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The Perception of Brazilian Livestock Regarding the Use of Precision Livestock Farming for Animal Welfare

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Abstract: This study explores pig producers' perceptions regarding the use of technologies for animal welfare in pig farming, highlighting the gap between the productive sector and academic institutions. The research was conducted through a questionnaire administered to producers from different cities in Brazil, addressing topics such as property infrastructure, technology adoption, knowledge about animal welfare, and interaction with academic institutions. The results revealed that although the majority of producers have access to information about technologies and animal welfare, there is a perceived resistance to adopting these technologies, reflected in the lack of interest in responding to academic questionnaires. The analysis also points to the influence of producers' profiles, highlighting the importance of academic education and experience in the sector in the perception and adoption of technologies. Additionally, the research highlights the growing presence of commercial companies, filling the gap between academic research and practical application and suggesting the need for more effective strategies to engage producers in the debate on animal welfare and related technologies. These results have important implications for the development of policies and practices aimed at the sustainable advancement of livestock, encouraging greater integration and collaboration among the various actors in the sector.

Keywords: academic interaction; productive infrastructure; sustainability; pig farming

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1. Introduction

Pig farming plays a fundamental role in global food production, with pork being one of the most consumed meats worldwide, according to data from the Food and Agriculture Organization of the United Nations [1]. This leadership in consumption underscores the economic and nutritional importance of livestock, presenting itself as a vital sector for food security.

In the context of Brazilian agribusiness, pig farming stands out as the fourth-largest livestock producer and the fourth-largest exporter of its products [2]. In 2023, Brazil produced approximately 4.983 million tons of pork, of which 1.120 million tons were exported, generating a gross production value of around 32 billion real [3]. This growth is the result of technological and conceptual advances in all stages of the production chain, reflecting an average annual increase of 4% in production and 13% in exports over the last 50 years [2].

The evolution of Brazilian livestock is closely tied to the adoption of innovative technologies, which have the potential to promote animal welfare, sustainability, and increased productivity. Precision livestock farming, encompassing technologies like sensors, cameras, and monitoring systems, enables more effective control of environmental conditions and animal health, thus contributing to improved animal welfare and productive efficiency [4].

These technologies offer non-invasive monitoring of animals, facilitating early detection of stereotypical behaviors and diseases, as well as individual animal tracking. This generates information that is fed into a database and serves both for future interventions and immediate actions.

The application of these technologies not only ensures sustainability but also enhances animal welfare, which is a growing concern among producers and a factor observed by consumers when purchasing pork. Monitoring and automation, such as automated feeders, ensure animals receive proper nutrition, enhancing growth and piglet survival rates.

Legislation plays a crucial role in regulating the swine industry and establishing standards for animal welfare practices and sanitary safety. In Brazil, Normative Instruction No. 113 from the Ministry of Agriculture, Livestock, and Supply (MAPA), in force since 2021, sets out good management practices and animal welfare standards on commercial breeding farms. Compliance with these standards is essential to ensure the quality and safety of pork products, as well as to access international markets [5].

However, the adoption of advanced technologies in livestock faces several challenges. Communication infrastructure, especially the availability of the internet in rural areas, limits access to precision technologies. Lack of contact with experts and universities also leaves producers lagging, reliant on commercial solutions that may not always be tailored to their specific needs [6]. This scenario underscores the need for greater integration between the productive sector and research institutions to overcome technological barriers and promote sustainable and efficient practices [7,8].

Globally, the adoption of technologies for animal welfare is essential to meet the growing demand for sustainable and high-quality products. Precision technologies not only improve animal welfare but also increase productivity and the sustainability of pork production, meeting consumer demands and international regulations [9].

This article aims to explore producers' knowledge and access to technologies and how they perceive the importance of adopting these technologies on their farms. Through an analysis of owners' biographical characteristics, their knowledge about animal welfare, and technology adoption, this study seeks to correlate pig farmers' views on the implementation of advanced technological practices.

The structure of the article, in addition to the introduction, is divided into four main sections. The materials and methods detail the data collection and analysis, including the application of the questionnaire to pig farmers. The results section presents the main data from respondents according to pre-established profiles. The discussion section analyzes the producers' perceptions of technology and animal welfare, correlating these with demographic data and political knowledge. Finally, the article concludes with practical recommendations and suggestions for future research, emphasizing the importance of integration between livestock farming and universities to promote efficient practices in livestock.

2. Materials and Methods

This study adopted a qualitative approach, using a structured questionnaire to gain an overview of pig producers' opinions on animal welfare and technology adoption. This questionnaire was developed using the technological innovation adoption determinants from [10], expanded with livestock farmers' perceptions regarding welfare and technology use [11–15], and consultations with experts in the field, considering the particularities of swine livestock production. The research focused on the profiles listed in Table 1.

Table 1. Structured Profiles in the Questions.

Profiles	Questions
1. Producer	01 to 05
2. Economic of the company	06 to 11
3. Company Structure/Information System	12 to 15

Table 1. *Cont.*

Profiles	Questions
4. Welfare Concepts and Precision Livestock Farming	16: a, b, d, h, i
5. Legislative knowledge	16: c, m, p
6. Technological	16: e to t (except the ones already mentioned)

2.1. Recruitment and Survey Implementation

The survey with 16 questions (Appendix A) was developed and distributed via the web from October 2023 to January 2024 (ethics committee process number CAAE 69313823.0.0000.5395). The questionnaire access link was distributed to contacts of pig farm owners and managers, including those associated with the São Paulo Swine Breeders Association, via email and phone. Additionally, contacts from producers in the South region of Brazil and the Sorocaba and Piracicaba regions (São Paulo state) were reached through referrals from industry experts. In total, 60 contacts were reached, of which 40% responded to the request, resulting in 24 responses.

