermal floor and age group. Finally, the results were presented through a decision sensitivity analysis according to the thermal floor in which the mutually exclusive structures and those that are not appropriate for the climate were taken into account, the viable relationships were marked with 1 and those that had no feasibility with 0.

The results of the structures with the highest feasibility for each age group were analyzed through a descriptive statistical process to allow an organized display of them. The constructive characteristics with the highest weighing were established as selection criteria, to develop an analysis of all the possible combinations according to each age group.

Selection of the most representative typologies:

In order to obtain the most viable typologies by age group and thermal floor, a weighting was used based on the consensus of experts on the priority of the factors that are typically used to add scores when working with multiple dimensions called *the analytical hierarchy process (AHP)* (Ameen & Mourshed, 2019). Three criteria were selected for the evaluation of the different constructive alternatives (constructive cost, maintenance cost, and efficiency in maintaining thermal comfort). The characteristics to

Table 2. Characteristics to be evaluated to obtain the construction typologies

Age group	Construction Features	Thermal floor
Gestation	Floor material	Cold
Breeding	Manure storage or conveyance system	Mild
Growth	Side ventilation structure	Warm
Fattening	Roof ventilation structure	

be evaluated were classified by age group, function and thermal floor (Tables 2). The AHP methodology uses the importance scale for the evaluation of the criteria described in Table 3 and equations (1), (2) and (3) to validate the results.

Table 3. Relative importance scale (1–9) of *the analytical hierarchy process (AHP)* (Ameen & Mourshed, 2019)

Numerical scale of importance	Verbal scale	Explanation
1	Equally important	Two elements contribute equally to the goal
3	Moderately important	Slight preference of one element over the other
5	Strongly important	Strong preference of one element over the other
7	Very strong or proven importance	Much more preference of one element over another Demonstrated dominance
9	Extremely strong importance	Clear and absolute preference of one element over the other
2,4,6,8		Intermediate of the above values

To give weighted weights and evaluate the prioritization of the typologies in a quantitative way, the following equations were used:

Consistency index

$$CI = \frac{nmax - n}{n - 1} \tag{1}$$

where $nmax$ = is the main value; n = # of elements evaluated;

Random consistency index

$$RCI = \frac{1.98 \cdot (n - 2)}{n} \tag{2}$$

where n = # of elements evaluated

Consistency ratio

$$CR = \frac{CI}{RCI} \tag{3}$$

where $CR < 0.1$ consistent relationship.

RESULTS AND DISCUSSION

Determination of criteria to classify a technified farm in a tropical climate:

From the concepts of the experts, 13 descriptive factors were obtained with their weighted weight to classify a farm as technified for tropical climates. In Table 4, the compilation of the answers is presented in order of importance, which determine the degree of technification of a pig farm. In the first place, there are administrative procedures that allow the registration of variables related to production levels to be carried out; secondly, there is a balanced diet and the implementation of a sanitary program; and thirdly, they highlighted the facilities where the animals are housed, which must have a design that guarantees animal comfort. Environmental issues such as legal compliance and the implementation of environmental management programs were found to be of low relevance compared to the parameters that directly affect production performance.

Table 4. Descriptive factors of a technified farm (Own research)

Assessment	Descriptive factors
6	Registers of variables such as: biosecurity measures, zootechnical parameters, job training and legal compliance
5	Offer balanced food to animals
5	Implement a sanitary or biosecurity program
4	Technical facilities, with a predominance of installed capacity and animal comfort
3	Animal welfare
3	Productive parameters program
3	Veterinary assistance
3	Job training
2	Legal certifications of health management and safety
2	Legal compliance
2	Animal genetics
1	Legal sacrifice
1	Environmental management program

Farm size classification by age group:

Table 5. Classification of farms according to the number of animals, minimum and maximum ranges (Own research)

