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Decision-Making Attitudes in the Beef Chain Industry Innovation Adoption: Brazilian Case Studies

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***Abstract*— The research objective was to analyze the attitudes of decision-makers in the innovation adoption process in the Brazilian beef chain industry. The study's approach was qualitative and exploratory, and the method was a study of multiple cases in the beef chain industry. To reach the objective, 17 rural properties in the Brazilian state of Mato Grosso do Sul were investigated. Unstructured interviews were conducted to map the decision-makers' attitudes regarding the innovation adoption process. Content analysis was performed using the ATLAS.TI software. The attitudes of the decision makers to evaluate the internal environmental conditions showed the characteristics of informality, slowness, centralization, and conservatism. The factors that affect the innovation adoption were the cost-benefit ratio analysis, the cohesion and connection between what already exists in the organization and the innovative technology, and the uncertainties regarding the return on investment. The Brazilian Beef Chain has been suffering competition in the domestic market, with several other production chains (mainly soy, sugar cane and forestry), and on the foreign market, with other countries (US and China). Beef Chain can find in innovation a mechanism that allows it to improve its strategic position and thus remain competitive. In this context, the present study contributes to understand the motivation and barriers of innovation adoption in the beef chain in Brazil. The findings enabled the proposal of an innovation adoption model based on the attitudes of the decision-makers for the beef chain industry. The contributions of this study are divided into 3 areas: Academic – proposed a model that allows us to understand how the innovation adoption process takes place, based on external and internal variables to the adopter, as well as innovation specificities; Organizational – identified the main innovations that have been adopted by large farms and that may be suitable for small rural properties; and, Governmental – demonstrated that despite the existence of policies to support the adoption of innovation. These policies rarely reach the small producer, evidencing the need for better publicity by the government, with a view to bringing government actions and small rural producers closer together.**

***Keywords*—** *Decision-maker, Decision-making attitudes, Innovation adoption, Beef chain.*

1. Introduction

In different contexts, innovation has been emphasized as a factor that enables a company to maintain its competitive capacity. [1] and [2] indicated that innovation can be a path toward competitive advantage. Other studies have also identified the contribution of innovation, both for a company's survival in the current competitive environment and for the defense of a position [3], [4], [5], [6], [7], [8].

The food industry is dependent on external innovations, whether from other industries in the chain or from relationships with research institutes and universities. In this sector, there is a greater incidence of incremental innovation than radical innovation — these usually occur at the company level, and there are more innovations in products and processes [9], 10], [11].

One specific sector within the food industry is that of beef, which is representative of the economic scenario of Brazil, an emerging country. Of note, Farming was the sector that most leveraged growth in 2013, with 7.0% — which compares with 2.0% growth in the Services sector and 1.3% in Industry — and movement of R$ 234.6 billion [12].

In this scenario, [13] demonstrated that the competitiveness of the Beef Production Chain is affected by several factors, including innovation. Distance from research centers and universities, infrastructure, and technical assistance to producers is one of the challenges for competitiveness. [14] also indicated the relevance of the modernization of the beef production chain, especially in the use of information systems technologies, use of Internet resources, and traceability. These incremental innovations are strategic for the sector to improve the production process and therefore achieve better results for the entire chain.

To identify what leads companies in the food industry to adopt innovations, [15] observed that the most innovative companies have the following profile: a) they have investments in externally developed technologies; b) they form alliances with other companies, research institutes, and universities for the external execution of research and development (R&D); c) larger companies are more likely

to innovate with greater intensity; d) companies with investment in R&D are more likely to innovate; and e) market-oriented companies have a greater tendency to innovate.

The adoption of innovation presupposes a favorable attitude about this adoption by the decision-maker. In their research regarding the adoption of innovation in the beef chain in Australia, [16] identified that the novelty introduced by the adoption of an innovation had a positive initial reception, but over time, there was discontinuance by the decision-makers.

