

## SUPPORTING SUPPLY-CHAIN ACTORS AND BOVINE TRACEABILITY SYSTEMS: CASE STUDY IN MATO GROSSO DO SUL – BRAZIL

### Apoio a atores da cadeia e ao sistema de rastreabilidade bovina: Estudo de caso no Mato Grosso do Sul

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#### ABSTRACT

Assessing supply chain actors may help to improve beef cattle traceability systems and identify potential pathways that may benefit beef ranchers. We developed a case study with actors that comply with the Brazilian bovine traceability system (SISBOV), in Mato Grosso do Sul. The Delphi method was used to collect information from rounds of questions, presented to livestock experts: ranchers (Rs), certifiers and auditors (CAs) from SISBOV. In the first round, open-ended questions were made to explore the interviewees' points of view. From these answers, textual content analysis generated a list of statements for the subsequent rounds. From the second round, the claims were validated on a Likert scale (respondents were given the opportunity to change their answers if they believed it was necessary). In Mato Grosso do Sul, our findings suggest that the union among Rs seems rather weak, and they lack the feeling of belonging to the supply chain. There also seems to be a lack of precise information on behalf of the Rs. This calls for extension mechanisms to reinforce, clarify and deliver accurate information. Several candidate pathways are discussed to encourage new members to join or to remain dedicated to the Brazilian traceability system (SISBOV), which is currently responsible for the exportation of certified beef cattle to the European Union.

**Keywords:** Agribusiness management. Beef certification. Specialists.

#### RESUMO

Acessar os atores da cadeia de suprimentos pode ajudar a melhorar os sistemas de rastreabilidade animal no setor de carne bovina e identificar caminhos potenciais que podem beneficiar os pecuaristas. Desenvolveu-se um estudo de caso no Mato Grosso do Sul com atores que atendem ao Sistema Brasileiro de Rastreabilidade Bovina (SISBOV). O método Delphi foi usado para coletar informações em rodadas de perguntas, formuladas para especialistas em pecuária, incluindo pecuaristas (Rs) e certificadores e auditores (CAs) do SISBOV. Na primeira rodada, perguntas abertas foram feitas para explorar a perspectiva dos entrevistados. A partir dessas respostas, a análise de conteúdo textual gerou uma lista de afirmações para as rodadas subsequentes. A partir da segunda rodada, as alegações foram validadas em uma escala Likert (os respondentes tiveram a oportunidade de mudar suas respostas, caso acreditassem ser necessário). Nossos resultados sugerem que a união entre os Rs parece bastante fraca e eles não têm sentimento de pertencimento à cadeia de abastecimento. Além disso, parece haver falta de informações específicas, principalmente entre os Rs, o que demanda mecanismos para reforçar, esclarecer e facilitar o fornecimento e entendimento de informações precisas. Vários caminhos possíveis são discutidos como alternativas para encorajar novos membros a aderirem ou a permanecerem comprometidos ao sistema de rastreabilidade (SISBOV) que atualmente é responsável pela exportação de carne de gado certificada para a União Europeia.

**Palavras-chave:** Gestão do agronegócio. Certificação de carnes. Especialistas.

## 1. INTRODUCTION

Worldwide, there is great concern about the quality of beef that moves along the supply chain (Luukkanen *et al.*, 2018). Not long ago, contamination and diseases (i.e. foot-and-mouth disease and bovine spongiform encephalopathy) hampered the consumption and export of beef for more than a decade. One outcome of these episodes was the establishment of Council Regulation (EC) n. 820/97 of April 21, 1997, with some protagonism from European countries. This regulation establishes a system for the identification and registration of cattle, related to the labeling of beef, in order to guarantee the control and food safety of products and processes. This was defined as “traceability” (Rogberg-Muñoz *et al.*, 2014; Hobbs, 2016). In these terms, traceability is defined as the practice of locating animals and/or products, from their origin to the consumption stage, through various supervised operations (European Commission, 2002; MAPA, 2021a).

Brazil adopted a cattle tracing system in 1996, with the objective of complying with the criteria imposed by European countries for the importation of beef. However, it was only in 2002 that traceability increased in the country, through the Bovine and Bubaline Identification and Certification System (SISBOV). Since then, in order to meet the legislation of the European Market, the country has adopted several preventive and corrective measures to meet the respective legislation. These include adjustments in the farm system and other stages of the beef cattle supply chain (MAPA, 2002).

Currently, to develop traceability in Brazil, SISBOV works together with certifiers, which are private organizations. Certifiers register in SISBOV to collaborate with the Brazilian government and act in the inspection of rural properties. This effort is linked to the Ministry of Agriculture, Livestock and Supply (MAPA). Currently, Brazil has 10 certifiers

accredited by MAPA, responsible for inspections at the farm level, with the function of verifying that all the rules and regulations are complied with. This is required in order to allow the goods to be exported to the European Union. Currently, Brazil ranks fourth as the largest exporter of beef to Europe (ABIEC, 2019a) and the largest exporter in the world, with an estimated export of 2.2 billion tons of meat (ANUALPEC, 2019).

Although SISBOV has been in force since 2002, there are still many ranchers who do not comply with the requirements of the system, who have no interest in joining SISBOV or decline membership (Rodrigues & Nantes, 2010; Lopes *et al.*, 2012). The low number joining SISBOV may challenge the credibility of the supply chain and the opportunity to maintain or open new consumer markets (Lopes *et al.*, 2012). In this context, our research question is: what could be done to encourage SISBOV membership, to provide renewal incentives and more support to ranchers in the area of bovine traceability?

The general objective of the present study was to identify possible ways to benefit ranchers and facilitate decision-making in segments of the bovine traceability system and the beef supply chain. The Delphi method was chosen in this study to mirror the opinion of the stakeholders (considered as experts). This was arranged so that the research outcomes could shed light on possibilities to encourage new members or retain current members in meat traceability systems. In turn, such achievements could potentially improve the entire supply chain (Rowe & Wright, 1999).

