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REVIEW ARTICLE

# Assessment of transdisciplinarity by its participants: the case of Tertúlias do Montado, Alentejo, Portugal

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## Abstract

Evaluation plays a pivotal role in transdisciplinary (TD) research, often discussed during funding stages or when assessing project impacts. A few studies delve into the participant perspective when examining the quality of transdisciplinarity. Our work contributes to this area of assessment. Rather than providing a definitive definition of transdisciplinarity, we developed a questionnaire to evaluate a set of TD principles within a specific TD initiative. We collected insights from 100 individuals out of a pool of 200 participants engaged in a TD initiative since 2016. Given the long-term nature of the case study, our sample included both frequent and occasional participants. Using non-parametric statistical, we concluded that frequent participants express higher satisfaction with their involvement, identify more outcomes stemming from their participation, and assign greater importance to TD principles. These findings highlight the significant impact of investing in long-term TD initiatives. Additionally, our questionnaires featured open-ended questions to capture participants' individual definition of the initiative, along with their perceived benefits and drawbacks. Through content analysis, we identified two distinct discourses: positivism and postpositivism. The positivist discourse predominantly features male participants over 60 years of age, primarily from the research community. These participants express lower satisfaction with their participation and assign less value to TD principles. We found no association between positivism/postpositivism and participation frequency (i.e., frequent/casual). This suggests that these two discourses can coexist and interact within a TD environment. Nevertheless, the perceived value of TD is not uniform across these groups, indicating that TD may not align with everyone's objectives, even in complex contexts where the approach is considered essential.

**Keywords** Transdisciplinarity · Questionnaire · Evaluation · Perspectives

## Introduction

The concept of transdisciplinary (TD) research, as defined by Klein et al. (2001), involves the collaborative effort of various academic disciplines in conjunction with non-academic practitioners to address real-world problems. Pohl (2011) further elaborates on TD research, highlighting four key elements:

1. *Comprehensive understanding of complexity* TD research aims to fully comprehend the complexity of the issue at hand.
2. *Diverse perspectives considered* It considers a wide array of perspectives related to the issue.
3. *Integration of abstract and case-specific knowledge* TD research combines theoretical knowledge with practical, case-specific information.

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4. *Generation of descriptive, normative, and practical knowledge* It creates knowledge that is descriptive, normative (involving ethical or value-based considerations), and practical, with the aim of promoting what is perceived as the common good.

In the TD research process, representatives from various disciplines, from both private and public sectors, as well as civil society, collaborate to develop knowledge on a specific issue while striving to align with these four key aspects. The question of how a TD process unfolds and reaches its final goal is pivotal for the development of such an approach. Consequently, the evaluation of transdisciplinarity constitutes a significant focal point within dedicated literature (e.g., Belcher et al. 2016; Bergmann et al. 2005; Hansson and Polk 2018; Pohl et al. 2010; Steelman et al. 2021; Zscheischler et al. 2018).

While much of the TD evaluation literature emphasizes assessment through external evaluators, often during funding application or project impact assessment stages, it primarily reflects the viewpoints of these external evaluators and rarely incorporates the perspectives of the broader science-practice community engaged in transdisciplinarity (Tobias et al. 2019; Zscheischler et al. 2018). However, to gain a deeper understanding of what occurs in a TD context and how the process can be enhanced, it is crucial to gather the perspectives of those actively involved.

A few studies center on TD evaluation by its participants, highlighting the need for more empirical research in this area (Fritz et al. 2019; Tobias et al. 2019; Zscheischler et al. 2018). Examining the perspectives of TD participants serves a dual purpose: it aids in assessing the quality and outcomes while offering valuable insights into how the process unfolds and can be improved. This paper addresses these critical areas. First, we aim to examine, from the participants' standpoint, the quality, and outcomes of transdisciplinarity. Second, we delve into how levels of participation and worldviews shape participants' perspectives about transdisciplinarity. As an empirical study, we narrow our focus to a specific case study and design a questionnaire instrument that can be adapted for use in other evaluation contexts. Our survey encompasses 100 participants from a pool of 200 individuals actively engaged in a TD case study. Within the specifics of our case study and the survey instrument we developed, we also aim to propose two transferable outcomes: first, the proposition of long-term constant problem framing platforms; and second, the survey to capture TD participants' perspectives.