In this context regarding innovation adoption as an important factor for the competitiveness of the beef production industry, faced with an attitude of resistance to this adoption indicated by the studies, the objective of this present study arises: analyzing the attitudes of decision-makers in the innovation adoption process in the beef chain.

To satisfy the research objective, 17 rural properties in the state of Mato Grosso do Sul, Brazil, were investigated in depth. The ATLAS.ti software was used for the retrieval and organization of the data. Particularly in the academic context, the in-depth study filled a gap concerning the description of an adopting company's profile, understanding of the intrinsic characteristics of innovations adopted, and evaluation of the internal and external environmental conditions by the decision-maker in relation to the adoption process. Added to this is the importance of the theme "innovation in beef's production chain" and the possibility of generating guiding reflections for future public policies regarding competitiveness and the promotion of technological development in this sector of the economy, which accounts for a significant share of the gross domestic product (GDP) of Brazil.

2. Literature Review

The literature has addressed the decision-making process via two lenses: one normative, which establishes how decisions should be made, and one descriptive, which explains how the decisions are made. Generally, for the normative chain, a decision-making process is composed of a sequential set of steps, namely, structuring of the problem faced, identification and weighting of decision criteria, generation and evaluation of alternatives, and choosing the optimal solution [17]. In the descriptive chain, the focus is on the description of the decision-making in a real situation, without the prescription of a suitable model for optimal decision-making [18].

There is an understanding that there is no concept of right or wrong for the various decision models (rational or behavioral). Depending on the context of the situation/problem that encourages the decision-making process, one of the approaches must be used. The rationalist approach applies to scenarios of little mutability, in which mathematical calculations (operational research) are sufficient to indicate alternatives to the problem. On the other hand, the behavioral approach is required in complex scenarios, such as the adoption of innovation, in which the subjective aspects (behavior of those involved) must be considered [19].

Specifically, regarding decision-making for the adoption of innovation, the following are notable in the literature: the organizational predisposition model for innovating [20]; the innovation assimilation model [21]; the TOE model, which considers the context for the adoption of innovative technologies [22]; and, finally, the multilevel model for innovation adoption [23].

An aggregate analysis of these theoretical models reveals that the innovation adoption process can be influenced by the following analysis categories: the profile of the adopting company, the intrinsic innovative characteristics, and the environmental influences perceived by the decision-maker. The following attributes that act as facilitating and/or inhibiting factors for the adopting organization are considered in the analysis of the profile of the adopting company: size, structure, and willingness of senior management to innovate. In the models of [20], [21], [22], and [23], the profile of the adopting company was an important determinant for the adoption of an innovation, and recent research — such as the studies of [24] and [25] — also confirms this statement.

Regarding the determinants of the intrinsic innovative characteristics of an innovation adoption process, the following subcategories stand out: relative advantage, compatibility, complexity, possibility for observation, possibility for experimentation, and uncertainty. [22] observed that both the characteristics intrinsic to the innovative technology and its availability influence the adoption process.

In determining the environmental influences that may affect the innovation adoption process, the following subcategories should be considered: level of development of the members of the chain and governmental regulations. [26], [27], identified that both public policies and production chain structures favored the adoption of the new feedlot technology.

3. Methodology

The study's approach was qualitative and exploratory. The method adopted was a study of multiple cases in the beef production industry. Seventeen rural properties in the state of Mato Grosso do Sul were selected (Figure 1).