The sampling method was non-probabilistic, utilizing a "snowball" approach, where initial responding producers recommended new producers to participate. This method proved effective in accessing information from a hard-to-reach audience [16,17]. Among the contacts in the South and Southeast regions of Brazil, 8 were from São Paulo state, 10 from Paraná state, 5 from Santa Catarina state, and 1 from Rio Grande do Sul state (Figure 1). The participants represented a variety of production contexts providing a rich and diversified sample of data.

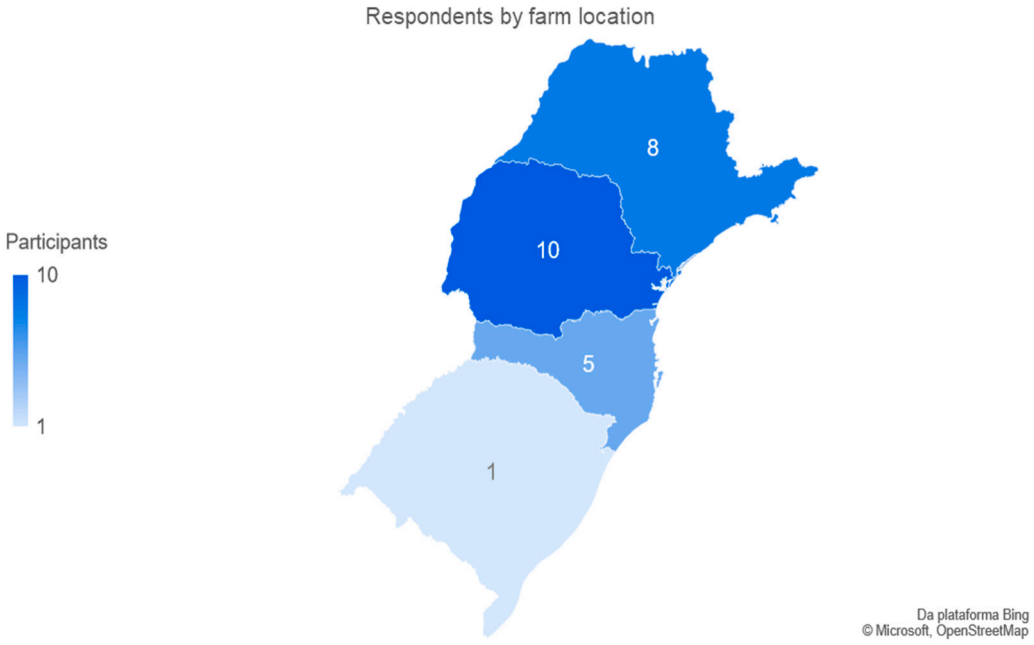

Figure 1. Number of farms that responded to the research questionnaire by state.

2.2. Construction of the Questions

The research instrument was structured into sections that address topics such as management practices [18], adopted technologies [19,20], economic challenges, and environmental aspects [21], among others. The electronic questionnaire developed contains sixteen questions divided into six profiles for analysis, as proposed in the objectives of the study, following the dimensions of conditioning technology adoption adapted from [22].

The demographic questions and farm characteristics had closed responses, except for the age of the respondent, the location of the farm, and the numbers of sheds, based on [22],

who applied his questionnaire to cocoa producers on technology adoption, and [23], a survey on pig welfare. Questions about the infrastructure of the properties were designed to assess the economic profile of the farm and the quality of the internet signal to evaluate the feasibility of acquiring devices that communicate through cloud data, a reality increasingly common in precision livestock farming.

In question sixteen, items "a" to "t" had the following response options: "I do not know how to opine", "strongly disagree", "disagree partially", "disagree", "agree partially", "agree", and "strongly agree", indicating the use of the Likert scale. The Likert scale is a measurement method used to numerically express quantitative attributes, allowing for descriptive, exploratory, or confirmatory statistical procedures [24]. To prevent respondents from selecting the same option for all items in a rush to complete the survey, some statements were phrased negatively, requiring respondents to pay more attention to the options. However, for the analysis of the results, the statements were rearranged in a positive sense.

2.3. Data Analysis

Due to the sample size, the data analysis used was descriptive, a methodology employed to characterize attributes and quantify them [25], along with inductive thematic analysis (reflective), where there isn't a specific theory, but it encompasses a broad and flexible approach to analyzing the issues [26].

For the analysis of producers' perceptions, a combination of profiles was used, following the article's objective of understanding the producer's perception regarding the use of precision technology for animal welfare. With the assistance of experts in the field, based on the determinants by [10], which comprise socioeconomic characteristics and the producer's condition; characteristics of production and rural property; technology characteristics; and systemic factors, the analysis was developed as presented in Table 2. Thus, an analysis of the rural producer's perception was established based on economic, technological, and legislative aspects regarding the use of animal welfare concepts on their properties.