Farm type	Statistical data	Small		Median		Large		Extra
		Min	Max	Min	Max	Min	Max	Min
Breeding	Mean	19	120	130	429	456	5,167	
	median	10	99	100	450	451	5,000	501
	standard deviation	29	130	156	322	384	4,752	
	Alpha	0.5	0.5	0.5	0.5	0.5	0.5	
	Interval	7	33	39	81	97	2,240	
	Lower limit	12	87	91	348	359	2,926	
	Upper limit	27	152	169	509	553	7,407	
	Research proposal	50	200	201	1,000	1,001	5,000	> 5,000
Growth	Mean	59	327	361	1,230	1,313	3,435	
	median	30	200	201	751	751	1,750	1500
	standard deviation	85	414	505	1,037	1233	3,891	
	Alpha	0.5	0.5	0.5	0.5	0.5	0.5	
	Interval	21	104	127	261	310	1,488	
	Lower limit	38	223	234	969	1,003	1,947	
	Upper limit	81	431	488	1,491	1,623	4,923	
	Research proposal	60	200	201	800	801	5,000	> 5,000
Fattening	Mean	104	586	665	2,172	2,338	8,327	
	median	45	200	201	900	901	5,000	1,000
	standard deviation	175	865	1,039	2,280	2,662	8,965	
	Alpha	0.5	0.5	0.5	0.5	0.5	0.5	
	Interval	44	218	261	573	669	42,26	
	Lower limit	60	368	404	1,599	1,669	4,100	
	Upper limit	148	804	926	2,746	3,007	12,553	
	Research proposal	50	500	501	2,000	2,001	5,000	> 5,000

Within a typological classification process, it was important to determine the size of a farm depending on the number of animals and by age group. Table 5 presents the results obtained by the experts and the construction of a proposal that allows determining a farm size classification for the department of Antioquia based on the number of animals. It is important to note that the results of the rearing stage include gestation and delivery, since both must be in the same farm, but in different accommodations.

Determination of the construction typologies: To determine the possible number of construction typologies according to the main variables that affect thermal comfort and the generation of gases from the accommodation, the following results are presented:

Construction features evaluated for typological classification

The construction characteristics that were taken into account for the classification of the construction typologies are presented in Table 6 and 7. The information was valued according to the possible combinations. 4,320 possible typologies were obtained, using the combination criteria and flowchart presented in the Fig. 1. All the possible combinations of construction typologies found in this investigation are presented in Fig. 1, construction features with the amount of the criteria for each one is presented in brackets: five (5) for floor material (MP); six (6) for manure storage or conveyance system (SCE); four (4) for side ventilation structure; and three (3) for roof ventilation structure.

Table 6. Variables obtained for classification of construction typologies (Age group and Thermal floor) (Own research)

Age group		Thermal floor	
Gestation	GE1	Cold	PT1
Breeding	GE2	Mild	PT2
Growth	GE3	Warm	PT3
Fattening	GE4		

Once the 4,320 possible typological combinations were obtained, the decision sensitivity analysis developed in this research was used toidentify the most used typologies in pig production by age group (GE) and thermal floor (Fig. 2). The methodology used allows observing that the manure storage or conveyance system has a direct relationship with the floor material (SCE), and only the pool or pond(SCE4) presents variations related to the thermal floor (PT) showing that those are not viable in cold climates (PT1); roof ventilation (VC) does not show any variability. On the contrary, the lateral ventilation structures (VL) are determined according to the thermal floor, presenting an inverse relationship between temperature and ventilation areas: 100% open (VL1) are not viable in cold thermal floors (PT1), high wall with side windows opening

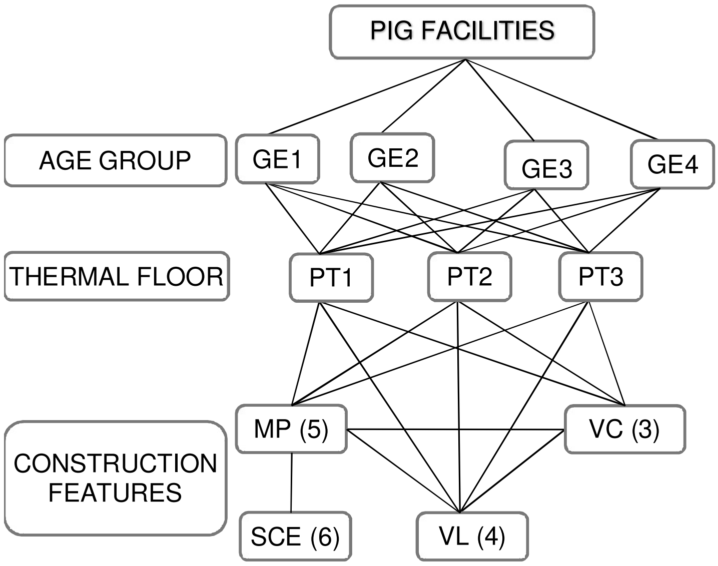

Figure 1. Decision tree to determine possible combinations (the numbers in brackets represent the amount of each construction features, see Table 6 and7) (Own research).

between 30–50% (VL3) do not show feasibility in warm thermal floors (PT3) and controlled ventilation systems (VL4) are not viable in mild climates (PT2). Once the methodology was applied, 948 viable typologies were obtained.