Moving forward, we provide an overview of the evaluation of transdisciplinarity (the section "Literature review on evaluation of TD"), which formed the basis for crafting the questionnaire. Subsequently, we expound upon the specifics of the case study (the section "The case study and methodological approach") and the methodological approach. In the section "Results", we detail the findings and discuss them in the section "Discussion". We conclude with final remarks in the section "Conclusions".

## Literature review on evaluation of TD

As a preliminary step in crafting the questionnaire, we conducted a review of the dedicated literature pertaining to TD evaluation approaches. Table 1 provides a concise summary of the insights garnered from this process.

While employing diverse formats, most of the literature advocates for an evaluation approach that aligns with the fundamental principles put forth by Klein (2008). These overarching principles of evaluation encompass:

1. Variability of goals.
2. Variability of criteria and indicators.
3. Leveraging of integration.
4. Interaction of social and cognitive factors in collaboration.
5. Management, leadership, and coaching.
6. Iteration in a comprehensive and transparent system
7. Effectiveness and impact (Klein 2008).

Pohl et al. (2010) introduced a set of questions that place significant emphasis on the quality of synthesis and integration. Building on this, Di Lacovo et al. (2016) further expanded upon the work of Pohl et al. (2010) to develop an evaluation framework that introduced two additional dimensions:

- *Broadness* Evaluated in terms of the extent of diversity and inclusivity across disciplines, methods, and involved actors in the research.
- *Reflection and learning* Evaluated in terms of the effectiveness of collaboration, mutual understanding, and the capacity for learning within the TD process.

Furthermore, Holzer et al. (2018) provided a detailed list of indicators that are well suited for evaluating various aspects of the research process, its outcomes, and resulting outputs.

While the referred authors primarily address evaluation approaches from the perspective of external evaluators, others put forth tools designed for participants engaged in TD processes. Edelenbos et al. (2011) and Restrepo et al. (2018) provide frameworks around the utility of co-produced knowledge and the enhancement of capacity. They inquire about participants' level of interest and the usefulness of the project, what insights they gained, how

**Table 1** Review about principles of transdisciplinarity used in evaluation approaches

| Principles of transdisciplinarity | | Details and references | |
|---|---|---|---|
| Variability of criteria and indicators | Variability of goals | The symbiotic relationship between science and practice is evident in the mutual benefits and learning that occur. This underscores the importance, significance, and practical utility of the research problem, its objectives, the processes employed, and the resultant findings within the specific context of the problem at hand | Di Lacovo et al. (2016), Edelenbos et al. (2011), Fritz et al. (2019), Hansson and Polk (2018), Holzer et al. (2018), Klein (2008), Pohl et al. (2010), Steelman et al. (2021), Tobias et al. (2019) and Zscheischler et al. (2018) |
| | Leveraging of integration | The thought-styles of various group members play a pivotal role in generating fresh perspectives and ideas. It is crucial to assess the level of detail in the approach to integration. Additionally, a balanced weaving of disciplines or fields of expertise is paramount for a comprehensive TD process. Furthermore, having a common research object that is accessible and beneficial to all members of the research team serves as a solid foundation for effective knowledge integration. This commonality ensures that the research object can be readily utilized by everyone involved, promoting a more collaborative and integrated approach | |
| | Interaction of social and cognitive factors in collaboration | The integration of various types of knowledge, encompassing both scientific and practical, extends into the tangible realm of the real world. This leads to the collaborative development of joint products and ideas. Moreover, the TD process fosters interaction among stakeholders with diverse thought-styles. This dynamic interchange often sparks innovative ideas for new collaborations between groups that have not previously worked together in this capacity. Additionally, it stimulates the generation of novel activities and approaches that can be implemented in the participants' own practical environments and working contexts. This process enriches the collective experience and enhances the potential for impactful outcomes | |