Properties		Main Innovations Adopted in each Property
1	Large	Creep feeding, supplementation (in the dry and wet season), crop-livestock integration, evaluation of 100% of the animals via chip/smartphone, mobile corral, identification earrings, and feedlot
2		Feedlot, semi-feedlot, creep feeding, early weaning, and pasture alteration with mineralization.
3		Crop-livestock integration, genetic improvement, industrial cross-breeding, and fixed-time artificial insemination (FTAI)
4	Medium	FTAI, supplementation to grazing, soil correction (pasture alterations with limestone and gypsum), fenced rotational grazing (cattle rotated), and *boitel*
5		Protein supplementation at weaning; hormone for the cows, FTAI, feed supplementation (mineral) for the breeding cow; management with less wintering; and industrial crossbreeding
6		Rotational grazing, FTAI, and industrial crossbreeding (Angus)
7		Fenced rotational grazing; pasture alteration with fertilization, limestone, and gypsum; and acquisition of a balance for weighing cattle.
8		Crop-livestock integration; traceability with data management; rational management of the animals; hydraulic trunk; fixed-time breeding season; automation of feedlot with individualized control; sealing in the field and storage in trenches
9		Fenced rotational grazing with fertilization and agricultural urea, insemination with implantation of embryos
10		Individualized control (computerized), feed supplementation, industrial crossbreeding, insemination with implantation of embryos
11	Small	Investment in equipment (tractor), investment in the handling corral (squeeze chute)
12		Pasture alteration with limestone and gypsum, crop-livestock integration, pickets for rotating
13		Pasture alteration with limestone and fertilization, as well as contour lines and pickets for rotation
14		Pasture alteration with limestone and fertilization, rotating picket
15		Rotating picket, pasture alteration with limestone and gypsum
16		Pasture alteration, protein and energy supplementation for the post-weaning grazing
17		Industrial crossbreeding

Figure 1. Size of the properties studied, and description of the innovations adopted

The selection of the analysis units followed the guidelines of [28], who proposed a procedure that favors a logic of agreement with the phenomenon studied, which should be carefully considered [29].

Accordingly, the rural properties selected met the following criteria: a) they raise beef cattle; b) they have adopted innovation in the last five years; and c) they are in the state of Mato Grosso do Sul, in the Center-west region of Brazil. The location in this region is justified by the fact that the Center-west is the region with the largest beef production area (37.88%) and the highest production (34.09%) in Brazil [30].

Of the 17 properties studied, 3 were large companies (cases 1, 2, and 3 — see Figure 1) — they had more than 10,000 hectares and the most employees (300, 97, and 186, respectively). Cases 4 to 10 were medium-sized companies — between 1,200 and 10,000 hectares and 3 to 50 employees. The others (cases 11 to 17) were evaluated as small enterprises, with sizes of less than 2,000 hectares and very small numbers of employees.

As for the data collection, 17 unstructured interviews were performed to map the attitudes of the decision-makers regarding the innovation adoption process. It should be noted that the decision-makers interviewed — directors (2), general managers (4), and owners (11) — were those that actively participated in the innovation adoption processes in the rural properties investigated. The interviews were face-to-face and were performed on the properties, which were visited by the researcher. In addition to the face-to-face interviews, there were several exchanges of emails and phone calls, in addition to use of reports and other supporting material, to guarantee the triangulation of the data.

After the field research, content analysis was performed using the ATLAS.ti software for retrieval and organization of the data [31]. Content analysis is a suitable technique because it follows a

systematic process for coding and extracting inferences from a text [32].

The organization and retrieval of information related to the study's analysis categories included the following: (1) the profile of the adopting company, (2) intrinsic innovative characteristics, and (3) environmental influences — all perceived by the decision-maker in the innovation adoption process. These categories were identified based on a literature review.

Finally, the following commands from the cross-analysis of ATLAS.ti were used: "code co-occurrence table" and "cluster quotations before calculating co-occurrence" [31]. These commands from ATLAS.ti enabled the interpretation and classification of attitudes relevant to the innovation adoption process in the rural properties investigated.

4. Discussion

The results indicated that the most significant innovations in the beef chain industry — such as crop-livestock integration and the use of the feedlot (intensive production) — were adopted by large properties (Figure 1), thus reinforcing the studies of [33] and [34], in which the adoption of different innovations is more favorable in larger companies.

