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What Drives Conservation Adoption? Social Science Insights from Cattle Ranchers in the Pantanal Wetland, Brazil

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ABSTRACT

Fostering meaningful and equitable collaboration between practitioners and local stakeholders remains a major challenge in conservation science and practice. Common barriers include differences in intentions, values, priorities, and access to decision-making processes. We used a novel multidisciplinary approach combining ethnography, theory of planned behavior (TPB), and diffusion of innovation theory (DOI) to investigate the intention to adopt a sustainable ranching certification scheme in the Brazilian Pantanal at the macro (e.g., sociological and political) and micro (e.g., psychological and anthropological) levels. Between August 2021 and July 2024, we conducted participant observation, semi-structured interviews, and surveys guided by the TPB and DOI frameworks with ranchers, managers, and cowboys. Results highlight the significant role of external recognition of local culture in ranchers' intention to adopt the sustainable ranching scheme. Mistrust of government and NGOs emerged as a barrier to adoption. By integrating micro- and macro-level factors, this research uncovered a more holistic perspective of the drivers that play a role in Pantanal ranchers' intention to adopt dynamics—identifying possible paths for conservation practice in the region. This research also underscores the importance of multidisciplinary research to better understand how to foster and sustain local engagement.

1 | Introduction

Deep local stakeholders' participation is a critical aspect of conservation success (Chiaravalloti, Scarano, et al. 2025; Sterling et al. 2017). Engaging with local people in all stages of a conservation initiative (from conceptualization to results, discussion and implementation) can help guarantee continuity and support long after the activities end (Moustard et al. 2021). However, implementing collaborative strategies remains a challenge (Dressler et al. 2010). In some cases, this stems from misaligned goals between conservationists and local people (Chiaravalloti 2019), but more often, there is a lack of a clear understanding of the factors that could better bridge conservationists' and local people' goals (Skarlatidou and Haklay 2021).

To address these challenges, several frameworks have been proposed (Manfredo and Dayer 2004). At the micro (or personal) level, scientists have highlighted the need to understand

people's beliefs, thought patterns, cosmologies, psychological constructs, and historical connections to their surroundings (Acheson 2011; Ribot and Peluso 2009). By looking at these aspects, conservationists can uncover people's views of reality, tailoring initiatives to individual perception of the world (Brosius 2006). A commonly used tool is the theory of planned behavior (TPB), which emphasizes that behavior is driven by "Intention," "Attitudes," "Subjective Norms," "Perceived Behavioral Control," and beliefs related to them (Sok et al. 2020; Ajzen 1991, 2011). Participant observation is also commonly used to uncover these dynamics in social sciences (Bernard 2006). Researchers immerse themselves in local communities aiming to identify complex and sometimes hidden drivers of behavior. At the macro (or group) level, the focus is on understanding communication, peer networks, governance structures, and multifunctional landscapes (Khuu et al. 2023), and how different stakeholders engage, negotiate, and navigate conservation initiatives (Ribot and Peluso 2009). A commonly used method is the diffusion of innovation theory (DOI) (Jagadish et al. 2024). DOI highlights the stages through which innovations spread, emphasizing the role of early adopters, social networks, and communication channels as critical to the rate of adoption (Rogers 1962, 2003). Researchers also use semi-structured interviews and participatory approaches (e.g., participatory mapping) to uncover patterns around power and political/economic dynamics driving adoption.

Integration of the macro- and micro-levels aims to bring a more holistic and systemic perspective of the drivers of adoption. For instance, although the TPB is useful for assessing individual motivations and intentions (Marchini and Macdonald 2012), it does not fully account for broader social dynamics or the flow of information that shapes collective behaviors and community-level engagement. Likewise, DOI effectively captures larger scale adoption dynamics, for example, examining rates and patterns in the establishment of conservation interventions (Mascia and Mills 2018), but overlooks the subtleties of human–nature relationships. Participant observation provides valuable cultural insights but risks missing broader structural contexts.

Although the need for holistic or systemic approaches for understanding people's intentions is frequently proposed and pointed out as a critical aspect of conservation projects, there are still only a few examples of such approaches (Drury et al. 2011). There is a need for more examples and frameworks that fully integrate macro and micro levels research aiming to explain drivers of adoption of conservation interventions.