**Table 1** (continued)

| Principles of transdisciplinarity | Details and references |
|---|---|
| Management, social and leadership skills | Evaluating the alignment of management structures with the project's objectives and the integration of various disciplines and fields of expertise is crucial. It is imperative to assess how well these structures are designed to support and facilitate the attainment of the project's overarching goals. Additionally, evaluating the collaborative skills is vital. This encompasses qualities such as open-mindedness, the capacity for self-reflection, adeptness in handling changing hierarchies, and the ability to bear and effectively manage tensions within the collaborative process. These skills are fundamental in ensuring a harmonious and productive TD endeavor. They contribute significantly to the overall success of the project and the effectiveness of the collaborative efforts |
| Iteration in a comprehensive and transparent system | The research process is perceived as fair and ethically sound. This involves ensuring that all parties involved are represented in an ethical and just manner. It also entails the genuine inclusion and consideration of a diverse range of participants, their values, interests, and perspectives |

**Table 1** (continued)

| Principles of transdisciplinarity | Details and references |
|---|---|
| Effectiveness and impact | The research should not only generate knowledge but also inspire concrete actions that effectively address the identified problem, thereby contributing to innovative solutions. It is imperative to evaluate whether the project is centered around an everyday life problem and assess its relevance in this context. Additionally, considering the potential impact, it is important to gauge how likely the project is to make a substantial contribution to problem-solving. These factors collectively determine the practical significance and applicability of the project's outcomes |
| | Assessing ecological impacts involves examining the changes in the ecosystem that be attributed to the research process or any subsequent alterations made in policy and practice. Understanding and quantifying these impacts provide valuable insights into the effectiveness and relevance of the project's outcomes. This assessment helps gauge the project's broader implications for environmental conservation and resource management. Recognizing the project's role in enhancing the sustainability of natural resources is crucial for identifying its potential long-term benefits and positive contributions to ecological well-being |
| | Examining social impacts encompasses assessing changes in human attitudes, beliefs, knowledge, relationships, interactions, and culture that can reasonably be linked to the research process or any subsequent alterations made in policy and practice. Understanding and quantifying these impacts provide valuable insights into the project's influence on the social fabric. For instance, evaluating changes in levels of trust, conflict, and the legitimacy of an idea, policy, or practice are indicators of social impact. Additionally, assessing the size or strength of a social network and examining the distribution of ideas are relevant metrics. These examples highlight the diverse range of factors that collectively contribute to the overall social impact of the project |

**Table 1** (continued)

| Principles of transdisciplinarity | Details and references |
|---|---|
| Broadness | The diversity of disciplines, methods, scales of analysis, and social actors involved is a critical aspect. A high level of diversity indicates a broader and more comprehensive approach to problem-solving, as it draws on a wide range of perspectives and expertise. The key is to assess whether the project effectively brings together relevant expertise, knowledge, and approaches to address the research problem in a comprehensive and holistic manner |
| Reflection and learning | The depth of the approach to self-reflection and adaptation involves considering how well the project team engages in ongoing reflection on their processes, outcomes, and collaboration dynamics. Furthermore, the likelihood of relating reflection to action is an indicator of the project's capacity to learn from experience and adjust its approach accordingly. Regular reflection on cooperation within the team and the implementation of plans for knowledge integration demonstrates a commitment to continuous improvement and a proactive approach to addressing challenges |
| Variability of outcomes | Concrete changes demonstrate the tangible outcomes and contributions of the research in various domains, ranging from policy and land management to education and scientific advancements. The generalization and transferability of results to other contexts highlight the broader relevance and potential scalability of the research findings, further enhancing their overall impact |
| Variability of outputs | This can be: publications, citations, or "reads" or "shares" on social media; students/mentees graduated/advised; representation on editorial boards, invited lectures, collaborations; patents awarded; membership in professional organizations; public goods/products produced; databases; tools; methods; policies; number of events; the project is recognized by the experts community; collaboration; follow-up projects; continuity; implementation of results into practice; to increase the popularity of the issue |