According to one of the interviewees, "being big brings privileges, allowing pioneering and better financial and infrastructure conditions in relation to the adoption of innovations".

Regarding the authority structure, it was found that the innovation adoption process is centralized at the top of the pyramid (owner, director and/or manager) and that there is a relative delay between awareness of the innovation, the decision to adopt, and the effectiveness of its adoption in the medium and large rural properties analyzed, thus corroborating the reflections of [22] and [23], in which more formalized and centralized organizations — even though they are better equipped — are slower in adopting innovations.

It is worth noting that due to the conservative stance and centralization of the decision-makers interviewed, it was observed that the flexibility normally present in smaller organizations did not result in greater speed in the innovation adoption process in the beef production industry, specifically in the smaller rural properties investigated, thus countering the findings of [22], [23], and [35], according to which smaller organizations are more receptive to adopting innovation.

According to one of the interviewees, "the fact that the property is smaller and has few hierarchical levels (at most an intermediary between the owner and the farm hand) is not necessarily an indicator that adoption of innovation occurs quickly. Decisions are taken centrally and often based on informal processes. Even if there is openness for an employee to express himself, the decision always comes from the person at the top of the hierarchical pyramid".

Regarding the willingness of senior management to innovate, in the search for innovations at the national level there was direct involvement from the decision-makers interviewed, in addition to at the international level in one specific case. Moreover, the decision-makers encourage the qualification and participation of employees (including with financial support for studies at higher levels), specifically in the phase for implementing the innovations, which agrees with the studies of [20], [21], [23], [36], and [37], in which the willingness of senior management to innovate is a factor favorable to the process for adopting innovations. One of the interviewees highlighted that "employees are given the opportunity to participate in the process of implementing innovations, which encourages growth and involvement".

For analysis of the intrinsic characteristics of the adopted innovation, six different aspects were used: relative advantage of the innovation, compatibility, complexity, possibility for observation, possibility for experimentation, and uncertainty. In general terms, it was found that the decision-makers interviewed evaluated the cost-benefit ratio of the innovation prior to its adoption, considering its impacts on administrative control, productivity, quality, and financial results. According to one of the interviewees, "the availability of hardware and software technologies, as well as materials and personnel, at the right time and in the right place, is evaluated to improve the processes and results of the property". Thus, these results reinforce the studies of [38, [22], and [23], which address the positive relationship between the relative advantages of innovation and the financial and production results of the adopting company.

It is worth noting that compatibility can be between the new technology and the existing operational infrastructure in the company, as well as in relation to the alignment with the organization's values [20, 21, 22, 23]. This tendency was observed in the reports of the decision-makers, and it was specifically indicated that prior to the adoption of the innovation, the compatibility of the innovative technology — with the physical infrastructure, the workforce, and the financial contributions required — is evaluated.

Regarding the complexity of the innovative technologies, the majority of the decision-makers interviewed (14) reported that they evaluate the difficulties that the company's employees have in understanding and using

the new technology and that they tend to opt for technologies that have fewer impacts on the processes of the property. As indicated by one of the interviewees, “innovative technologies should lead to little change in everyday procedures”. This trend is consistent with the theoretical models of [20], [21], [22], and [23], who suggest a negative relationship between innovation adoption and complexity, thus leading potential adopters to opt for simplicity.

The possibility of anticipating eventual results generated by an innovation, especially in cases in which the adopters are conservative, is a condition that encourages the adoption of innovation [38, 21, 22, 23]). According to the reports of the decision-makers interviewed, the possibility for observation was a strong indicator of innovation adoption. According to one of the interviewees, “observations occurred in nearby companies and in distant companies, and even abroad”.