In this article, we aim to merge and harmonize macro- and micro-level factors while combining qualitative and quantitative approaches to examine a sustainable ranching certification scheme for ranchers in the Brazilian Pantanal, a critical ecosystem for the global conservation agenda - particularly in the context of 2026 as the International Year of Rangelands and Pastoralists (FAO 2026). We used semi-structured interviews and ethnography to evaluate perceptions of sustainable cattle ranching. Through TPB, we assessed ranchers' beliefs shaping their intentions towards sustainable cattle ranching, whereas the DOI framework was used to evaluate the contextual drivers influencing the adoption of the certification scheme.

2 | Methods

2.1 | Study Area

The Pantanal wetland is located in the center of the Upper Paraguay River Basin in South America encompassing 179,300 km^2 across Brazil (78%), Bolivia (18%), and Paraguay (4%) (Figure 1) (Tomas et al. 2019). The Brazilian Pantanal stretches from southern Mato Grosso state (35% of the Pantanal) to Mato Grosso do Sul state (65% of the Pantanal). The region has a seasonal flood pulse with monomodal hydrological signature (Junk et al. 2011), influencing animal and plant communities, nutrient cycling, and primary productivity. The landscape consists of a mosaic of floodable and non-floodable grasslands, forests, open woodlands, and temporary or permanent aquatic habitats.

The first ranch in the Pantanal was established in the early 18th century during the Portuguese colonization in the region soon after they found a gold mine in 1716 in the outskirts of the Pantanal and funded the city of Cuiabá in 1719—currently the capital of the state of Mato Grosso (de Abreu et al. 2010). In the late-18th century a new colonization process started from the southern area of the Pantanal. The Portuguese established the Fort Coimbra in 1775, funded the city of Corumbá in1778, and established the first ranches in the south Pantanal. In many instances, the establishment of cattle ranches and cities were used mainly as a way to occupy an area that belonged to the Spanish Crown. In 1860, the region was invaded by Paraguayans aiming to claim back the areas that belonged to the Spanish —known as the Paraguayan War. During the war ranchers were expelled, only returning after the end of the war in 1864. Today, most of the ranching practices in the region are based on extensive ranching with a low rate of deforestation and poaching, with around 80% of the native vegetation of the Pantanal floodplain still standing (Chiaravalloti et al. 2025). There are around 5000 ranches in the Brazilian Pantanal.

2.2 | Data Collection and Analysis

2.2.1 | Free, Prior, and Informed Consent and Ethics

In this project, we collected data between August 2021 and July 2024. We sought free, prior informed consent before carrying out any data collection (Brittain et al. 2020). Participants were allowed to withdraw their consent anytime during the project. We interviewed ranch owners, managers, and cowboys; over 95% of them were men. The study was approved by the Brazilian Ethics Committee (process number: CAAE 34296720.7.0000.5161) and by Smithsonian Institution Human Subjects Review Board (protocol number: HS20024).

2.2.2 | Ethnography

To better understand ranching practices and ranchers' views of adopting sustainable ranching schemes, C.S. lived and worked on a Pantanal ranch for a month, actively participating in daily activities. Informal conversations and perceptions about the practice were written down in a notebook and tabulated afterwards.