The study was developed by adopting a systematized framework of the productive sector (beef cattle supply chain), prepared by the Brazilian Association of Meat Exporting Industries (ABIEC), summarized in Casagrande *et al.* (2021), in which the beef cattle production chain is broadly considered and defined. Thus, the segments of the supply chain constituted the rural property (agricultural

production), responsible for raising, breeding and fattening, animal health and seeds for pasture, followed by agroindustry, responsible for processing and slaughter, and the market (internal and external), responsible for distribution and trade.

It is noteworthy that in the scope of the research the actors assessed were restricted to experts from the productive segments of the rural property (the ones licensed to export to the EU), the certifying (private) companies and the ones in charge of internal audits, on behalf of SISBOV and the federal government.

## 2. MATERIAL AND METHODS

### 2.1. Study site

The study was carried out in the state of Mato Grosso do Sul, Brazil. This is a prioritized region for the research team, entirely based at UFGD University (Nupace, Agribusiness Program). The state of Mato Grosso do Sul is considered the fourth largest livestock producer in Brazil, with an estimated 22.49 million head of cattle produced in 2017 (ABIEC, 2019b).

The state comprises an area of 357.045.532 km<sup>2</sup>, with a population of 2.619.657 inhabitants, made up of 16.245 rural properties dedicated to soybean and corn cultivation and 54.331 to livestock. In Mato Grosso do Sul, there are a total of 5.072.152 agricultural establishments, with 15.036.978 people serving these places. The areas used are divided as follows: 63.366.059 ha<sup>1</sup>, intended for planting crops, 101.627.798 for planting soybeans, 158.622.704,02 for pasture production and 26.636.769,00 for other production (IBGE, 2017). In respect to municipalities and rural establishments licensed to export to the EU in the scope of SISBOV, some data are provided.

In 2017, the Agricultural Census estimated that Brazil had 2,554,415 establishments that raised beef cattle, among the 5,073,324 agricultural establishments in the country (IBGE, 2017).

In 2021, 1538 rural establishments in Brazil were licensed to export beef to the EU. Mato Grosso do Sul was ranked as the third State with 256 establishments (16.6% of establishments with a license), after Goiás (23%) and Mato Grosso (29%) (MAPA, 2020; MAPA, 2021b; Silva *et al.*, 2021). Additionally, among the 27 Brazilian federative units, and 5570 municipalities, eight States were home to 8.83% (492/5570) of the municipalities with establishments licensed to export beef to the EU.

As for certifiers of traced (bovine) beef exported to the EU, within the scope of SISBOV, a total of 19 certifiers qualified 1538 rural establishments in Brazil by 2021. Over 84.00% of certifiers were Brazilian companies and a total of 44.40% of the rural establishments qualified within SISBOV were certified by two companies (MAPA, 2021b; Medina, 2021; Silva *et al.*, 2021).

Notably, sampling of certifiers was limited to certifiers that answered the e-mails sent by the research team. Additionally, former estimates supported that certification from a certain company was not restricted to a specific State of Brazil. Data was limited to the regions in which the certifiers performed in the scope of SISBOV and not the number of head at the farm level or slaughterhouse.

In respect to slaughterhouses, a representative sector in beef exports, these were not accounted for in the survey. Slaughterhouses are responsible for paying cattle farmers that comply with SISBOV. Currently, there are twelve slaughterhouses responsible for beef exports in the scope of the Hilton quota. Overall, more than 65.00% of the beef productive chain in Brazil is controlled by national groups, especially equipment, production, seeds and refrigerators, with lower representation in animal health and reproduction (Medina, 2021; Silva *et al.*, 2021).

A geographical perspective revealing the number and the variability of certifiers, slaughterhouses and establishments licensed to export

beef to the EU was reported in Silva *et al.* (2021), and market share was reported in Medina (2021). However, data were limited to the license to export, not the number of head certified or slaughtered.

### *Specialist Group*

Participants were chosen considering two different groups of specialists. The first group consisted of ranchers (R) licensed to export beef to the European Union (SISBOV members), according to the list available on the MAPA website. In this group, the manager, the technician in charge or the ranch owner were considered livestock specialists. To establish a second group of specialists, we invited three certifying companies accredited by MAPA\* and one federal auditor (Certifiers and Auditor - CA), who is responsible for auditing ranches, all from Mato Grosso do Sul.

### *2.2 Data collection and analysis*

Data collection was carried out from May to October/ 2019. At that time, according to the official list of the Ministry of Agriculture, Livestock and Supply (MAPA), 253 ranches were listed as members of SISBOV in the State of Mato Grosso do Sul. These were all entitled (licensed) to export bovine meat to the European Union. To arrange interviews with the managers of the ranches, we searched for rancher's phone numbers in Google and accessed contacts from professional networking. Of the 253 properties listed, 98 phone numbers were found. Subsequently, these numbers were used to choose the breeders who would participate in the research, based on a previous random selection, through simple random sampling. For the initial sample, of the 98 contacts obtained, by convenience, 31 were invited to participate.

#### *1<sup>st</sup> round of questions*

In the first round, 17 open questions (available for readers upon request of first author) were sent to obtain and appraise the content shared by the respondents. Potentially, the answers could reveal

any issue faced by farmers. The method that was applied to create statements from the textual content written by the interviewees in the open questions of the first round followed a manual clipping procedure (Bardin, 2004). This tool has been incorporated into other fields of knowledge, such as Animal Sciences and Agribusiness (Solano *et al.*, 2011; Gordo *et al.*, 2013; Silva *et al.*, 2013; Silva *et al.*, 2019).

The time given to answer the questionnaire in the first round was 21 days. After this period, it was found that of the 31 ranchers who accepted the invitation to participate, 27 answered the questionnaire in the stipulated period, and then were invited to the subsequent rounds. All three certifiers and the MAPA auditor responded within the expected time frame, and were soon invited to participate in the next round.

#### *2<sup>nd</sup> round of questions*

In the second round, four open questions were used (Table 1).