In the search for more reliable and predictable results, the possibility for experimentation was an instrument adopted by the decision-makers interviewed to minimize uncertainty, which gave greater confidence and consequently enhanced innovation adoption. Thus, it was common to observe that after the decision, the effective process for adopting innovation in the properties analyzed occurred gradually: in the improvement of the breed (cross-breeding or substitution and/or changing of the breed), in insemination (FTAI or embryo), and in improvement of the pastures (alteration, fertilization, integration, fenced rotational grazing, etc.). Consequently, in the interviews, it was found that the decision-maker first implemented the innovation chosen in a small part of the property for tests and then extended it to other areas after obtaining positive initial results. This trend — in which the entrepreneur seeks greater confidence from initial tests and progressive growth from the adoption of the innovative technology — was also observed by [20] and corroborated in later studies ([21]; [22]; [23]; [39].

The characteristics of most of the interviewees revealed conservatism, or what [38] denominated traditional or late adopters. In this case, uncertainty is something to be avoided most vehemently. Although in the stages prior to adoption, it was common to see that the decision-maker was observing and experimenting, uncertainties regarding the return on investment, the availability and qualification of the workforce, and the proof of the technical efficiency of the innovation were highlighted by the majority of respondents as the main inhibitors of the decision to adopt the innovation. If on one hand, the advantage desired from adoption of the innovation acts as a factor propelling adoption, the doubts existing between adoption and perception of the outcome act as an inhibitor. In this case, it is stressed that the production cycle — being long (between 18 and 36 months) — contributes to increasing the period for return on the investment and for the innovation's proof of technical efficiency because with some innovations, it is necessary to wait the whole cycle (or more than one cycle, as in the case of using embryos for genetic improvement).

[40], and [41] observed that chain-specific characteristics interfere in the adoption process, by creating either favorable conditions or barriers. Thus, two aspects were considered for analyzing the environmental influences: the level of technological development of the production chain (upstream, downstream, and lateral), and government regulations (public research, financing, and incentive legislation). The interviewees reported that both suppliers (upstream) and other farmers (lateral) contribute to the process for adopting new technologies. In the case of potential competitors, it was observed that there is more cooperation than competition in the chain. Regarding downstream relationships (relationship of the cattle rancher with the slaughterhouse), the interviewees determined that there was no influence (positive or negative) regarding the decision to adopt. Despite government influence, the decision-makers exhibited a lack of knowledge regarding favorable legislation and financial support for the adoption of innovations.

4.1 Proposition of a descriptive model for innovation adoption based on the attitudes of the decision-maker

From the understanding of how the decision-maker's attitudes influenced innovation adoption in the rural properties studied, it was possible to propose a descriptive model with the following propositions (Figure 2): (a) the decision-making processes investigated explained how the decisions were actually made, that is, without the prescription of a model suitable for optimal decision-making, thus assuming the descriptive chain of [18]; (b) the innovation adoption decisions analyzed were administrative, that is, they involved the structuring of organizational resources to create execution possibilities that sought better results. Additionally, some analyzed decisions also assumed an operational connotation due to the low technological intensity of the sector, which prioritizes the maximization of the efficiency of the resource-conversion process and the maximization of the profitability of current operations, thus corroborating the discussions of [42]; c) to the detriment of the low technological intensity of the sector and the prevalent characteristic of conservative and late adopters [38], it was found that the technological alternatives evaluated were covered with the use of the cyclic search tactic, that is, the one in which the alternatives were developed through multiple searches (in other rural properties), in which the needs were often redefined according to what

was available and minimally affected the processes already in place in the adopting properties [43]; (d) in the description of the decision-making processes investigated, the organizational routines and procedures, the capacity for observation and organizational adaptation, the influence of the decision-makers, and the possibility for gradual experimentation of the technological alternatives chosen were considered, thus incorporating the decision-making behavioral model of [44] and [45]; (e) after understanding the meanings of the attitudes of the decision-makers interviewed (item 4), it was possible to validate — based on the return to the qualitative data — the attitudinal phases that influenced the innovation adoption process, and a logic of simultaneity was observed in this, that is, the attitudinal phases — (1) evaluation of the internal conditions, (2) evaluation of the innovation's intrinsic characteristics, (3) evaluation of the external conditions, and (4) gradual experimentation of the new technology — occurred simultaneously throughout the adoption process.