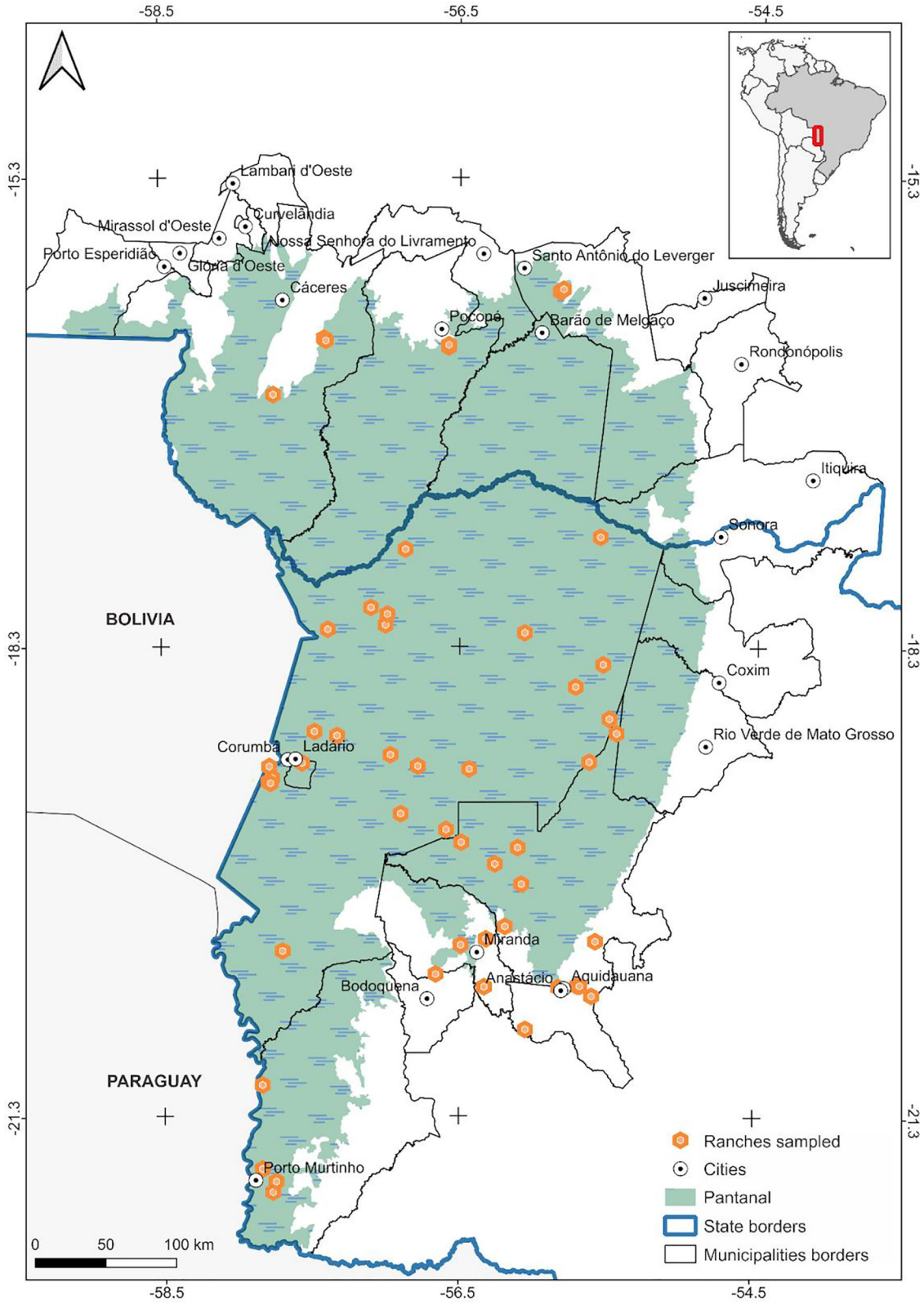

FIGURE 1 | Location of the properties of the ranchers interviewed in the Brazilian Pantanal and adjacent areas.

Walking interviews provided further insights, allowing observation of behaviors in a natural setting (Evans and Jones 2011). This immersive approach aimed to offer a nuanced perspective on how ranchers perceive and implement sustainability in their daily practices (Bernard 2006). The data were analyzed through content analysis, seeking patterns within people's behaviors and answers (see Supporting Information section for the full explanation of the content analysis).

2.2.3 | Semi-Structured Interviews

To explore initial perceptions of sustainable cattle ranching among local stakeholders, we used semi-structured interviews and focus groups. They were held in government-organized visits to Pantanal ranches aiming to discuss regional ranching challenges. This exploratory phase led to the identification of key themes representing local perceptions of sustainable cattle ranching, which subsequently informed the application of the TPB and DOI frameworks (see Supporting Information section for details).