In addition to the open questions (x5, x17, x19, x22) (Table 1), 18 closed statements were developed (Figure 1, Figure 2) on the Likert Scale with scores ranging from 1 to 5, in which: 1 - *Totally disagree*, 2 - *Partially disagree*, 3 - *Neutral*, 4 - *Partially agree* and 5 - *Totally agree*.

The time given to answer the questionnaires in the second round was 30 days. After this period, of the 27 questionnaires sent (Mato Grosso do Sul), 17 ranchers (R), 2 certifiers and the auditor (CA) responded.

#### *Validation*

After the second round, all participants (ranchers) received a simplified summary of the preliminary results. This was done by preserving anonymity among ranchers and, at the same time, enabling each participant to compare his responses (scores) with the other interviewees from the second round. Thus, all specialists had the opportunity to compare his or her answers with those of the other participants and, therefore, to reiterate any statement if he considered it necessary. The time given to

analyze and provide their statements was 30 days. After sending the 17 questionnaires, only five ranchers (1/3 of the ranchers and 1/4 of the population sampled) made modifications to the original answers, configuring the end of the validation process.

### 2.3. Statistical analysis

The script used to construct the graphs in the *Statistical Analysis System - SAS* software was developed by Matteson, made available on the *Data Science Central* page. To determine consensus and/or divergence of opinions (non-consensus), we used graphs and descriptive statistics. The rationale was to obtain and summarize the agreement and consensus, the disagreements and consensus and the divergence of opinion between R and between CA (intragroup and intergroup), and to verify the major contrasts between groups evaluated (Table 2).

A 70% criterion was used to determine consensus and divergence of opinion (non-consensus), based on the scores of the Likert scale. To be considered consensus, an affirmative had to present 70% or more of agreement or disagreement in the experts' scores (Naughton *et al.*, 2017; Vogel, 2019). For example: if a statement scored 70% or more on "disagree" or "strongly disagree" or 70% or more on "agree" or "strongly agree", it was considered consensus. It is noteworthy that in this research the term "divergence of opinion" is the same as "non-consensus".

To analyze and interpret the data after validation, *Minitab® statistical software*, free version, was used to test the difference in ranchers' responses before and after the validation process. The difference between the responses from the early process and those obtained after validation were compared using two complementary approaches. First, the *Wilcoxon signed rank test* to evaluate the differences between medians (5% significance level). Then, a *2-sample standard deviation test* to verify differences between the standard deviation of the responses before and after the validation carried out with the ranchers (5% significance level). These two analytical approaches were carried out using interquartile range (IQR) values, obtained from box plots prepared with the responses in the 18 statements.

## 3. RESULTS AND DISCUSSION

### 3.1. Statistical analysis using median, standard deviation and interquartile range (IQR) data.

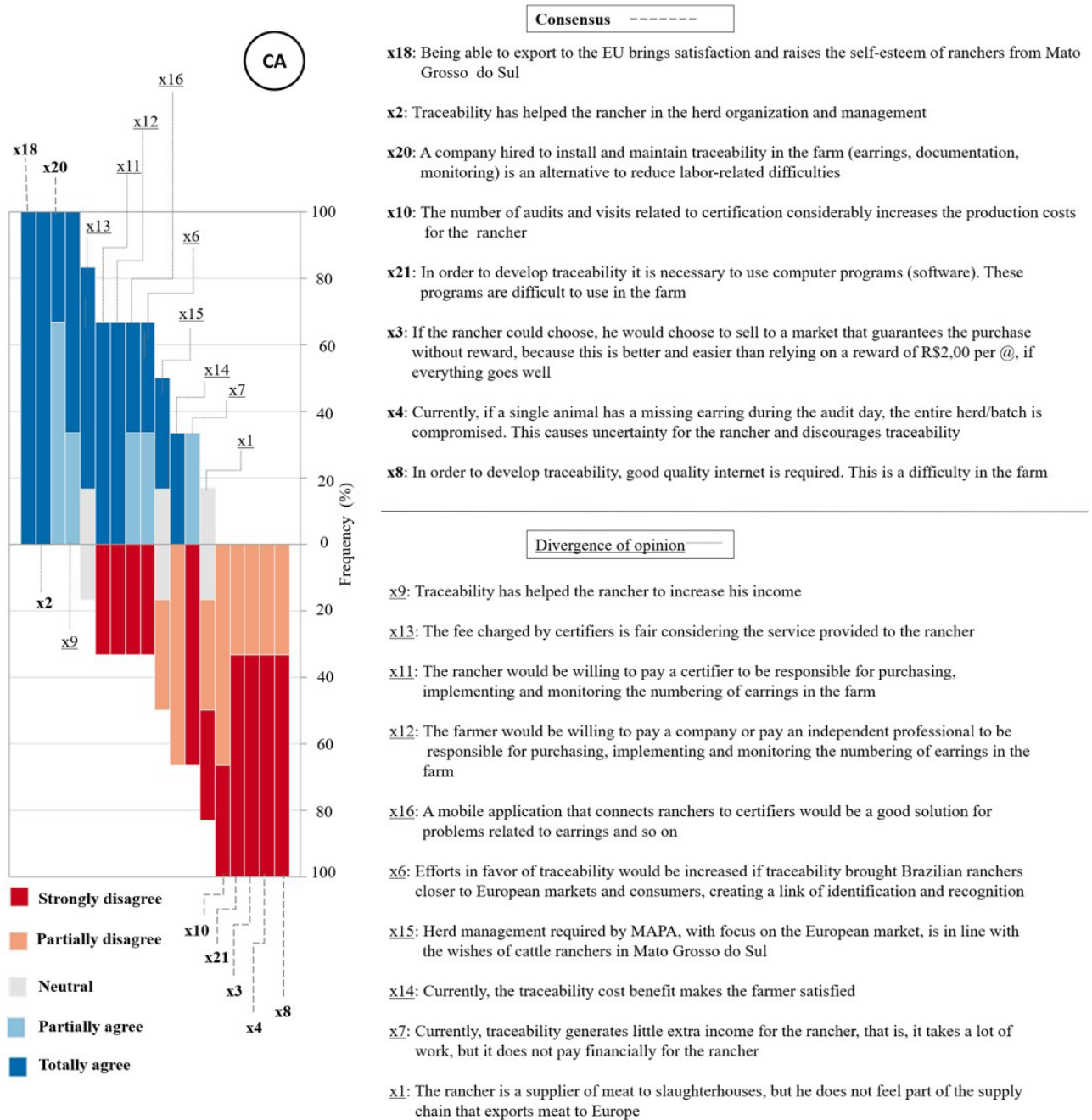
In the validation stage, only 5 of the 17 ranchers wanted to modify the score of their responses. Among the 18 statements in the second round, five were not modified by Rs (x2, x4, x7, x13, x14). The distribution of the interquartile range (IQR) values, before and after the validation, for each statement and set of responses, respectively, is presented in the form of a histogram and box plot (Figure 3).