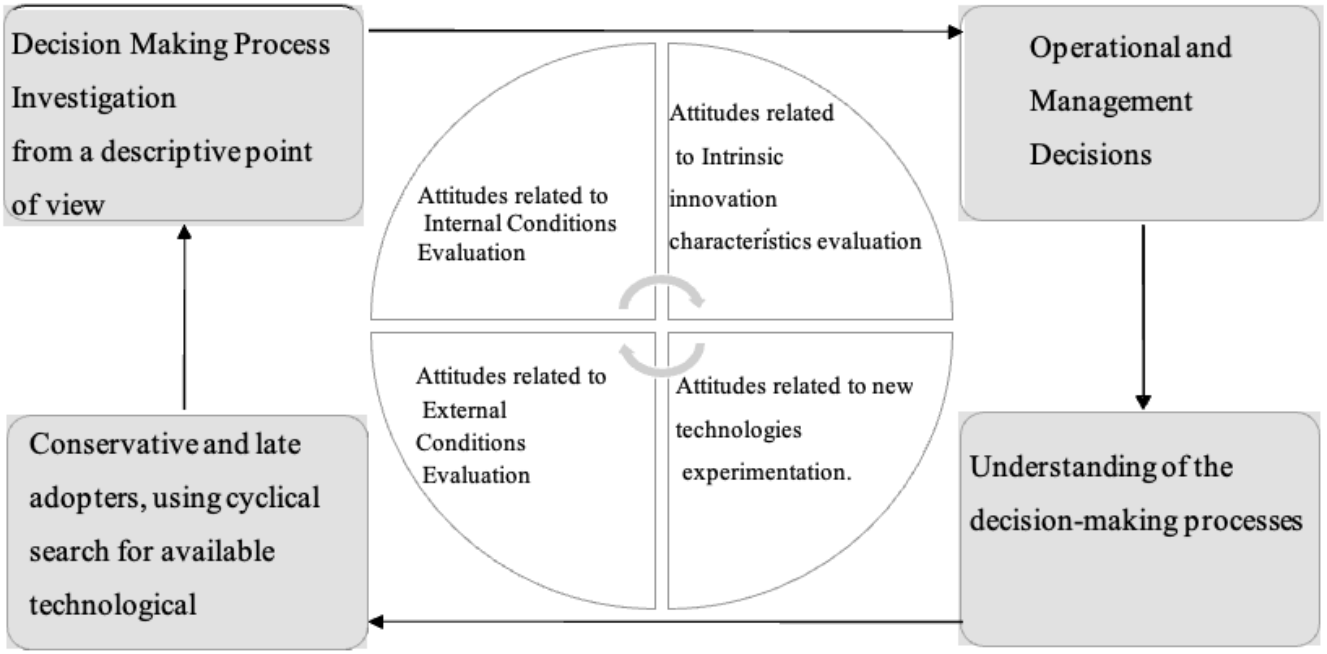

Figure 2. Descriptive model of the innovation adoption based on the decision-makers' attitudes.

Considering the propositions of the descriptive model (Figure 2), the cross-analysis commands "code co-occurrence table" and "cluster quotations before calculating co-occurrence" from ATLAS.ti were used, based on the total number of decision-makers (17 interviewees) considered to be active in the innovation adoption processes. These ATLAS.ti commands provide a visualization (gray areas of Figure 3) of the attitudes that characterize the innovation adoption process in the rural properties investigated, considering the levels of high (dark gray areas), medium (medium gray areas), and low (light gray areas) incidence — see Figure 3.