Table 2. Analysis of the established profiles in the survey.

Profiles	Analysis
1. Producer 3. Company Structure/Information System 6. Technological	Identifying the relationship between the education and experience of the interviewees in influencing company structures and animal welfare.
4. Welfare Concepts and Precision Livestock Farming 5. Legislative knowledge 6. Technological	Relating the understanding of technology adoption, compliance with laws for animal welfare, and the perception of academic contribution to technological improvement.
2. Economic of the company 4. Welfare Concepts and Precision Livestock Farming 6. Technological	Perception of the economic factor in the adoption of animal welfare and technology.

3. Results

The results are presented in the sequence in which they were addressed to the producer.

3.1. Producer's Profile

The demographic characteristics of the participants are presented in Table 3 by gender, years of experience, education, and role on the farm. Among the respondents, the average age was 40 years, and all of them were male. The academic background of the interviewees shows that approximately 54% do not have higher education, and only 13% have some specialization. It was found that 62.5% of the interviewees on the rural property hold the position of owner or partner, and 37.5% work as managers or supervisors, with the majority having between 21 and 30 years of experience in livestock.

Table 3. Demographic Data of Participants.

Demographics	N	%
Gender		
Male	24	100
Female	0	0
Work experience		
Up to 10 years	8	33.3
Between 11 and 20 years	3	12.5
Between 21 and 30 years	10	41.7
More than 30 years	3	12.5
Educational background		
Completed Elementary School (1st grade)	1	4.2
Completed High School (2nd grade)	5	20.8
Incomplete Higher Education	7	29.2
Completed Higher Education	8	33.3
Postgraduate	3	12.5
Role on the farm		
Owner or partner	15	62.5
Manager or supervisor	9	37.5

3.2. Economic and Structural Profile of Farms

The number of independent production sheds varied from 8 to 30 sheds, and for cooperatives, it ranged from 3 to 6. The characteristics of the farms and infrastructure are presented in Table 4 and Figure 2. These property data help understand the level of investment and the size of the farms.

Table 4. Physical characteristics of the surveyed properties.

Property		
Production Type	**Independent**	**Integrated/Cooperative**
Number of farms		
Only 1	0	10
Between 2 and 3	6	4
Between 4 and 5	1	2
More than 5	1	0
Production Model		
Complete cycle	5	0
Sow Unit (SU)	2	7
Finishing Unit (FU)	1	9
Number of sows:		
Less than 100	0	5
Between 301 and 600	1	1
601 to 1200	0	7
More than 2000	7	1
Unable to answer	0	2

The production model in 67% of the farms is integrated/cooperative, totaling 16 properties, with this process being adopted in the southern region of the country. In 33% of the properties, the production process is independent, a model adopted in pig farming in the state of São Paulo.

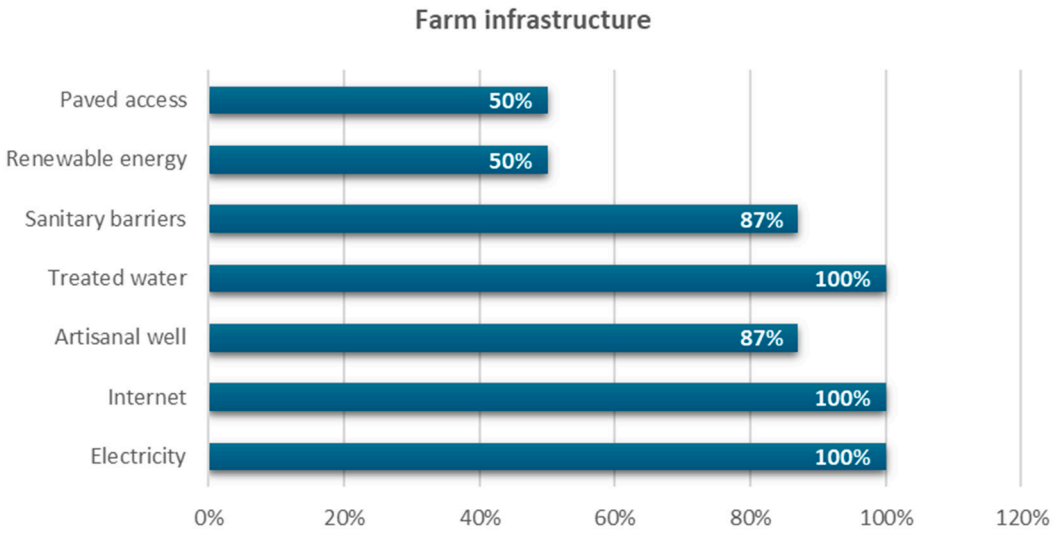

Figure 2. Summary of the infrastructure of the surveyed properties.

In 42% of the properties, the pig production model is classified as Finishing Units (FU)—responsible for fattening the animals and encompassing the piglets' exit from the nursery. In 38% of the properties, the classification is as Sow Units (SU), which include the breeding sector, maternity, and piglet weaning. In 20% of the properties, the classification is a complete cycle model—encompassing all production phases from the arrival of gilts destined for reproduction to the end of finishing. Each model has specific characteristics and needs regarding the technologies and processes employed.