**TABLE 1** – Open questions addressed to ranchers (R) and certifiers and auditor (CA)

Open questions*	
"Recently, there was a new agreement between the MERCOSUR countries and the European Union for free trade in beef. If you want, give your opinion about it"	x5
"Currently, is there a platform or method used to collect opinions on difficulties and possible improvements in the beef traceability and export sector in the country? If so, what is it? If not, how do you think this communication should be done?"	x17
"Thinking about traceability, livestock ranching in Mato Grosso do Sul and the European market, what kind of service provision does the rancher need most and which one would he like to receive?"	x19
"What should be done to make life easier and benefit the rancher in Mato Grosso do Sul (ranchers that are SISBOV members and, therefore, are licensed to export) ?"	x22

Source: research data. \*Are not part of the list of 18 statements in Figure 1 and Figure 2

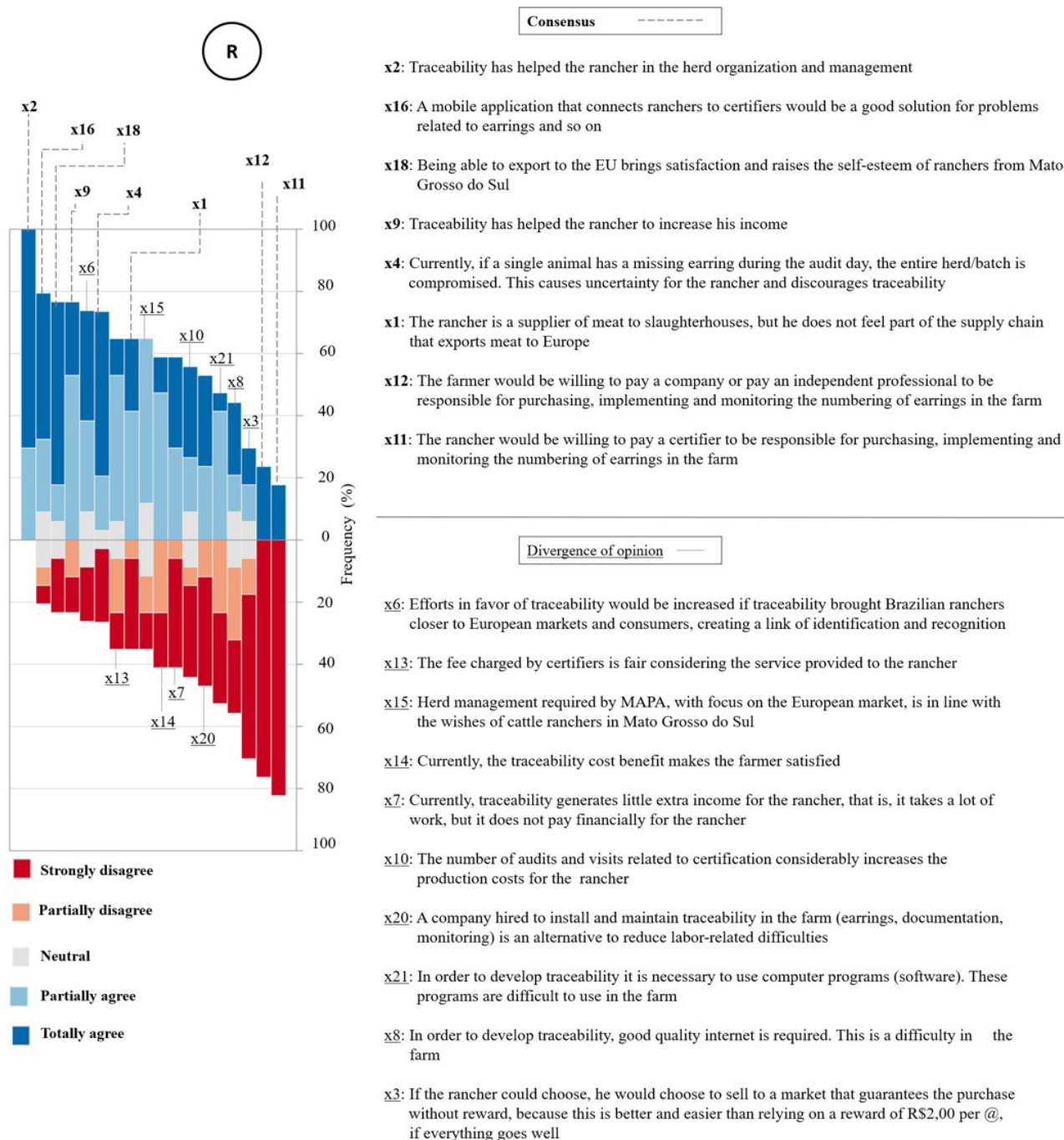




**FIGURE 1** – Consensus and divergence of opinion analysis between certifiers and auditor (CA) (%) for each statement  
 Source: research data. \*\*Statements 11 and 12 were developed to be scored as “would be willing to pay more” or “would not be willing to pay more”

Even if there was a more narrow-based distribution after validation stage, no significant difference ( $P > 0.05$ ) was observed (medians, standard deviations, and IQR distributions) between the responses obtained before and after the validation step (Figure 3). The IQR showed that, before and after validation, most of the statements were in the third quartile ( $75\% < 25$ ) with little variation in the two results (before and after validation). These analyses

were carried out to verify the degree of interest of the participants in continuing to answer the questionnaires. The absence of statistical difference ( $P > 0.05$ ) was one of the indicators used to stop the rounds of questions, assuming that the results were consistent and represented the opinion of the interviewees, who had the opportunity to review and to modify their responses from the earlier questionnaires, in previous steps of the Delphi rounds.