	Innovation Adoption Process Phases			
Sequence of the events	Evaluation of the internal conditions in relation to the adoption decision	Evaluation of the intrinsic characteristics of the innovation in relation to the adoption decision	Evaluation of the external conditions in relation to the adoption decision	Evaluation of the gradual experimentation of the new technology
Event 1		Measurement of the cost-benefit ratio		
Event 2		Differentiation of the infrastructure		
Event 3			Pioneering	
Event 4		Weighting of the impacts on the financial results		
Event 5		Weighting of the impacts on the productivity and quality		
Event 6			Searching for innovations at the international level	

Event 7			Searching for innovations at the national level	
Event 8				Qualification and participation of the employees
Event 9		Weighting of the impacts on administrative control		
Event 10	Informality			
Event 11	Slowness			
Event 12				Suitability of the new technology for the physical infrastructure
Event 13		Cohesion and the connection between what already exists in the organization and the new technology		
Event 14				Suitability of the new technology to the financial investments required
Event 15				Suitability of the new technology for the workforce
Event 16		Difficulty for the employees in understanding and using the new technology		
Event 17				Choice of technologies with reduced impacts on the processes in place
Event 18				Adoption and gradual growth of the innovative technology
Event 19				Conducting evaluative tests of the new technology
Event 20			Observation of the potential results of the innovative technology in other national properties	
Event 21			Mapping of the contributions of the suppliers and other farmers	
Event 22			Searching for cooperation with potential competitors	
Event 23			Consideration of the small contribution of the slaughterhouses	
Event 24			Reflection on the low technological intensity of the chain	
Event 25			Observation of the potential results of the innovative technology in international properties	
Event 26	Centralization of the processes			
Event 27	Conservatism in the processes			
Event 28				Formalization in experimentation of the innovative technology
Event 29		Uncertainties related to the return on the investment		
Event 30		Weighting of the uncertainties related to the availability and qualification of the workforce		
Event 31		Weighting of the uncertainties related to the technical efficiency of the innovation		

Event 32			Lack of knowledge regarding governmental financial support	
Event 33			Lack of knowledge regarding legislation favorable to innovation	
Event 34			Monitoring of governmental regulations for the sector	
Event 35				Observation of the potential results of the innovative technology in an internal pilot plan

Legend: Levels of high (dark gray areas), medium (medium gray areas), and low (light gray areas) incidence.

Figure 3. Attitudinal phases of the innovation adoption process in the properties investigated

Thus, it was possible to map the attitudes of the decision-makers interviewed, which are in fact descriptors of the innovation adoption process in the rural properties investigated (high and medium incidence), and they are summarized as follows: (a) descriptive attitudes for evaluation of the internal conditions in relation to the adoption decision — informalization (E10), slowness (E10), centralization (E26), and conservatism (E27) in the internal decision-making processes; (b) descriptive attitudes for evaluation of the intrinsic characteristics of the innovation in relation to the adoption decision — measurement of the cost-benefit ratio (E1), cohesion and connection between what already exists in the organization and the new technology (E13), difficulty of employees in understanding and using the new technology (E16), and uncertainties related to the return on investment (E29); (c) descriptive attitudes for evaluation of the external conditions in relation to the adoption decision — searching for innovations at the national level (E7), observation of the potential results of the new technology in other national properties (E20), mapping of the contributions of suppliers and other farmers (E21), search for cooperation with potential competitors (E22), consideration of the low contribution of slaughterhouses (E23), reflection on the low technological intensity of the chain (E24), lack of knowledge about government financial support (E32), lack of knowledge about innovation-friendly legislation (E33), and monitoring of government regulations regarding the sector (E34); and (d) descriptive attitudes for evaluation of the gradual experimentation of the innovative technology — qualification and participation of employees (E8), suitability of the new technology to the financial contributions required (E14), choice of technologies with reduced impacts on existing processes (E17), adoption and gradual growth of the new technology (E18), and conducting evaluative tests of the new technology (E19) — see Figure 3.