Table 7. Variables obtained for classification of construction typologies (Construction features) (Own research)

Construction features							
Floor material		Manure storage or conveyance system		Side ventilation structure		Roof ventilation structure	
Flat concrete	MP1	Flooded pit	SCE1	100% open	VL1	Gable roof with laternim	VC1
Plastics slatteds	MP2	Pit not flooded	SCE2	Low wall open between 50–80%	VL2	Gable roof without laternim	VC2
Concrete slatteds	MP3	Flat concrete	SCE3	High wall with side windows openings between 30–50%	VL3	Gable roof with one open side	VC3
Deep bed	MP4	Pool or pond	SCE4	Automatic ventilation systems	VL4		
Mixed (flat and slatted)	MP5	Sump	SCE5				
		Absorbent material	SCE6				

Taking into account that 948 combinations are a high number for a classification, a new debug process was carried out, where 3 evaluation criteria were defined and weighted according to the *AHP* methodology: 1) Effectiveness of maintaining the animal's thermal comfort (72.4%); 2) Construction costs (19.3%); and 3) Maintenance costs (8.3%). In Table 8 a normalized comparison matrix is show, where the consistency ratio is 0.084, giving the weighting as correct.

Table 8. Normalized comparison matrix (Own research)

Evaluation criteria	Effectiveness in maintaining thermal comfort	Constructive cost	Maintenance cost	Weighing
Effectiveness in maintaining thermal comfort	0.74	0.79	0.64	0.724
Constructive cost	0.15	0.16	0.27	0.193
Maintenance cost	0.11	0.05	0.09	0.083
CI = 0.056				
RCI = 0.66				
CR = 0.08444				