**FIGURE 2** – Consensus and non-consensus analysis among ranchers (R) (%) for each statement

Source: research data. \*\*Statements 11 and 12 were developed to be scored as “would be willing to pay more” or “would not be willing to pay more”

**3.1. Agreement and consensus between ranchers (R)**

Figure 2 shows the percentages (%) of agreement and disagreement between Rs, which varied according to the statements used in the research. The results of agreement and consensus between Rs were six, namely: the statement mentioning that traceability helped ranchers manage the herd (x2), that it increased income (x9), that Rs are meat suppliers that do not feel

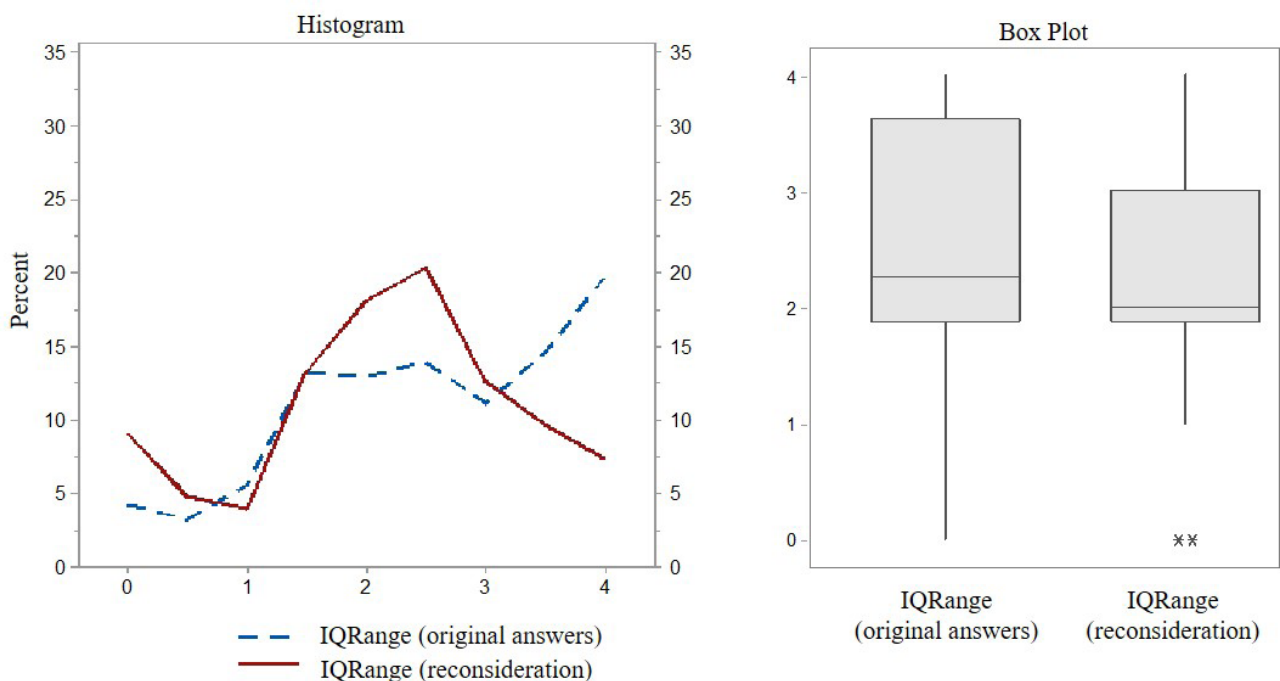
part of the supply chain that exports to the EU (x1), that a phone app would reduce problems of placing ear tags during the technical visits (x16), that exporting to the EU increases self-esteem (x18), and that the entire herd would be compromised if a single ear tag is missing on inspection day (x4). These findings are useful indications of how ranchers can be encouraged (or not) to remain in or to comply with SISBOV.

**TABLE 2** – Situations of agreement, disagreement, divergence of opinion within and between ranchers (R) and certifiers and auditor (CA)

OPINION	AFFIRMATIVE (X)
<i>Intragroup</i>	
Agreement and consensus between R	2, 18, 16, 4, 9, 1
Agreement and consensus between CA	18, 2, 20, 9, 13
Disagreement and consensus between R	11, 12
Disagreement and consensus between CA	8, 4, 3, 21, 10, 1
Divergence of opinion between R	6, 13, 10, 15, 7, 14, 21, 20, 8, 3
Divergence of opinion between CA	11, 12, 16, 6, 15, 14, 7
<i>Intergroup</i>	
Agreement and consensus between R + CA	2, 18, 9
Disagreement and consensus between R + CA	-
Divergence of opinion between R + CA	6, 15, 14, 7
<i>Major* contrasts between groups</i>	
Agreement and consensus between R, with disagreement and consensus between CA	4, 1
Agreement and consensus between R, with divergence between CA	16
Divergence of opinion between R, with agreement and consensus between CA	13
Disagreement and consensus between R, with divergence between CA	11, 12
Divergence between R, with disagreement and consensus between CA	8, 10, 21

(Intragroup = within a group, Intergroup = between groups).