2.2.4 | TPB and DOI

The results of the semi-structured interviews, TPB, and DOI frameworks were used to develop a survey aiming to understand intention to adopt a possible sustainable ranching certification scheme. We interviewed ranchers and ranch managers. To assess the TPB, we used three items for "Intention," four items for "Attitude," three for "Subjective Norm," five for "Perceived Behavioral Control," four items for "Behavioral Belief," four items for "Normative Belief," and two for "Control Beliefs." The "Behavioral Belief," "Normative Belief," and "Control Beliefs" items were each constructed from two questions, one measuring expectations and the other motivations. The DOI-related questions were adapted from Jagadish et al. (2021). To ensure clarity and minimize redundancy, overlapping questions between the two frameworks were carefully inspected. We carried out 82 interviews, including eight via telephone, eight via video calls, and 66 in-person. We interviewed ranchers and managers from different regions of the Pantanal (Figure 1). Similarly to the semi-structured interviews, samples were non-probabilistic, and ranchers were chosen opportunistically (a non-probabilistic method).

The TPB analysis was performed in two steps using descriptive statistics and partial least squares structural equation modeling (PLS-SEM). Our goal was to evaluate the relationships among TPB constructs and ranchers' intentions to adopt a possible sustainable ranching certification scheme . Reliability, validity, and multicollinearity tests followed standard procedures (Hair et al. 2021), and the model showed satisfactory performance. Full methodological details and results are provided in the Supporting Information section.

For the analysis of the DOI attributes, we treated most survey questions as distinct explanatory variables representing different attributes within the theory. We developed an index for questions with more than one item (e.g., support from (a) government, (b) EMBRAPA, (c) NGOs, and (d) universities) by summing positive responses. We had a total of 29 explanatory variables (Supporting Information section). The response variable was the intention to adopt, calculate by averaging the response to the four intention-related questions.The first step was to carry out a VIF analysis checking which explanatory variables were too similar to be analyzed together (we considered the VIF threshold of 3 as the limit). We deleted 3 (DT05, DT09, and DT15) (Supporting Information section), reducing the model to 26 explanatory variables. Second, we carried out a subset regression, which created all possible models with all variables and evaluated those with the lowest Bayesian Information Criterion, adjusted-r factor, and Mallows' CP (Agostinelli 2002) (Supporting Information section). Then we ran a bootstrap analysis (10,000 times) with the best model, creating confidence intervals and checking which variables touched the zero threshold, in other words, were not significant. More details on the methods are presented in the Supporting Information section, and the code and the data for TPC and DOI are available here https://doi.org/10.5522/04/28293263.

3 | Results

3.1 | The Pantaneiro Culture and Biodiversity

"Cultural values and pride" were particularly pronounced among our sample of ranch owners and managers, who emphasized the importance of preserving the Pantanal as cultural heritage. One owner articulated this sentiment, saying, "Pantanal ranchers are the ones who know how to produce here, so we have to provide conditions for these people." This connection to cultural traditions and the desire to pass them on to future generations were very strong among all stakeholders. It shaped their approach to ranching practices. A ranch owner expressed their strong belief in their practices, highlighting their confidence in increasingly "ecologically friendly" methods and their commitment to preserving the heritage of ranching. He added: "We believe that only ranching can promote the sustainable development of the Pantanal."

These observation were further supported by our quantitative analyses. Recognition of the Pantaneiro culture was the most important belief that were analysed using TPB . Recognition of Pantaneiro Culture played the most imporatnt role in "Behavioral Belief" (CC_3; weight = 0.70, CI 0.33-0.94) which played a significant role in "Attitude" ($\beta = 0.72$, CI 0.59–0.84), "Attitude" played a significant role and explained a substantial proportion of the variance in "Intention" ($r^2 = 0.52\beta = 0.76$, CI 0.57–0.93). (Figure 2). Our findings indicate that interviewees would be inclined to adopt a sustainable certification scheme should it recognize their Pantaneiro culture (Figure 3). This result was complemented by our analysis of the DOI attributes; recognition of local culture was among the six variables that played a significant role in their chance to adopt the certification scheme (Figure 4) ($\beta = 0.05$, CI 0.02–0.08).

Protection of wildlife also emerged as an indirect but important driver of "Attitude" (protection of wildlife played a role in Behavioral Beliefs, Behavioral Beliefs played a role in Attitude, and Attitude in Intention) in the TPB model, a finding corroborated by qualitative data, which showed that ranchers widely share values of sustainability and environmental awareness.