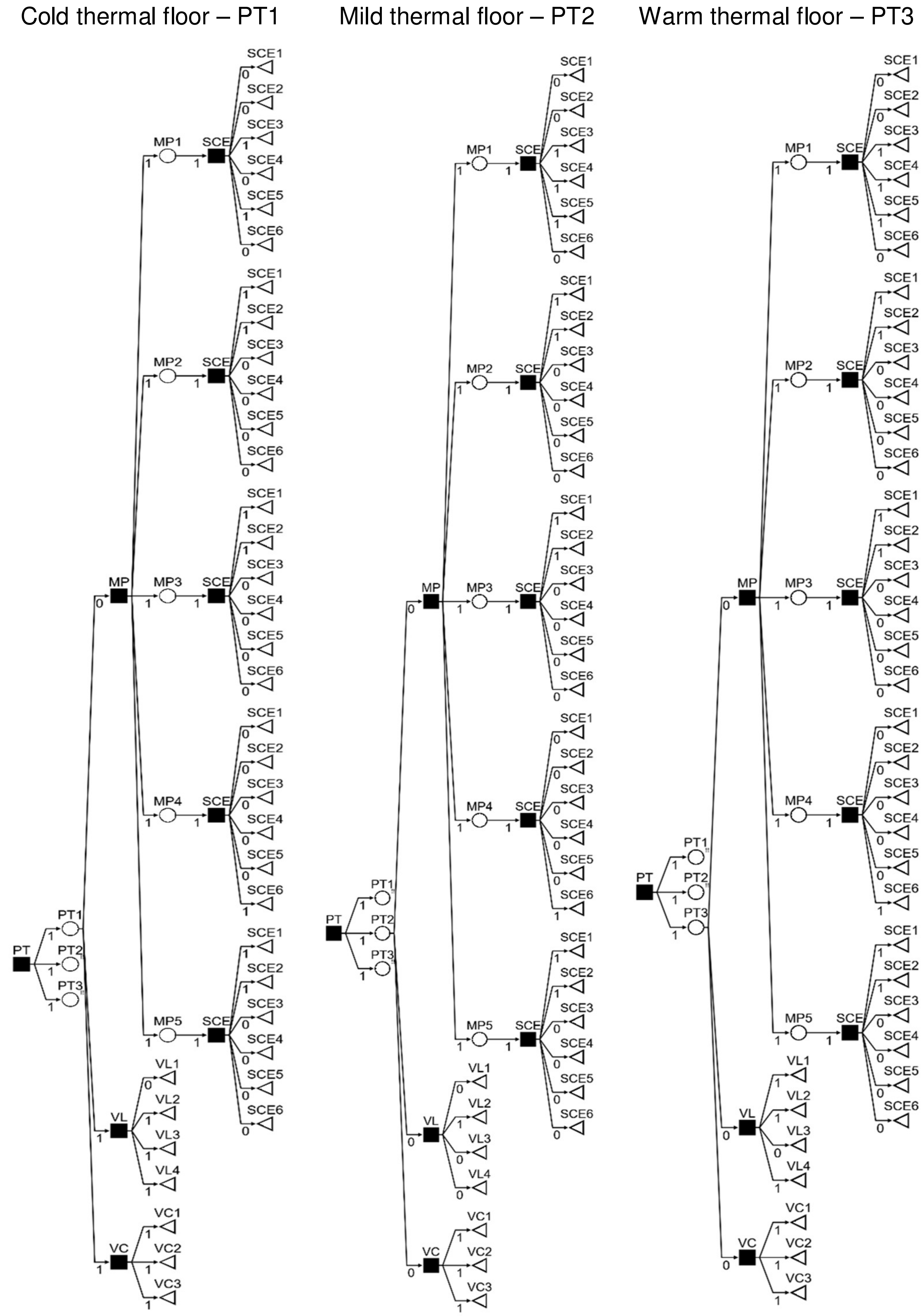

Figure 2. Methodological proposal for a decision sensitivity analysis of the different alternatives obtained in Antioquia - Colombia (Own research).

Table 9. Ranking results of the alternatives (Own research)

Age group	Evaluation criteria	Construction Features	Alternatives	Weighing, %
Gestation (GE1)	Effectiveness in maintaining thermal comfort	Floor material (MP)	Flat concrete (MP1)	42.5
			Plastics slatteds (MP2)	30
			Mixed (flat and slatted) (MP5)	26.4
	Constructive cost	Manure storage or conveyance system (SCE)	Flooded pit (SCE1)	39.4
			Sump (SCE5)	59.6
	Maintenance cost	Side ventilation structure (VL)	100% open (VL1)	10
			Low wall open between 50–80% (VL2)	61.9
			High wall with side windows Openings between 30–50% (VL3)	27.5
		Roof ventilation structure (VC)	Gable roof with laternim (VC1)	73.5
			Gable roof with one open side (VC3)	25.5
Breeding (GE2)	Effectiveness in maintaining thermal comfort	Floor material (MP)	Flat concrete (MP1)	6.2
			Plastics slatteds (MP2)	54.1
			Mixed (flat and slatted) (MP5)	38.7
	Constructive cost	Manure storage or conveyance system (SCE)	Flat concrete (MP1)	67.9
			Plastics slatteds (MP2)	31.1
			Mixed (flat and slatted) (MP5)	
	Maintenance cost	Side ventilation structure (VL)	Low wall open between 50–80% (VL2)	72.3
			High wall with side windows openings between 30–50% (VL3)	26.7
		Roof ventilation structure (VC)	Gable roof with laternim (VC1)	73.5
			Gable roof with one open side (VC3)	25.5
Growth (GE3)	Effectiveness in maintaining thermal comfort	Floor material (MP)	Plastics slatteds (MP2)	80.8
			Deep bed (MP4)	18.2
	Constructive cost	Manure storage or conveyance system (SCE)	Flooded pit (SCE1)	58.5
			Pit not flooded (SCE2)	24.6
			Absorbent material (SCE6)	15.9
	Maintenance cost	Side ventilation structure (VL)	Low wall open between 50–80% (VL2)	72.3
			High wall with side windows openings Between 30–50% (VL3)	26.7
		Roof ventilation structure (VC)	Gable roof with laternim (VC1)	73.5
			Gable roof with one open side (VC3)	25.5

Table 9 shows the ranking results of the alternatives of the construction features. Floor materials such as concrete was prioritized for the gestation and fattening groups, in contrast to breeding and growth where plastic had a greater weighing; manure storage or conveyance system for fattening was the only group where structures flooded with water (pool or pond (SCE4)), that allow animals to cool off, were taken into account, however, according to Table 1, 70% of the farms in Antioquia are located in cold climates where this type of structures are not feasibility; Lateral ventilation with low wall open between 50–80% (VL2) is predominant in all groups, as well as Gable roof with laternim (VC1) for Roof ventilation structure (VC). To sum up it is possible to define that breeding and growth facilities have similar patterns in terms of housing requirements, as well as gestation and fattening; the explanation may be given by the vulnerability of small animals to climatic conditions, which requires a greater protection, according to Cecchin et al.,2019, these is one of the objectives that an accommodation must ensure to guarantee animal welfare. The results also confirm the observations of Reckmann et al., 2013 who state that in tropical and subtropical areas, many animal facilities have open sides allowing natural ventilation that represents lower operating costs.