**Table 1** (continued)

| Principles of transdisciplinarity | Details and references |
|---|---|
| Enhanced capacity | The motivation and attentiveness of practitioners are crucial for effective collaboration and successful problem-solving. Their active engagement ensures that the project benefits from their practical insights and experiences. It is important to assess the readiness and capacity of both the academic and practice partners to engage in TD work and address real-world challenges |
| Credibility and legitimacy | The research findings are robust, and the sources of knowledge are dependable. This includes clear demonstration of the adequacy of the data and the methods used to procure the data including clearly presented and logical interpretation of findings |
| Network effects | Network(s) created or expanded; community created or expanded; trust; accountability |

this new knowledge influenced their actions, and the benefits derived from these changes.

Hansson and Polk (2018) emphasized on aspects related to credibility and legitimacy. Tobias et al. (2019) identified TD objectives that comprehensively represent the principles outlined in Table 1, while Zscheischler et al. (2018) identified indicators of TD success that mirror participants' preferences. Like Tobias et al. (2019), the questionnaire encompasses closed questions employing a five-point Likert scale, culminating in a shared 'success profile' of TD projects. Finally, Fritz et al. (2019) delved into the social effects of TD processes, while Steelman et al. (2021) employed social network analysis (SNA) to discern the patterns and practices associated with TD.

## The case study and methodological approach

The current study began by creating a questionnaire, which was completed by participants involved in the "Tertúlias do Montado" initiative (Guimarães and Herrera 2021). In this context, we first provide an overview of the case study, followed by a description of the questionnaire's design, and our approach to data collection and analysis.

### Tertúlias do Montado case study

The "Tertúlia do Montado" serves as a long-term TD dialogue platform addressing the contemporary decline of the Montado agro-silvo-pastoral system. This system, prevalent in the Mediterranean landscape of Portugal, holds significant ecological value and is deeply rooted in the nation's cultural heritage. Moreover, it exhibits remarkable resilience in the face of harsh climatic conditions (Pinto-Correia et al. 2021). The system's ability to thrive in such conditions underscores the urgency to devise strategies for mitigating the current reduction in both its extent and density (Godinho et al. 2016; Pinto-Correia et al. 2021). The decline of the Montado can be attributed to various factors, and there is not a straightforward solution to this multifaceted challenge (Guimarães et al. 2018). As a result, this issue presents a complex yet opportune case for testing and refining a TD approach.

The initiative started in 2016 and is ongoing, primarily supported by internal resources from the coordinating institute (MED, UE). It operates independently of a specific project, and thus, there are no pre-defined outcomes or deadlines to meet. This provides the flexibility to collaboratively shape a customized agenda and work pace. The objectives of "Tertúlias do Montado" are twofold:

1. To consolidate over 20 years of multidisciplinary and interdisciplinary research on the Montado into a format that can contribute to addressing the system's decline.
2. To focus on transdisciplinarity at MED, UE, not solely in practice but also as a subject of research.

The initiative operates under the hypothesis that TD dialogue should be viewed as a socialization process between the realms of science and society, emphasizing the critical importance of acquiring proficiency in working within a TD framework. This learning process is often constrained within financed research projects, which are bound by time constraints and specific objectives. Additionally, within the Portuguese context, there are no funding opportunities to initiate a TD process at the "Problem Framing" step (Pohl et al. 2021). The prevailing work mode implies that a project proposal addresses a pre-defined problem, often identified by researchers themselves.

"Tertúlias do Montado" can be understood as a platform dedicated to Problem Framing, where researchers from diverse disciplines or interdisciplinary fields collaborate with practitioners from various sectors associated with the Montado. Together, they define and refine the sustainability challenges faced in the Montado (Fig. 1). The outcomes of these dialogues can lead to the generation of new research inquiries, which may be further investigated in initiatives beyond the scope of "Tertúlias do Montado". Conversely, in cases where a solution is already identified, a direct transition to the phase of exploring its impact may occur. Additionally, groups engaged in activities focused on problem analysis or impact exploration might return to "Tertúlias do Montado" if the issue needs to be reframed again.