3.2 | The Role of Neighbors

Another factor highlighted in the TPB analysis was the importance of peers. The results showed that "neighbors' opinion" played a central role in shaping ranchers' "Normative Beliefs" (*weight* = 0.80, CI 0.41–0.99—CN_1), which in turn significantly

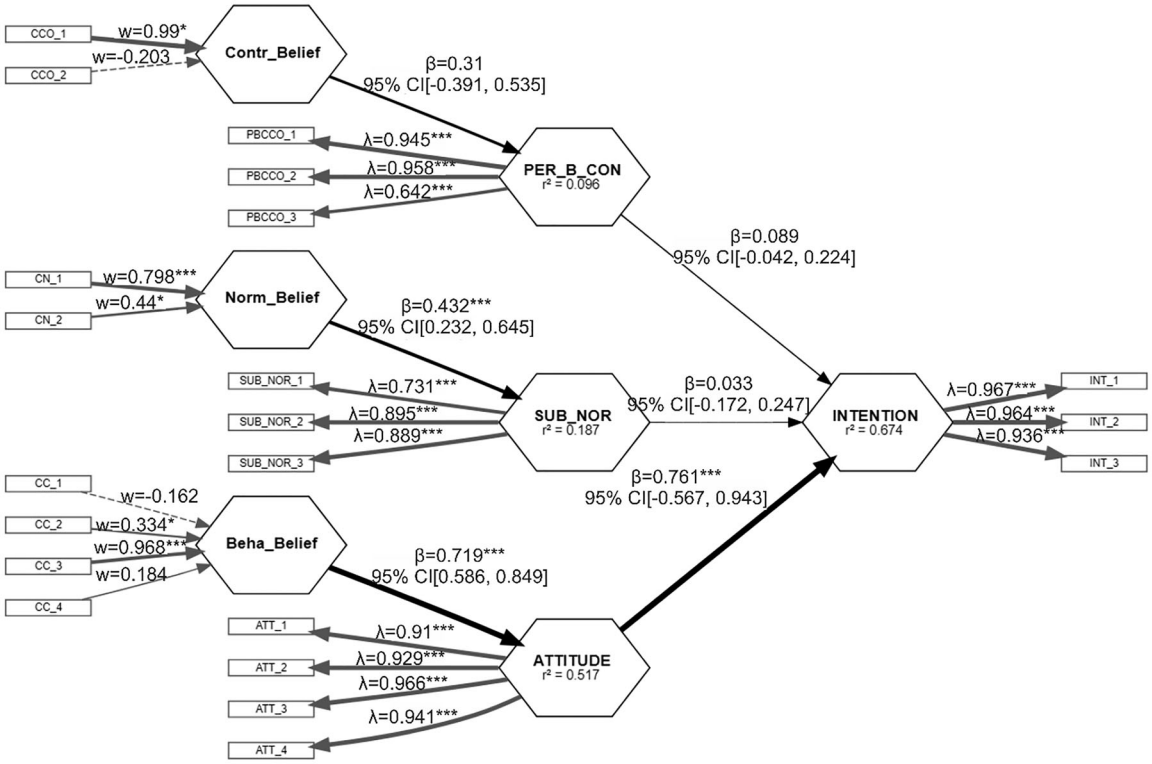

FIGURE 2 | Results for the integrated model for theory of planned behavior (TPB). The hexagons represent constructs; the rectangles are the items of the constructs (composites). Arrows between constructs are β coefficients, and numbers inside constructs are the r^2. Arrows going from the items to the constructs are formative weights, and arrows going from constructs to items are reflexive loadings. ATT = Attitude; Beha_Belief = Behavioral Beliefs; CC = Behavioral Beliefs; CCO = Control Beliefs; CN = Normative Beliefs; Contr_Belief = Control Beliefs; INT = Intention; Norm_Belief = Normative Beliefs; PBCCO = Perceived Behavioral Control/Capacity and Control; PER_B_CON = Perceived Behavioral Control; SUB_NOR = Subjective Norm; SUB_NOR_1;2;3 = Subjective Norm.