In 46% of the properties, there are 6 units of sheds installed; in 29% of the properties, there are 1 to 5 units; and 25% of the properties have 8 to 30 sheds installed. In 38% of the surveyed properties with FU and complete cycle production models, the number of installed sows is over 1200, 25% have between 601 to 1200 sows, and 8% have 301 to 600 sows installed.

Figure 2 presents the infrastructure of the properties of livestock participating in the study. The data reveals that 100% of the properties have electricity, treated water, internet access, and artesian wells. Additionally, 87% of the properties have sanitary barriers, and 50% have paved access and use renewable energy. Currently, data from electronic devices feed cloud databases, and the access and quality of the internet can be a motivating factor for productive growth and alignment with contemporary management trends. Despite all properties having internet access, 75% of pig farmers responded to question 14 that the signal meets their needs, while the rest described it as unstable. Complementing this information, in question 15, regarding the use of computerized systems that require the internet, 25% responded negatively.

3.3. Producer Perceptions

In this subsection, the results regarding the producers' perceptions are presented. Regarding their knowledge of animal welfare and precision livestock farming, the responses indicate a positive perception of the importance of adopting welfare management practices and variable control devices in production, aiming at improving and increasing productivity. However, 50% of the participants were unable to respond regarding the use of indicators and how knowledge can assist in the production process (Figure 3). In the positive proportion, 96% of the interviewees apply available management techniques from the market, but 54% do not find it easy to use them.

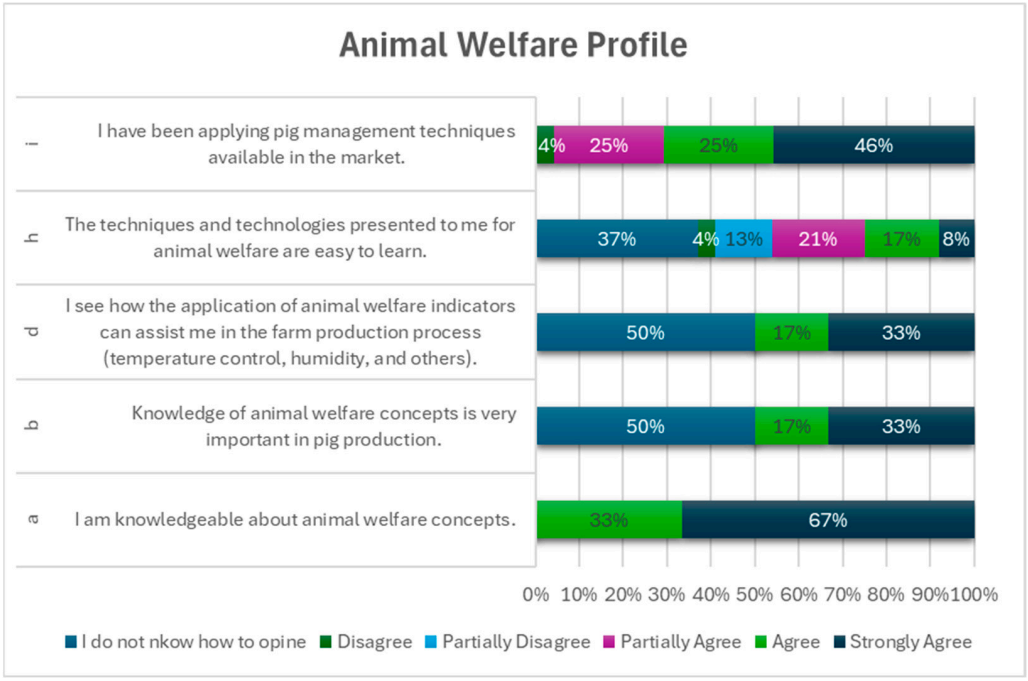

Figure 3. Knowledge of animal welfare and precision livestock farming concepts among the surveyed properties.

A less heterogeneous scenario is perceived regarding knowledge about public policies and legislative compliance regarding their property/production. In 79% of the responses, participants either did not know or disagreed that the government promotes technological improvements, and as a result, 63% agreed that it is important to know public policies. Consequently, only 4% of the producers disagree with adopting management for animal welfare to comply with legislation (Figure 4).

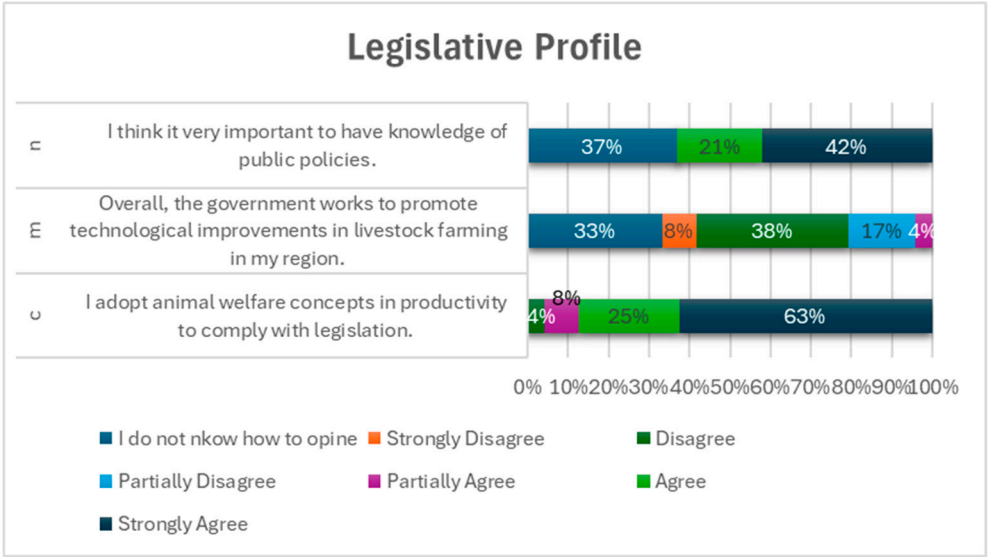

Figure 4. Knowledge of legislative concepts of animal welfare among the surveyed properties.