From the ranking results of Table 9, Table 10 shows the final proposal of construction typologies according to the age group and the thermal floor, seeking to improve the conditions of animal thermal comfort, better management of spin off products and mitigation of biogas generation. From the 4,320 initial combinations and from the 948 feasible typologies, the three most feasibility alternatives are proposed by age group and thermal floor, for a total of 36 alternatives that would be the most viable and would represent the constructive typologies for Colombian pig farming.

Table 10. Proposal of construction typologies according to the age group and thermal floor (Own research)

Age group	Thermal floor	Alternatives	Typologies		
			1	2	3
Gestation	Warm	Floor material	MP1	MP2	MP5
		Manure storage or conveyance system	SCE5	SCE1	SCE5
		Side ventilation structure	VL2	VL3	VL2
		Roof ventilation structure	VC1	VC3	VC1
	Mild	Floor material	MP1	MP2	MP5
		Manure storage or conveyance system	SCE5	SCE1	SCE5
		Side ventilation structure	VL2	VL2	VL2
		Roof ventilation structure	VC1	VC3	VC1
	Cold	Floor material	MP1	MP2	MP5
		Manure storage or conveyance system	SCE5	SCE1	SCE5
		Side ventilation structure	VL2	VL1	VL2
		Roof ventilation structure	VC1	VC3	VC1
Breeding	Warm	Floor material	MP2	MP5	MP1
		Manure storage or conveyance system	SCE1	SCE1	SCE5
		Side ventilation structure	VL3	VL3	VL3
		Roof ventilation structure	VC1	VC3	VC1
	Mild	Floor material	MP2	MP5	MP1
		Manure storage or conveyance system	SCE1	SCE1	SCE5
		Side ventilation structure	VL2	VL2	VL2
		Roof ventilation structure	VC1	VC3	VC1
	Cold	Floor material	MP2	MP2	MP5
		Manure storage or conveyance system	SCE1	SCE1	SCE5
		Side ventilation structure	VL2	VL2	VL2
		Roof ventilation structure	VC1	VC3	VC1

Table 10 continued

Growth	Warm	Floor material	MP2	MP4	MP2
		Manure storage or conveyance system	SCE1	SCE6	SCE2
		Side ventilation structure	VL3	VL3	VL3
		Roof ventilation structure	VC1	VC3	VC3
	Mild	Floor material	MP2	MP4	MP2
		Manure storage or conveyance system	SCE1	SCE6	SCE2
		Side ventilation structure	VL2	VL2	VL2
		Roof ventilation structure	VC1	VC3	VC1
	Cold	Floor material	MP2	MP4	MP2
		Manure storage or conveyance system	SCE1	SCE6	SCE2
		Side ventilation structure	VL2	VL2	VL2
		Roof ventilation structure	VC1	VC3	VC1
Fattening	Warm	Floor material	MP1	MP5	MP3
		Manure storage or conveyance system	SCE3	SCE1	SCE2
		Side ventilation structure	VL2	VL3	VL2
		Roof ventilation structure	VC1	VC3	VC1
	Mild	Floor material	MP1	MP5	MP3
		Manure storage or conveyance system	SCE3	SCE1	SCE2
		Side ventilation structure	VL2	VL2	VL2
		Roof ventilation structure	VC1	VC3	VC1
	Cold	Floor material	MP1	MP5	MP3
		Manure storage or conveyance system	SCE4	SCE1	SCE2
		Side ventilation structure	VL2	VL1	VL2
		Roof ventilation structure	VC1	VC3	VC1

CONCLUSIONS

Parameters were obtained to describe the concept of a technified farm, the most relevant are: biosecurity measures, measurement of zootechnical parameters, development of training for personnel and legal compliance. Farms were classified into three categories small, medium and large and the ranges were established according to the number of animals per age group the results were: 1) breeding small (50–200), medium (201–1,000) and large (1,001–5,000); 2) growth small (60–200), medium (201–800) and large (801–5000); and 3) finishing stage small (50–500), medium (501–1,000) and large (2,001–5,000). 4,320 initial typological combinations were identified and a total of 948 with feasibility were determined. The research showed that thermal floor and age group are considered relevant factors for the design of pig production facilities. Fattening facilities presented a great variability of the different construction features, in contrast to breeding and growth facilities where the structures are more homogeneous even at different thermal floors. furthermore, structures used in breeding and growth seek to maintain the heat of the facilities to protect the animals from the climatic conditions due to their young age, while in gestation and fattening the structures used seek to contribute to the ventilation of the place. 36 construction typologies were classified as the most feasible to be implemented in the department of Antioquia and the Colombian country, achieving a first typological classification for the pork sector in tropical climates. It will serve as the basis for legislation and a reference for future research work.

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