Source: research data. \*When one group agreed by consensus and another disagreed or presented divergence of opinion



**FIGURE 3** – Variability of the interquartile range (IQR) before and after the validation stage in round 2, given the answers of ranchers in the Likert scales. The medians, standard deviations and IQR distribution did not differ ( $P > 0.05$ ) according to the *Wilcoxon rank test* and *2-sample standard deviation test* at 5% significance

\*\* Outliers



### 3.2. Disagreement and consensus between ranchers (R)

The results with situations of disagreement and consensus among Rs refer to two statements, x11 and x12 (Table 2). In both statements, it was observed that the Rs are not willing to pay a certifier (82.35%), a specialized or independent professional company (88.23%) to follow the operational process of traceability. This finding likely relates to a regional or cultural aspect, because herd management may configure a tradition (Silva *et al.*, 2012). It is noteworthy that these findings suggest that decisions that result in an increase in production costs may discourage joining SISBOV, even if Rs perceive several (positive) aspects of traceability.

### 3.3. Opinion divergence between ranchers (R)

The opinion divergence between Rs represented more than half, totaling 10 statements. There was opinion divergence on strategies to bring Brazilian farmers closer to European markets and European consumers, as an attempt to build greater recognition of Rs (x6). This suggests some suspicion among ranchers.

The Rs did not present a consensus on the statement that quotes the fees charged by the certifiers as fair for the service provided (x13). There was also disagreement regarding the number of audits and visits by certifiers and the significant increase in production costs (x10).

Similarly, there was a divergence of opinion among Rs regarding their wishes, with divergent opinions in the statements on herd management required by MAPA, focusing on the European market (x15). There was divergence of opinion among Rs in relation to the fact that traceability generates little additional income, giving a lot of work and, therefore, little financial compensation for the R (x7). Also, Rs presented divergence of opinion on the cost-benefit of traceability (x14). Again, this suggests that the

perceived cost-benefit of being a member of SISBOV relates to the (un)stability among Rs who join, remain in or decline to join the SISBOV system.

The Rs presented a divergence of opinion on hiring a company to carry out the traceability service within the ranch (placement of ear tags, documentation, monitoring of ear tags), with the aim of reducing labor difficulties (x20). There was also a divergence of opinion on whether traceability requires the use of high-quality computer programs (software) (x21) and Internet on the ranch (x8). There was a divergence of opinion about the predilection to sell to a market that guarantees the purchase without reward, since it is easier than practicing traceability, with a remuneration of R\$ 2.00 / 'arroba' (x3) (Figure 2). This can negatively affect supply chain performance. Specifically, it seems that campaigns working on greater transparency of profit-sharing among key partners could alleviate burdens of noncompliance with SISBOV.

### 3.4. Agreement and consensus between certifiers and auditor (CA)

The results with situations of agreement and consensus between CAs were five (Figure 1; Table 2). The CAs agreed that being able to export to the European Union provides satisfaction and increases the self-esteem of the rancher from Mato Grosso do Sul (x18). They also agreed that traceability has helped the farmers organize and manage the herd (x2) and increase income (x9). This overlaps with the viewpoints of Rs. However, CAs agreed that a company hired to develop and maintain traceability on the ranch (placement of ear tags, documentation, monitoring of ear tags) is an alternative means to reduce difficulties related to labor (x20). Moreover, CAs agreed that the fee charged by certifiers is fair, when comparing the services provided to ranchers (x13). These findings contrasted with Rs' viewpoints, configuring opinion discrepancy among actors from different segments of the supply chain.

### 3.5. *Disagreement and consensus between certifiers and auditor (CA)*

The results with situations of disagreement and consensus between CAs were six (Figure 1; Table 2). The CAs disagreed that good quality computer programs (x21) and Internet (x8) represent difficulties in practicing traceability on the ranch; they disagreed that if a single animal is missing the ear tag on the day of the technical visit, the entire herd is penalized (x4); they disagreed that the number of inspections increases costs for the rancher (x10) and that the farmers do not feel that they are part of the meat chain that exports to Europe (x1); also, CAs disagreed when stating that the rancher would be willing to sell to a market that guarantees the purchase, but does not pay a bond (i.e. premium price) (x3). Notably, the contrasting viewpoints configure distance gaps among Rs and CAs, which poses a risk to the adherence to SISBOV and the social and corporate performance of the certified cattle beef supply chain. In practice, this could be tackled by creating transformative spaces for multistakeholder dialogue and action (Camara *et al.*, 2019; Pereira *et al.*, 2020).

### 3.6. *Divergence of opinion between certifiers and auditor (CA)*

The results with situations of divergence of opinion between CAs were seven (Figure 1; Table 2). The divergence of opinions between CAs was observed regarding the rancher's willingness to pay for a certifier to be responsible for the purchase, implementation, and monitoring of the ear tag numbering on the ranch (x11), or in relation to the farmer's propensity to pay for a company or independent professional to perform these activities (x12).

There was divergence of opinion between CAs over an alleged smartphone app that could connect ranchers to certifiers, resolve ear tag issues, among others (x16). There was divergence of opinion between CAs on how to bring Brazilian producers closer to

European markets and consumers, strengthening a link for greater identification and recognition (x6). There was also divergence of opinion between CAs whether the management of herds that is required by MAPA (with a focus on the European market) is in line with the wishes of ranchers in Mato Grosso do Sul (x15). Likely, this relates to a rather long list of requirements from the EU and the obligations regulated by MAPA, coupled with perceived limitations of infrastructure and management capacity at the farm level (i.e., the permitted age and minimum weights for slaughter according to the sex of the animal and between neutered and intact males; the time the animals should stay on the property before finishing; obligations on the phases in which feeding (and raising) must be exclusive to pasture, among others). There was a divergence of opinion between CAs on the cost-benefit of traceability (x14), on the financial compensation (extra income) offered by traceability in view of the great work required (x7) (Figure 1). Likewise, this seems to relate to the effort and management of cattle in the corral, checking ear tags, registering sanitary inputs, communicating and storing data among others (Cócaro & Jesus, 2007; Almeida *et al.*, 2019).

In addition, in the statements of scale "yes" or "no" (x11 and x12), on the willingness of ranchers to pay for a certifier or an independent professional responsible for the purchase, implementation and monitoring of the numbering of ear tags in the ranch, there was a divergence of opinion between CAs (Figure 1).