The adoption of technology on rural properties is fundamental to ensure animal welfare and maximize the efficiency of precision livestock farming. Figure 5 presents the results of producers' perceptions regarding the adoption of their properties. Technology can reach properties through technical visits from hired specialists and/or from researchers interested in testing their projects on farms. Among those surveyed, 50% are open to

receiving the university on their properties, but acceptance is higher when it comes from machinery and equipment suppliers (75%).

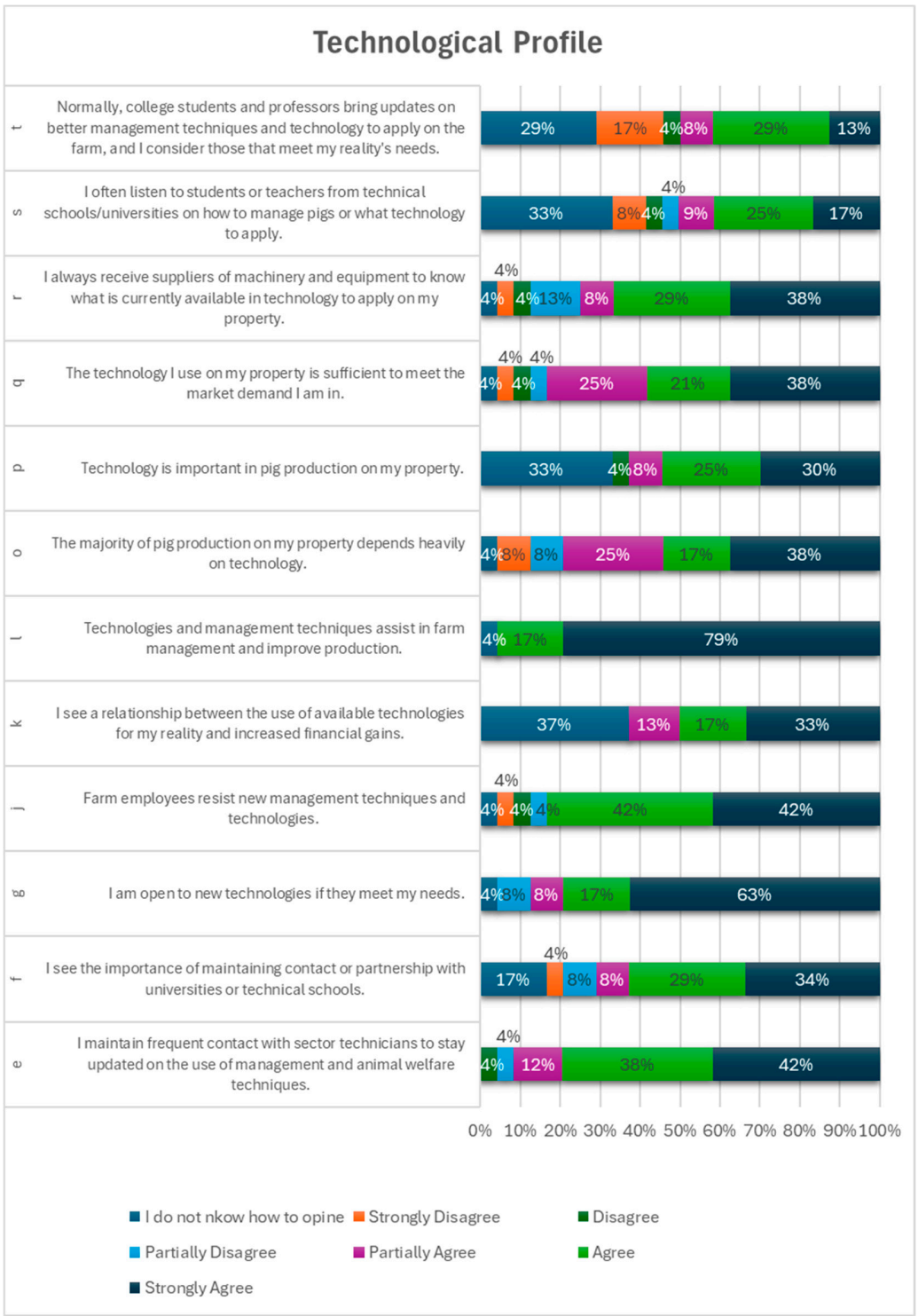

Figure 5. Adoption of technologies for the production process and animal welfare among the surveyed properties.

Perceptions in the economic realm show that technology used to manage the business has a significant contribution (96%), while 63% agree that it can help in financial gains within what is available for their reality. However, there is a perceived resistance to acceptance from employees, with 84% sharing this sentiment.