It is worth noting that the attitudes of the low incidence decision-makers (light gray areas in Figure 3) indicate the need for reflection on the professionalization of the decision-making process for innovation adoption in the rural properties investigated, given that the following attitudes are still incipient: (a) attitudes for evaluation of the intrinsic characteristics of the adoption in relation to the adoption decision — differentiation of the infrastructure (E2), weighting of the impacts on the financial results (E4), weighting of the impacts on productivity and quality (E5), weighting of the impacts on administrative control (E9), weighting of the uncertainties regarding the availability and qualification of the workforce (E30), and weighting of the uncertainties related to the technical efficiency of the innovation (E31); (b) attitudes for evaluation of the external conditions in relation to the adoption decision — pioneering (E3), search for innovations at the international level (E6), and observation of the potential results from the new technology in international properties (E25); and (c) attitudes for evaluation of the gradual experimentation of the innovative technology — suitability of the new technology for the physical infrastructure (E12), suitability of the new technology for the workforce (E15), formalization in the experimentation of the new technology (E28), and observation of the potential results of the new technology in an internal pilot plan (E35) — see Figure 3.

5. Conclusion

Given the objective of analyzing the attitudes of the decision-makers in the innovation adoption process in the beef production industry, the findings enabled the proposal of an innovation adoption model for the beef production industry described below. Regarding the decision-making processes, the companies studied follow the descriptive chain, in which the focus is the description of the decision-making in a real situation, without the prescription of a model suitable for optimal decision-making. The decisions are of an administrative and operational nature with the presence of conservative and late adopters, using cyclical search for technological alternatives that are already available and have minimal impact on the processes already in place. Understanding the decision-making processes based on the behavioral decision-making model and the simultaneity of the attitudinal phases influencing the innovation adoption process involves evaluation of internal and external environmental conditions and understanding of the intrinsic characteristics of the innovation, in addition to gradual experimentation with the innovation.

Specifically, regarding the attitudinal phase of evaluating the internal environmental conditions, the characteristics of

informality, slowness, centralization, and conservatism in the internal decision-making processes were notable. Regarding the attitudinal phase of understanding the intrinsic characteristics of the innovation, it is worth emphasizing the following attitudes for measuring: the cost-benefit ratio, the cohesion and connection between what already exists in the organization and the innovative technology, the difficulty for the employees in understanding and using the innovative technology, and the uncertainties regarding the return on investment. For the attitudinal phase of evaluating the external environmental conditions, the following attitudes are of particular note: searching for innovations at the national level; observing the potential results of the new technology in other national properties; mapping the contributions of suppliers and other farmers; searching for cooperation with potential competitors; consideration of the small contribution of the slaughterhouses in the adoption process; reflection on the low technological intensity of the chain; lack of knowledge regarding government financial support and legislation favorable to the adoption of innovation; and finally, monitoring of governmental regulations for the sector. Regarding the attitudinal phase of gradual experimentation of the innovation, it is worth evaluating the following: the attitudes that involve the qualification and participation of the employees, the suitability of the innovative technology to the financial contributions required, the choice of technologies with reduced impacts on current processes, the adoption and gradual growth of the innovative technology, and evaluations of the innovative technology.

5.1 Results

The contributions of this study are divided into 3 areas: Academic – proposed a model that allows us to understand how the innovation adoption process takes place, based on external and internal variables to the adopter, as well as innovation specificities; Organizational – identified the main innovations that have been adopted by large farms and that may be suitable for small rural properties; and, Governmental – demonstrated that despite the existence of policies to support the adoption of innovation. These policies rarely reach the small producer, evidencing the need for better publicity by the government, with a view to bringing government actions and small rural producers closer together.

Regarding the limitations of this present study, given the method chosen (a study of multiple cases), it is not possible to generalize the results. As for the proposal for future studies, we could recommend the need for scientific studies and business reflections about the professionalization of the decision-making process for innovation adoption in the beef production industry.

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