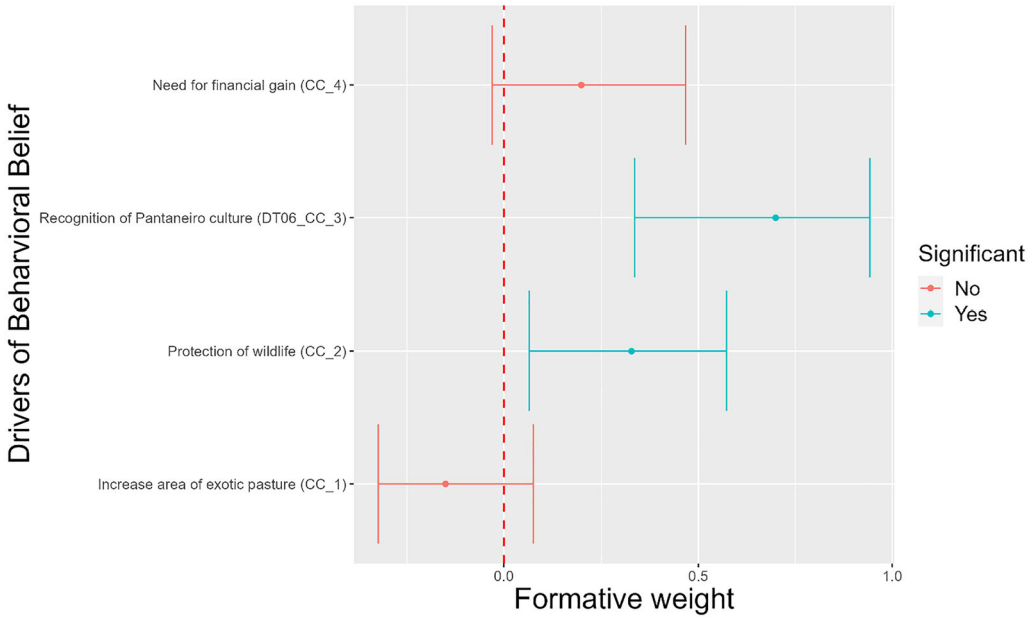

FIGURE 3 | The role played by each indicator (weight) on the latent variable "Behavioral Belief." The bar represents the confidence interval produced through a bootstrap with 10,000 interactions. Those indicators that touch the red dotted line are not significant.

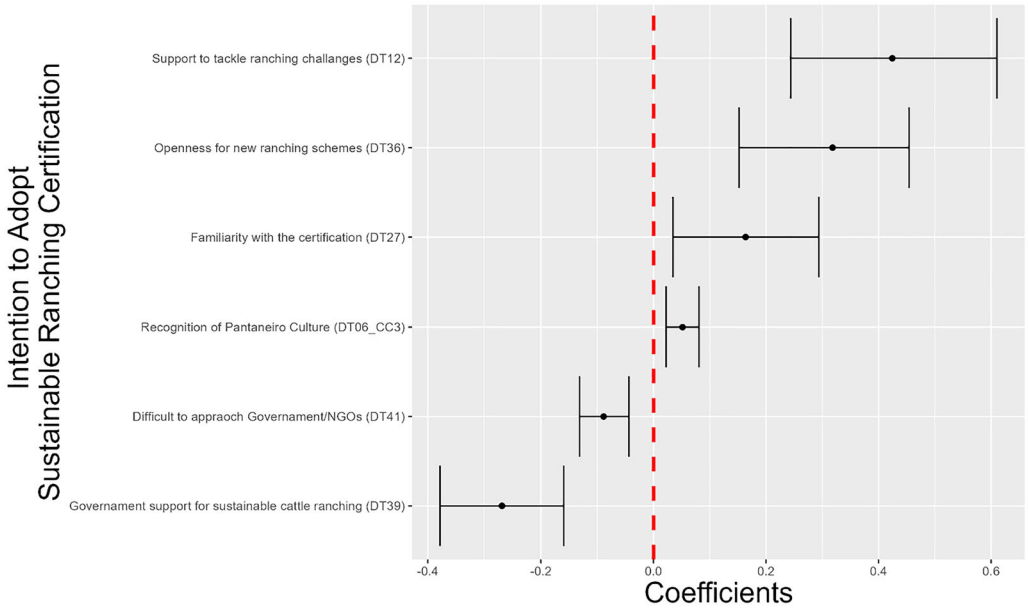

FIGURE 4 | Weight of factors from the diffusion of innovation (DOI) model on participants' intentions to adopt conservation schemes in their properties in Pantanal. The items shown in the graph are from the final model selected using BIC, and the effects of other excluded items are not shown (see the full list of items in the Supporting Information section).