When looking at how they perceive the existing technology on the farm and how their animals are served by it, 84% believe it is sufficient, and 80% say that their production depends on technology, even though a smaller number believe that its use is important for production (62%).

To conclude, regarding the reestablishment of contact with universities and technicians in the field, 92% maintain this connection; however, 70% see importance in this exchange relationship. Nonetheless, 80% express openness to new technologies if they meet their needs.

4. Discussion

This study aims to analyze the correlations between technology adoption, animal welfare, and the characteristics of pig farmers and their properties, providing an overview of this scenario to researchers. Obtaining information from rural producers is hindered by distrust and resistance towards academic institutions, as well as a busy routine that limits availability for participation in interviews or questionnaires [27].

In countries of the European Union and in China, researchers have great access and adherence from rural producers [23,28–32]. However, in Brazil, this access is hindered, impairing data collection and knowledge dissemination. Of the 60 forms sent, only 40% were returned, even with all formal procedures followed, indicating resistance from the productive sector to disclose data to the academic sector [12].

The relevance of pig farming in its growing economic participation in Brazil's GDP is reflected in the number of regulations and laws regulating pig production. Special emphasis is given to animal welfare, a topic on the rise in scientific publications. Another point worth noting is the studies on producers' perception regarding the use of technologies in various livestock cultures, although still incipient and less explored in the pig farming area. It is observed that many technologies developed and validated in the scientific field hardly reach the farms, as evidenced by the producers' responses [23,33,34].

One of the main limitations of this study is the low number of observations, resulting from the relatively low response rate to the applied questionnaire. However, this limitation can be interpreted as a valuable indicator of the reality in the field. The low response rate may reflect a lack of interest or even resistance among producers towards the adoption of precision livestock farming technologies, a phenomenon previously observed by the statistician Moore [35]. Moreover, this lack of engagement may be related to several other barriers, such as difficulties in organizing time due to the absence of auxiliary technologies, limitations in access to digital tools, or even a knowledge gap regarding the use and benefits of these technologies.

There is a clear correlation between the profile and education of pig farmers, most of whom have significant experience, and slightly less than half have considerable academic education, suggesting they have access to information about technologies and animal welfare [36]. However, regarding universities' access to field validation or commercialization of their research, there is still timid growth.

The communication capacity between researchers and producers, who do not always have the same everyday vocabulary for understanding research, proves to be an important factor in data collection in online questionnaires or information collection applications. Faced with these difficulties, researchers need to develop specific strategies and approaches to overcome obstacles and obtain reliable information [12].

4.1. Analysis of Profiles: Producer × Company Structure/Information System × Technological

The analysis of producer profiles and company structure/information systems concerning the adoption of precision livestock technologies reveals important insights for promoting animal welfare and productivity efficiency. The infrastructure of rural properties plays a fundamental role in animal welfare, providing suitable conditions for comfort, safety, and animal development, which in turn directly influences productivity efficiency and profitability [37].

Furthermore, the infrastructure indicators (Figure 2) are fundamental to characterize that the owners are in compliance with sanitary legislation since items such as treated water, sanitary barriers, and electricity are basic requirements to ensure animal welfare and production quality. The presence of the internet in all properties, for instance, may suggest that connectivity is not a limiting factor for the adoption of remote access technologies, although not all properties may have a satisfactory signal [37].

The profile of interviewed producers shows a predominance of middle-aged professionals with good academic backgrounds or ongoing education and extensive experience in the sector. This profile highlights a concern with property structure and the use of information systems, as demonstrated by universal internet access in all researched farms and the use of renewable energy systems in half of the properties. These data indicate that the technological profile of producers aligns with the proposal of using precision livestock to promote animal welfare [38–40].

Moreover, the data suggest a generational renewal in the rural sector, with new generations taking over family businesses and hiring qualified professionals to manage properties. This movement is supported by the age range of the interviewees, their roles on the property, and their academic background. Pol et al. (2021) confirm that swine farming practices that improve animal welfare also favor the working conditions of farmers, presenting similar profiles in terms of age, academic background, and role on the property [30].

Producers show significant openness to new technologies, with four-fifths of respondents expressing interest in their adoption. However, just over half recognize the dependence of swine production on intensive technology use. A critical point requiring further academic exploration is the managerial view on the return on technology investment. Notably, just over a third of respondents do not know whether the use of technologies results in financial gains, indicating an area where more information and clarification are needed [41,42].

The integration of robust infrastructure, qualified producer profiles, and advanced information systems is essential for the successful implementation of precision livestock. This scenario, combined with the growing interest and adoption of new technologies, points to a promising future in promoting animal welfare and productivity efficiency on rural properties [40].

4.2. Analysis of Profiles: Welfare and Precision Livestock Concepts × Legislative Knowledge × Technological Understanding

The correlation between welfare and precision livestock concepts, legislative knowledge, and technological understanding is evidenced by the data obtained in this research. The majority of producers demonstrated a favorable attitude towards the adoption of technologies, reflecting a positive disposition towards precision livestock. Furthermore, a large portion of the respondents reported mainly adopting animal welfare concepts to comply with legal requirements, indicating that compliance with legislation is a crucial factor for the implementation of these practices [42,43].

Legislative knowledge is essential for the proper application of animal welfare practices, as laws and regulations provide specific guidelines and standards to be followed. The research also revealed that a significant portion of respondents recognize the importance of being informed about public policies related to animal welfare, highlighting the interconnection between legislative and technological knowledge [34].