An illustrative example of this process is the creation of a Results-based Model for the Montado, with comprehensive details provided in Pinto-Correia et al. (2022). The policy issue was initially shaped within the discussions of "Tertúlias do Montado" and subsequently examined in a dedicated TD arena (Pinto-Correia et al. 2022). Presently, within the current agro-environmental framework of the Common Agricultural Policy, this results-based model is being implemented (Guimarães et al. 2023).

In practice, "Tertúlias do Montado" follows TD principles and is overseen by an integration expert (Hoffmann et al. 2022), with specialized expertise in integration methods. The participants include researchers, students, landowners, land managers, representatives from public administration, policy makers, private companies, and non-governmental organizations. There is a dedicated blog (http://tertuliasdomontado.blogspot.com/) for publicizing all sessions and hosting reports (one report per session). Participation is open

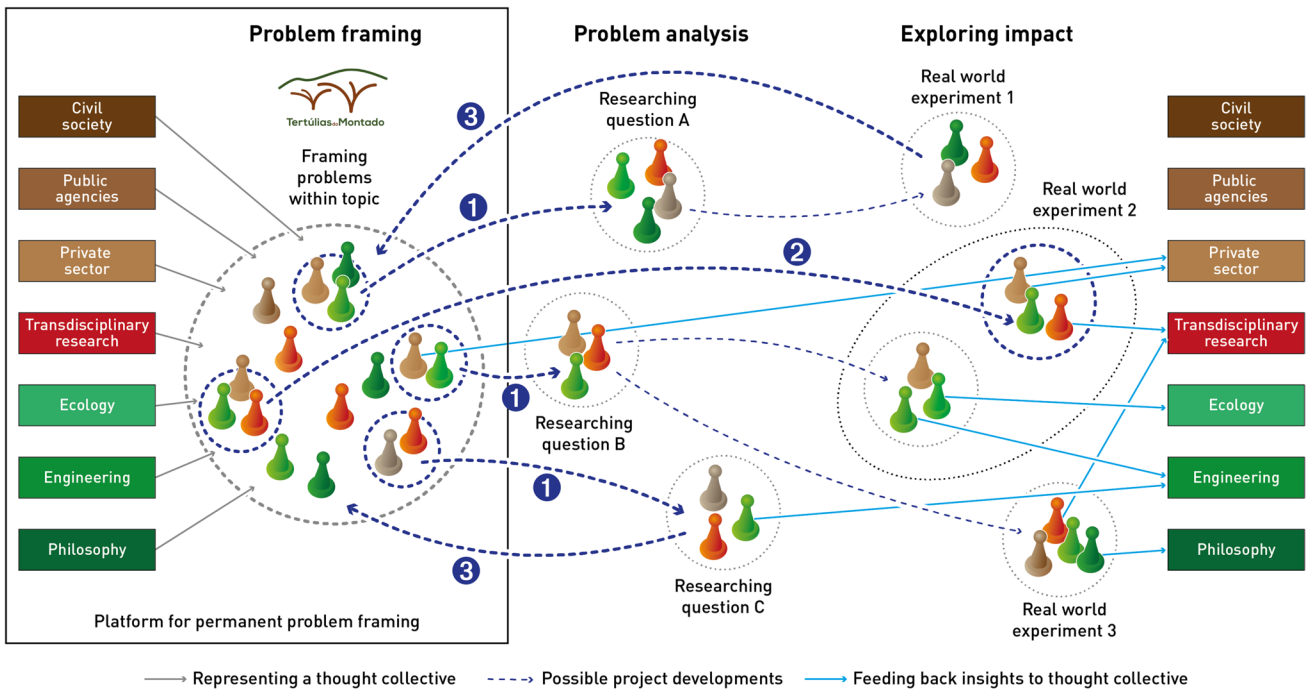


**Fig. 1** "Tertúlias do Montado" as a permanent problem framing platform where researchers of different disciplines or interdisciplinary field and practitioners of different sectors related to the Montado jointly frame the Montado sustainability problems (adapted from Pohl et al. 2021). From this 1st phase, different pathways can be developed, moving to problem analysis phase (1) or directly to exploring impacts (2). The inverse pathway is also possible as "Tertúlias do Montado" is an open platform, so groups working in the analysis or impact phases can also come back to problem framing (3) in "Tertúlias do Montado"

to all, though there is a limit of 40 attendees per session. As of October 2023, a total of 34 indoor or outdoor sessions have been conducted.