influenced the "Subjective Norm" ($\beta = 0.43$, CI 0.23–0.64). This was consistent with ethnographic observations, where cowboys were frequently seen working alongside neighbors, moving cattle, and gathering for meals to exchange experiences about their practices. However, the analysis also revealed that the "Subjective Norm" itself did not have a significant effect on "Intention" ($\beta = 0.03$, CI −0.17 to 0.25), suggesting that although peers shape perceptions, these social pressures do not ultimately determine the willingness to adopt a sustainable ranching certification scheme. In the DOI analysis, as familiarity with the certification scheme is a significant driver of adoption; neighbors are also likely to play a key role in spreading information about sustainable ranching initiatives or practices.

3.3 | Need for Support

The availability of support to address ranching challenges played a significant role in the rancher's intention to adopting a sustainable certification scheme ($\beta = 0.42$, CI 0.22–0.61) in the DOI analysis. Ranch owners are acutely aware of the management constraints and challenges associated with maintaining sustainable ranching practices. This was corroborated by our qualitative analysis, as one rancher pointed out, "Sustainable practices are difficult and expensive to implement and therefore must be supported for us to succeed." Although ranchers were more likely to adopt when support was available, not all types of support were valued. The DOI analysis showed that ranchers were less likely to adopt the sustainable certification when they believed government and NGOs were difficult to contact and if they believed government was involved (DT41: −0.08, CI −0.13 to −0.04; DT39: −0.26, CI −0.37 to −0.15, respectively). The latter suggests conflict regarding who should be spearheading sustainable ranching initiatives in the region.

4 | Discussion

Today, resouce-dependent local communities live in some of the most of the critical ecosystems (Fa et al. 2020; Garnett et al. 2018). Understanding how to better engage with them is a fundamental step towards an effective and equity-based conservation approach (Chiaravalloti, Tomas, et al. 2025; Garrett et al. 2024; Convention on Biological Diversity 2022; Dawson et al. 2021; Mace 2014). However, single methods and narrow frameworks frequently fail to address the complex lives (or milieu) that people are embedded in (Drury et al. 2011). Our article brings an innovative approach to uncover the complex dynamics of stakeholders' perception of a conservation program by combining macro- and microlevel perspectives from psychology, sociology, and anthropology, using qualitative and quantitative methods.

Pride and recognition of the local culture stood out as a significant variable in all methods. In the Pantanal, cattle ranches were first established in the early-18th century underpinned by extensive ranching with minimal intervention in the environment (de Abreu et al. 2010). In the past there have been several attempts to intensify ranching in the Pantanal through railways, highways, and dams (Wilcox 1999). Partly due to the unpredictability of the ecological dynamics and partly due to a lack of government interest, most of the infrastructure projects were abandoned or never completed (Kauffman 2015). As a consequence, ranching practices have not changed much since they were first established (de Abreu et al. 2010). The long-standing presence of most ranchers in the region, often spanning several generations using similar management practices, has also fostered a strong sense of identity as "Traditional Pantaneiros" (Chiaravalloti, Tomas, et al. 2025). Today, most of them have a strong connection with landscape and nature, reflected in discourses related to protecting wildlife, including iconic and locally symbolic species such as

jaguars and macaws, as evidenced by both the TPB results and the qualitative analyses.

Many times, many of these ranchers own large areas (sometimes over 50,000 ha) and thousands of cattle (over 30,000 heads), situating them among the local elite. Therefore, they are frequently portrayed as a wealthy group, far from what is commonly recognized as a "traditional community." This mismatch between being part of the local elite while also identifying themselves as "traditional" causes suspicions and mistrust among the general public. Some ranchers argue that there is a narrative against them (Chiaravalloti, Tomas, et al. 2025), blaming government and external agents for it (such as NGOs and media). Moreover, the pride of being a Traditional Pantaneiro also represents an important identity marker that stands in contrast to the arrival of new ranchers and corporate actors. For ranchers, this external recognition as "Traditional Pantaneiro" is important to their own position and power dynamics in the society. Therefore, a certification or conservation scheme that could support them to reassure their position as "Traditional Pantaneiro" would play a major role in their "Intention" to adopt it.