In terms of management, a significant majority of respondents adopt techniques available in the market, and almost all agree that these technologies and techniques assist in property management. These data confirm that technology adoption and compliance with laws are integrated aspects in the profile of producers regarding animal welfare [11–15]. However, there is a perception of inefficiency in government action, with about half of the respondents expressing this opinion and more than a third unable to assess the importance of knowledge of public policies and the promotion of technological improvements by the government [34].

Precision livestock, which is based on the use of advanced technologies to monitor and manage animal production efficiently, depends on robust infrastructure. In the study, all surveyed properties have internet access, with three-quarters of the properties reporting that the signal quality meets their needs, although one-quarter report instability in the service [44].

Additionally, renewable energy infrastructure was also highlighted, with half of the properties using systems incentivized by government and private programs in Paraná, such as the Paraná Solar Program and the Sustainable Energy Paraná Program [45].

Animal welfare concepts are widely known and valued by producers, with all respondents showing interest in the topic. However, half of the participants were unable to opine on the practical application of animal welfare indicators, suggesting the need for further discussion and deepening of this topic in the context of technological management. As Turner et al. (2023) suggest, the application of animal welfare techniques and concepts constitutes a promising field for academic action, indicating an opportunity for greater collaboration between the productive sector and research institutions [21].

4.3. Analysis of Profiles: Company Economics × Welfare and Precision Livestock Concepts × Technology

Technology provides vital information about the health status and behavior of animals, enabling more efficient managerial and technical decision-making [46]. Among those surveyed, the majority are open to new technologies, and just over half agree that pig production relies heavily on technology.

Regarding the relationship between the use of available technologies and increased financial gains, half of the respondents agree, while just over a third do not have an opinion. Most respondents regularly receive visits from machinery and equipment suppliers to stay technologically updated, with only a small minority disagreeing with this practice [12,41,42].

The application of techniques and technologies for animal welfare is widely recognized as important, with more than two-thirds of respondents adopting available management techniques in the market. However, there is resistance from farm workers to new management techniques and technologies, with almost half of the respondents agreeing with this statement and a similar proportion partially agreeing [12,21,27].

The interaction between rural properties and the academic sector is essential for knowledge transfer and the development of new research [3]. In the surveyed properties, about three-fifths of respondents see the importance of maintaining contact or partnerships with universities or technical schools, although a small number do not have an opinion [27].

The analysis shows that the education and experience of the respondents influence the structure of the company, the adoption of animal welfare, the adoption of technology, compliance with laws, and the perception of academic contribution to technological improvement [47]. The academia can assist producers in understanding and applying animal welfare indicators, an area where half of the respondents do not have an opinion. Moreover, greater involvement with government actions is needed to promote knowledge dissemination in the sector [48].

The economic profile of the properties shows expanding businesses, with nearly half owning up to five farms with modern infrastructure and adopting good technological practices. However, approximately one-third of respondents do not have an opinion on the importance of contact with academic institutions for technical updating, a space being filled by commercial companies developing technology focused on application in the sector [27,48].

For the future, it is recommended that additional research be conducted to explore in greater depth the reasons why producers prefer to trust commercial technicians rather than university researchers. Understanding these dynamics can facilitate the development of more effective strategies for engaging rural producers. Additionally, there is a need to

develop technologies that are economically viable and technically accessible for properties of different sizes and financial capacities.

It is also recommended to detail the types of technologies used on farms, as despite the positive indicators in the infrastructure of the properties, the absence of other specific data on the effective use of precision livestock farming technologies prevents a definitive confirmation of the level of technification of these properties. The availability of basic infrastructure, although essential, does not necessarily translate into high adoption of advanced technologies, which requires a more detailed and comprehensive analysis of the use and implementation of these tools.

5. Conclusions

In this study, it became clear that pig farmers' perceptions vary regarding the use of precision livestock farming technologies to promote animal welfare. Although a significant portion of producers recognize the benefits of these technologies, substantial barriers to their adoption were evident, such as high costs, technical complexity, and a lack of specific technical knowledge.

The results indicated that younger pig farmers and those with higher education levels tend to be more receptive to new technologies. This suggests that continuous training and education programs can play a critical role in promoting the adoption of technologies. Furthermore, familiarity with animal welfare concepts and compliance with current legislation were also determining factors in the willingness to accept precision livestock farming.

Another crucial point raised was the difficulty of access and communication between universities and rural producers. The deficiency in direct communication limits the access of academic researchers in the field, often being filled by commercial companies that provide specific technologies. This dynamic highlights the need for policies and initiatives that encourage collaboration between the productive sector and academic institutions, promoting more effective knowledge transfer tailored to the needs of producers.

In a broader context, the adoption of precision livestock farming technologies can bring significant benefits not only in terms of productive efficiency but also in improving animal welfare conditions. The implementation of these technologies can lead to more ethical and sustainable management, aligning with the growing societal demands for responsible and transparent agricultural practices.

In summary, this study highlights the importance of integration between livestock farming and universities, emphasizing that a joint effort is essential for promoting efficient and sustainable practices in pig farming. Overcoming the identified barriers could enhance the positive impact of precision technologies, benefiting animals, producers, and society as a whole.