In the inaugural session in April 2016, participants collaboratively formulated what is referred to as the "common agenda", consisting of 17 issues line up for collective exploration [further details in Guimarães and Herrera (2021)]. This common agenda remains open to the addition of new topics. At the conclusion of each session, participants jointly determine which issue warrants further discussion. While some matters can be explored in a single session, others necessitate multiple sessions for thorough examination. Additionally, participants are encouraged to propose ideas for organizing upcoming sessions. Farm visits are a common activity in outdoor sessions. Feedback is received through both face-to-face interactions and the completion of an anonymous evaluation questionnaire at the end of each session. To date, an average of 28 participants have been involved, constituting an overall total of around 200 participants. Furthermore, there is a WhatsApp group with approximately 100 members.

## The questionnaire design and data collection

The questionnaire (Annex 1) was crafted considering the described literature review. In Table 2, we align the TD principles, as defined in Table 1, with the corresponding questions. Our aim was to formulate a set of questions, both open-ended and closed-ended, which allowed us to verify responses. As such we could track the coherence of participants' discourse across different replies. We intentionally refrained from providing a pre-defined definition of TD. This deliberate choice enabled us to evaluate participants' perspectives and compare them with the fundamental principles of TD. This was an essential element of the approach to determine whether the TD dialogue, in the context of this specific case study, aligns with the intended principles.

The questionnaire, as detailed in Annex 1, was divided into three sections. Section A gathered socio-economic information about the respondent, including their connection to the Montado. Section B consisted of open-ended questions aimed at understanding how participants conceptualize the initiative 'Tertúlias do Montado' in their own terms. This section was intentionally designed to allow the assessment independent of any criteria related to TD nature.

The formal evaluation of the TD nature of the initiative was conducted in the third section. The principles outlined in Table 1 were assessed through closed-ended questions, with responses measured on a five-point Likert scale, or by gauging the level of agreement with pre-defined statements. To enhance readability and reduce cognitive effort for the interviewees, all statements that required ranking, based on the level of agreement, were grouped together.

Participants of "Tertúlias do Montado" were contacted in advance to schedule a convenient time for an on-line interview. The questionnaire was administered with the assistance of an interviewer and audio recorded. This interviewer had no prior involvement with "Tertúlias do Montado" and was exclusively contracted for conducting this evaluation questionnaire. While respondents had access to the questionnaire beforehand, all questions were read aloud by the interviewer. On average, participants took approximately 45 min to complete the questionnaire. The survey was conducted in 2019, resulting in 100 completed responses. The interviewees' participation in "Tertúlias do Montado" ranged from 1 to 17 times, representing a diverse sample including researchers, landowners, land managers, public administration officials, and representatives from non-governmental organizations.

## Data analysis

We began by employing descriptive statistics to delineate the variables of interest. Following this initial analysis, we categorized the interviewees based on their level of participation in the initiative:

- Casual participants took part between 1 and 9 times from 2016 to 2019.
- Frequent participants were involved from 10 to 17 times within the same period.

In Section B of the questionnaire, content analysis was employed due to the prevalence of open-ended questions. Question 7 was deliberately designed to inquire if participants had prior involvement in similar initiatives (see Annex 1). In case of an affirmative response, we asked them to specify which initiatives were akin to the current one. With this approach, we differentiated participants who recognized the co-construction and active participation aspect of the initiative from those who compared it to knowledge dissemination initiatives, where participants play a passive role in receiving information, often in a conference or seminar format. By cross-referencing these responses with those provided in questions 11 and 16, we observed that a subset of participants viewed "Tertúlias do Montado" primarily as a science dissemination initiative, where scientific knowledge held the utmost importance on the platform.