The need to consider people's own identity in conservation projects goes beyond the Pantanal. The debate around Indigenous Peoples and Local Communities (IP and LCs) is frequently based on scholars, practitioners, or policy makers' defined understanding of IP and LCs (Kremen and Merenlender 2018). Groups that do not fit in a fixed profile tend to be left out from discussions (Chiaravalloti 2019). To promote sustainability in a diverse and multistakeholder landscape, it is critical to understand how people view themselves before defining stakeholders and actions (Bennett et al. 2022).

Another two important findings in the research regards financial incentives and the role of peers in the intention to adopt a sustainable ranching certification scheme. Many conservation initiatives are based on the idea that any nature-based solution that generates revenues will prevail—"if it pays it stays" (Bayon and Jenkins 2010). Although this is might be true in some cases (e.g. ecotourism), our research found that intention to adopt among Pantanal ranchers was not significantly influenced by the need for financial gain. For ranchers, the technical support was more important than direct finantial incentives (Spangenberg and Settele 2016). Likewise, peer pressure, a common driver of adoption in conservation programmes, did not show to be as important in our case study (Eyster et al. 2025; Mascia and Mills 2018; Weigel et al. 2014). Our TPB results indicate that although interviewees considered their peers important in their daily lives, "Subjective Norm" and "Peers" did not significantly shape their "Intention." This pattern, supported by qualitative findings, suggests that ranchers—like many individuals—tend to deny that their decisions are influenced by peer pressure. Perhaps peers serve mostly as information transmitters within the system allowing ranchers to familiarize themselves with the initiative but not necessarily influencing engagement. There is possibly pragmatic weighing of the negative and positive aspects of joining a specific program. People tend to join a program that brings more individual benefits than costs as predicted by game theory (Frank and Sarkar 2010). However, while evaluating the complex reality people are embedded in, we need to acknowledge that some decisions may deviate from the rational framework (Nolan et al. 2008). Therefore, establishing a long-standing relationship that supports ranchers in their daily activities with knowledge and technical capacity would be more effective than a direct financial incentives, as presented in previous research in other contexts (Mills et al. 2025).

The insights from this study reinforce the importance of integrating qualitative and quantitative approaches when designing conservation initiatives. It is critical to ensure that these programs reflect how people perceive and envision their participation, rather than imposing blueprint "solutions," which can ultimately lead to abandonment and failure of the conservation initiative. By mixing qualitative and quantitative data through ethnography, semi-structured interviews, TPB, and DOI, we were able to investigate the macro-level aspects of adoption of a sustainable certification ranching scheme in the Pantanal wetland, such as the role of government support and external agents' mistrust. We also captured micro-level aspects, including elements such as "pride" and the need for "capacity sharing", suggesting that certification programs can simultaneously strengthen identity around traditional and sustainable practices, while fostering co-learning and co-production processes to enhance participants' ability to access and develop markets that value certification.

5 | Conclusion

Understanding how to better engage with local stakeholders is a critical aspect of conservation science and practice. In this article, we present results from analyses that encompasses both qualitative and quantitative methods looking at micro and macro drivers of adoption. We test our approach with a sustainable ranching certification scheme in the Pantanal wetland. Our findings show that certification programs that prioritize strategies that directly target recognition and support would be best placed for widespread adoption. We show that conservationists need to acknowledge the complex social milieus in which people are embedded and move beyond viewing conservation schemes solely as business opportunities. Our results present a clear path for conservationists and policy makers to deeply engage with ranchers in projects that seek the common goal of sustainability of the Pantanal.

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Ethics Statement

The study was approved by the Brazilian Ethics Committee (process number: CAAE 34296720.7.0000.5161) and by Smithsonian Institution Human Subjects Review Board (protocol number: HS20024). This is

contribution #24 from the "Insights for Catalyzing Conservation at Scale" initiative.

Data Availability Statement

The data are available at https://figshare.com/articles/dataset/Code_and_data_for_Theory_of_Planned_Behaviour_TPB_and_Diffusion_of_Innovation_Theory_DOI_/28293263.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section.

Supplementary Materials: conl70033-sup-0001-SuppMat.docx