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Institutional Review Board Statement: This study was submitted and approved by the ethics committee process number CAAE 69313823.0.0000.5395.

Data Availability Statement: The datasets generated and/or analyzed during the current study are available upon request to the corresponding author.

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Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

The questionnaire questions are listed below:

1. How old are you?
2. What's your gender?
   Male
   Female
   Other
3. What is your level of education?
   NO EDUCATION
   INCOMPLETE ELEMENTARY SCHOOL (1st LEVEL)
   COMPLETE ELEMENTARY SCHOOL (1st LEVEL)
   INCOMPLETE HIGH SCHOOL (2nd LEVEL)
   COMPLETE HIGH SCHOOL (2nd LEVEL)
   INCOMPLETE COLLEGE
   COMPLETE COLLEGE
   POSTGRADUATE
4. How much experience do you have in pig farming?
   Less than 10 years
   Between 11 and 20 years
   Between 21 and 30 years
   More than 30 years
5. What is your role on the farm?
   Owner or partner
   President or vice-president
   Manager or supervisor
   Animal scientist or veterinarian
6. How many farms make up your company?
   1
   Between 2 and 3
   Between 4 and 5
   More than 5
7. What is the production model on the farm?
   Integrated/cooperative production
   Independent production
   I don't know how to answer
8. How is the pig farming model on the property classified?
   A Full cycle (includes all phases of production, from the arrival of gilts for reproduction to the end of finishing)
   B Piglet production unit (PPU) (includes the reproduction, farrowing, and weaning sectors)
   C Finishing unit (FU) (responsible for fattening the animal and includes the pigs' exit from the nursery)
   D I don't know how to answer
9. For answers 8A and 8B (from the previous question), what is the number of installed breeding sows?
   Less than 100
   101 to 300
   301 to 600
   601 to 1200

1201 to 2000
More than 2000
I don't know how to answer

10. What is the annual turnover of animals on your property?
Less than 1000 animals
More than 1000 animals
11. In which state is your property located
AC
AL
AP
AM
BA
CE
DF
ES
GO
MA
MT
MS
MG
PA
PB
PR
PE
PI
RJ
RN
RS
RO
RR
SC
SP
SE
TO
12. City of the property
13. Please check the infrastructure items that the property has:
Electricity
Renewable energy (solar, wind, other)
Biogas plant with energy cogeneration
Internet
Artesian well
Treated water
Sewage system
Settling tanks
Sanitary barrier
Composting system for animal carcasses
Paved road access
Other:
14. What is the number of barns used for production?
What is the quality of the internet signal?
No internet signal
Terrible
Unstable

Meets the property's needs
Excellent

15. Does the property use computerized systems that require internet access?
Yes
No
16. Answer the following considering your perception or opinion regarding the statements, choosing the term that corresponds to your degree of agreement, from 0 to 6 according to the indication below: (0) I do not know how to opine; (1) Totally Disagree; (2) Disagree; (3) Partially Disagree; (4) Partially Agree; (5) Agree; and (6) Totally Agree.

(a) I am knowledgeable about animal welfare concepts
(b) Animal welfare concepts knowledge is of little importance in pig production
(c) I do not see how the application of animal welfare indicators can assist me in the farm's production process (temperature control, humidity, and others)
(d) I adopt animal welfare concepts in productivity to meet legislation
(e) The government generally promotes technological improvements in livestock farming in my region.
(f) I find it of little importance to have knowledge of public policies
(g) I maintain frequent contact with sector technicians to update myself on the use of management and animal welfare techniques
(h) I do not see the importance of maintaining contact or partnership with universities or technical schools
(i) I am open to new technologies if they meet my needs
(j) The techniques and technologies presented to me for animal welfare are difficult to learn
(k) I have applied swine management techniques available in the market
(l) Farm employees do not resist new management techniques and technologies
(m) I do not see a relationship between the use of available technologies for my reality and the increase in financial gains
(n) Technologies and management techniques help in farm management and improve production
(o) Most of the pig production on my property depends on heavy use of technology
(p) Technology is not important in pig production on my property
(q) The technology I use on my property is sufficient to meet the market demand I am in
(r) I always receive suppliers of machinery and equipment to find out what is currently in technology to apply on my property
(s) I do not usually listen to students or professors from technical schools/universities about how to manage pigs or which technology to apply
(t) Normally, students and professors from college bring updates on better management techniques and technology to apply on the farm, and I consider those that meet the needs of my reality.

Appendix B

Questionnaire Link: https://forms.gle/ydu9n9gYEqCm9j1t8 accessed on 25 July 2024.

Appendix C

Explanatory text:
Hello,
I'm Michele Moreira, a master's student in Agricultural Systems Engineering at USP Piracicaba/SP—ESALQ. I'm conducting a research on the use of electronic devices in pig production management to improve animal welfare. I would like to invite you to participate by answering a brief questionnaire. Your responses will be confidential and valuable to enhance the swine industry. If you're interested, please access the questionnaire link. To provide further clarification, here's a video explaining the research. If you have any questions or interest in the research, feel free to contact me on this WhatsApp number.

Thank you for your consideration, and I hope to have your participation.
Best regards,
Michele

Appendix D

Video link: https://photos.app.goo.gl/wRbLzLjrdkdvbDGq6 accessed on 25 July 2024.

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