Despite several contrasting viewpoints between Rs and CAs, some findings suggest that CAs are sensitive to some concerns and difficulties faced by Rs, recognizing that some alternatives may run into resistance.

### 3.7. *Agreement and consensus between R and CA (intergroup)*

The situations of similar agreement and consensus between distinct groups (ranchers (R)

x certifiers and the auditor (CA)) were described according to Table 2 (x2, x9, x18). In general, despite the difficulties in developing traceability (Liu & Batt, 2011; Knoll *et al.*, 2017), the respondents perceive economic and social benefits linked to the production and export of food (Dadzie, 2015; Sippel, 2016).

### 3.8. Divergence of opinion between R and CA (intergroup)

The results with situations of divergence of opinion between Rs and CAs were four (Table 2). The group consisting of ranchers, the certifying team and the auditor presented divergences of opinion on eligible alternatives to favor traceability, i.e., efforts to increase SISBOV adherence by bringing Brazilian ranchers closer to European markets and consumers (x6). Ranchers typically prioritize the return of direct investments, i.e., achieving higher bonds (Oliveira *et al.*, 2017) and usually opt for individual decisions, fearing changes and/or precedents that will develop sanctions, rather than new benefits (Michalak, 2020). However, shortening the distances between partners, regarding contact, could facilitate and clarify doubts, creating a sense of a more powerful voice and collective decision-making (Buckley *et al.*, 2019). In fact, increasing the participatory nature of the certified beef cattle traceability system may alter the efficiency of these programs (Qian *et al.*, 2020). This includes building networks, strengthening relationships and other aspects that may alter decisions and behavior (Pini *et al.*, 2014; Vinholis *et al.*, 2017).

The divergence of opinion between Rs and CAs was also verified when referring to the wishes of the rancher in Mato Grosso do Sul and the herd management required by MAPA, focusing on the European market (x15). Some ranchers may perceive a gap between the current conditions at the farm level and what is required. Indeed, not all ranches have suitable infrastructure, management

systems and technology to function according to certified beef standards. Divergences of opinion may emerge from the variability in the specific claims, goals, and objectives of each rancher, some more conservative and others determined to incorporate innovative management techniques (Borges *et al.*, 2019).

Likewise, the profiles (stereotypes) of farmers, their understanding of agribusiness and the level of entrepreneurship may vary considerably (Dias *et al.*, 2019; Aguiar *et al.*, 2021). These features likely affect capability to recruit new members to the SISBOV system, the ability to retain current members and to prevent ranchers from declining traceability adherence. The dynamics regarding signing-in, staying in, or declining the SISBOV system is nebulous and uncertain. In fact, some participants were withdrawn from the study in the second round of questions because they declined SISBOV during the course of the study.

The Rs and CAs presented divergences of opinion in statements relating to the cost-benefit of traceability and rancher satisfaction (x14) and how traceability compensates the amount of work required and the additional income it generates (x7). Again, these are topics that should be accounted for in campaigns aimed toward greater adherence to SISBOV and the performance of the supply chain.

The condition of mutual disagreement and consensus between R and CA was not verified (absent) in this study (Table 2).

### 3.9. Major contrast between R and CA

The situations that revealed the major contrasts in opinion between R and CA were associated with 9 statements (Table 2). The major contrast occurred when one group of participants agreed by consensus and another team disagreed, or when there was agreement in one group and divergence of opinion in another.

In this study, the conflicting viewpoints between R and CA are considered as indications of distance gaps between the actors and the segments involved. Possibly, greater interaction among actors and innovations in the way of transmitting information would be opportune to address system issues (Camara *et al.*, 2019). The quality of the relationships and the collaborative features may likely influence the behavior of staff and the performance of food export channels (Dadzie, 2015; Johnson & Raven, 2015; Bergsten *et al.*, 2019).

With respect to the feeling of belonging (x1), it is likely that uncertain payment guarantees and limited clarification about the bonds and the costs charged makes ranchers show a negative opinion. The complex and bureaucratic features of the certified beef cattle supply chain and the current communication networks may not be working in favor of Rs.

Since 2018, there has been regulation number 51, of October 2018 (MAPA, 2018), which determines that 0.5% of a batch of cattle may be without external ear tags on the day of the technical visit and that these animals will be identified in another way by the certifier. Therefore, no later problems for the Rs. Hence, the lack of precise information regarding the standard procedures reinforces the need to rethink the communication methods adopted (Rodrigues & Nantes, 2010).

Furthermore, government strategies aiming at the demand of Rs with different socioeconomic conditions has been a trend in order to achieve improvements in the agribusiness sector (Paudel *et al.*, 2019). That said, Rs may engage more with the adoption of a mobile app (x16) designed to promote connectivity between actors in each process of the supply chain and solve operational difficulties.

It is likely that conservative perceptions of a possible application and resistance to increasing the number of technical visits may stem from a perspective related to an increase in costs. Additionally, some

may perceive that a digital tool could configure some sort of interference, intrusion or redundancy in the *modus operandi* currently established in SISBOV. This could be the case among CAs. Some may believe that shortening distances between Rs and CAs with the usage of software opens precedents for exposure, scope for harassment or violation of the formal and technical nature of operations related to technical visits and audits.

The divergences of opinion regarding the potential solutions from innovative technological applications may reflect different ideas and perceived opportunities to enhance agility. Moreover, some may think that these innovations imply higher costs and are difficult to handle. The establishment of practical solutions is critical, bearing in mind that until inadequacies at the farm level are properly sorted, the ranch is prevented from selling the carcass through SISBOV.

In the literature, many aspects mentioned above resemble barriers that hinder the adoption of technology in a large number of rural properties (Higgins *et al.*, 2019; Kaler & Ruston, 2019).

Groups with tighter unity in the beef production sector tend to find it easier to obtain information and increase the introduction of technologies at the farm level. However, the private sector and local organizations often require greater investments by the government, which allows them to be oriented towards knowledge and technology (Ayele *et al.*, 2012).

It is likely that Rs hesitate more to reveal satisfaction with the prices charged and the service provided for certification, justifying results about the compatibility of the service provided and the fees charged by the certifiers (x13), the will of Rs to pay more for certifiers or companies to develop the operational process on ranches (x11, x12) and the increase in the number of inspections and site visits (x10) (Table 2). Some insecurity on the rancher's



behalf (profits and expenses) may mirror a lack of accurate planning and cost management at the farm level (Liu & Batt, 2011; Pessotto *et al.*, 2019).

Currently, there is more than one annual visit to each registered ranch. In cases where livestock are kept in feedlots (containment systems), ranches may be visited by certifiers three times per year (x10). From the certifiers' and auditor's perspective, the price charged is apparently not an issue. CAs probably have a more holistic understanding of the expenses related to hiring a technician and the need for more precise operational management at ranch level. As for the ranchers' lower satisfaction with the values charged for certification, this is likely because ranchers pay for the technician's visit, the fuel and food (technician displacement and meal ticket), and the fee which is transferred to the certifier.

In Brazil, there is no single platform or no single standard software recommended for monitoring individual identification. Ranchers and potential service providers adopt computer programs at random. This usually occurs by some indication, by convenience or personal preferences. Consequently, the adoption of diverse software probably makes problem-solving harder when it comes to technical assistance.

We are aware of reports that highlight factors linked to human behavior and the adoption of reliable smart farming and network mechanisms that rely on precise data management for livestock systems (Maciuc *et al.*, 2015; Yoon *et al.*, 2020). However, we are not aware of literature that properly addresses the bottlenecks related to the absence/failure of the internet at the farm level, the advances in the debates on computer systems and diversity of software with respect to bovine traceability systems. There was evidence that technological programs (x21) and internet absence/failure needs some consideration on behalf of Rs, but not among CAs.

The intention of Rs to adhere, or not, to technology innovation i.e., investments to adopt

innovative alternatives that may optimize individual identification of cattle at the farm level, depends on various factors, including potential on-farm benefits perceived by ranchers, the influence of external opinion makers, family members, implementation costs, etc. (Shanahan *et al.*, 2009; Bechini *et al.*, 2020). This is why farmers' confidence and ability to use digital innovative tools is often related to decision-making (Borges *et al.*, 2016). This is probably a case of a cultural shift, in which regionality plays a role in farmer behavior.

As a recommendation, we consider that besides the provision of information to the government (mainly controlling cattle herds and listing farmers that are licensed) the traceability system discussed should evolve and play a role in the provision of feedback to companies and farmers. In a paper by Cócáro and Jesus (2007), the return of managerial or zoo-technical information by SISBOV was considered absent. In this sense, advice and reports based on data from SISBOV (i.e., performance and reproductive indexes, animal movements and stock, sanitary and nutritional aspects) would likely prompt modernization of the production systems and encourage Rs to join SISBOV.

## CONCLUSIONS

This study delivers assessment and evaluation of the points of view of experts closely related to a certified beef cattle traceability system in Brazil, including ranchers, certifying companies, and an auditor from MAPA.

The study focused on interviewees from Mato Grosso do Sul and a particular meat traceability system (SISBOV), aligned with the exportation of certified beef to the EU. The analysis of data was made by combining qualitative and quantitative statistics, and the insights derived can offer starting points for similar research and comparisons with beef traceability systems from other countries.

The study contributes to understanding situations that are likely to affect whether Rs join and remain within the SISBOV system. In this context, some noteworthy features are apparent.

The fact that several Rs declined to be SISBOV members during the course of the study was evidence THAT FUTURE RESEARCH should tackle data scarcity and provide in-depth analysis about the Rs that enter, remain in or decline membership of the certified beef traceability system. The lack of this information is a limitation to quantifying and validating ranchers' satisfaction with SISBOV, likely leading to underestimation of the urgency of adjusting and improving SISBOV and the supply chain. This calls for data sharing initiatives among government, service providers, Rs and academics that could lead the way to expanding our findings and continuing the progress made in this study.

On the one hand, experts agreed about several (positive) contributions of the traceability system, which provides useful data to encourage SISBOV memberships. On the other hand, rancher's diversifying viewpoints, i.e., the (non) financial compensation of traceability, challenge the recommendation of a single and practical solution to improve individual identification, herd management and certified beef traceability. A discussion needs to take place about the costs of different alternatives to improve traceability before and beyond the farm gate.

The verification that ranchers' lack of a sense of belonging to the certified beef cattle supply chain is the tip of the iceberg in terms of the gaps and disconnections between the opinions of beef supply chain actors. Shortening distances between actors from the same segment or different segments should be prioritized, because this likely affects the performance of the beef supply chain considered.

Additionally, it is doubtful that Rs are aware of all the accurate information and that they become fully updated when there are changes in SISBOV

standards over time. For this, we argue that alternative communication strategies should be discussed in order to benefit supply chain actors, especially the Rs.

We recommend focusing on low-cost smart actions, i.e., focusing on greater dialogue and collective understanding of the pros and cons of being a member of SISBOV. These are points where certifiers, autonomous companies, extension and advisory services, slaughterhouses and public managers could approach Rs.

Because of notable opinion divergence, it seems convenient to work on clarifying responsibilities, especially among Rs. This may promote more conscious decision-making and have an impact on the capability of SISBOV to recruit new members, retain the current members and prevent the Rs from refusing to join the traceability initiative.

One research limitation is the failure to fully embrace supply chain segments, i.e., missing the opinions coming from agroindustry. This could shed light on how (non) integration and (non) verticalization of operations along the Brazilian beef cattle supply chain impact the management of the relationships and agreements among key partners. Also, it may clarify aspects linked to purchase guarantee, transparency of profit sharing and issues related to market seasonality, which potentially affect the adherence of Rs to SISBOV.

Neglect of the problems faced in the certified beef cattle supply chain is a risk for the reputation and the financial, corporate, and socio-environmental performance of the supply chain and traceability system considered. Meanwhile, the pressure on the supply chain actors and the certified beef supply chains will likely increase, challenging the burden of noncompliance.

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