From this analysis, we were able to categorize the sample into two distinct groups based on interviewees' epistemological stance. We labeled these groups as follows:

- *Positivists* This group comprises interviewees who emphasized the importance of distinguishing and valuing scientific knowledge from other forms. They may

**Table 2** Identification of questions in the questionnaire (Annex 1) that gather participants' perspectives on the various TD principles summarized in Table 1

| Principles of transdisciplinarity used in evaluation approaches (Table 1) | | Questions in the questionnaire (Annex 1) |
|---|---|---|
| Variability of criteria and indicators | Variability of goals | Questions 10, 11, 12, 13, 14, 15, 18, 19, 20. All of these questions are open-ended and designed to approach the topic from various angles. They enable us to discern if participants identified different goals |
| | Leveraging of integration | Questions 22, 28, 35, 36, 37, 39, 40, 44. These are closed-ended questions that evaluate integration from multiple perspectives, including the integration of knowledge, perspectives, and participants |
| | Interaction of social and cognitive factors in collaboration | Questions 10, 11, 13, 14, 15, 16, 20, 23, 24, 26, 28, 29, 30, 31, 32, 37, 38, 39, 40, 41. Many of these questions facilitate a deeper exploration of the social and cognitive aspects of participating in Tertúlias. They include both open-ended and closed-ended questions that later are juxtaposed to substantiate this principle |
| | Management, social and leadership skills | Questions 7, 8, 10, 11, 13, 14, 15, 16, 17, 22, 23, 24, 25, 26, 27, 28, 34, 35, 36, 37, 38, 39, 40, 41. Between the responses to open-ended and closed-ended questions, we evaluate the integration expertise capacity in designing and implementing the initiative |
| | Iteration in a comprehensive and transparent system | Question 7, 8, 9, 10, 11, 20, 26, 27, 28, 33, 34, 35, 36, 38, 39, 41. The replies to these questions also contribute to understanding the clarity of the initiative in terms of content and working mode |
| | Effectiveness and impact | Question 10, 12, 18, 19, 20, 21, 29, 30, 31, 32, 33, 34, 41, 43, 45. These predominantly closed-ended questions shed light on participants' perception of the capacity of "Tertúlias do Montado" to drive the systems toward actions, learnings, and changes |
| | Broadness | Question 22, 35, 36, 37. These questions offer insights into participants' perspectives on the achieved level of diversity in terms of knowledge types, worldviews, and interests |
| | Reflection and learning | Question 42, 45. There are several other questions where learning can be observed; the ones identified here specifically assess the dimension of reflection |
| | Variability of outcomes | Question 18, 19, 20 and 21 directly evaluate the initiative's capacity to promote changes |
| | Variability of outputs | Some questions can provide information on outputs, but we did not directly ask about them, because they were not pre-defined at the start of the initiative |
| | Enhanced capacity | Questions 20, 32, 33, 34, 45. These questions directly assess whether the initiative is providing opportunities for capacity-building |
| | Credibility and legitimacy | Question 20, 27, 35, 38. These questions directly inquire about the level of trustworthiness of the initiative |
| | Network effects | While several responses may indicate this effect, questions 20 and 30 are specifically dedicated to assessing it |

discourage discussions involving anecdotal knowledge, viewing such discussions as a potential drawback.

- *Postpositivists* This group includes interviewees who recognize that in 'Tertúlias do Montado', there is an effort to integrate various sources of knowledge. They highly value this aspect and do not establish a hierarchy among different knowledge sources. Significance is placed on subjectivities, worldviews, and values.

The ability to differentiate the sample into these two typologies (i.e., frequency of participation and epistemological stance) offered us an opportunity to analyze potential associations between these groups and the survey responses. The association analysis was conducted using the Chi-square test to assess the relationships between the satisfaction level and epistemological stance and the interviewee socio-economic characteristics and their responses up to question 27. In assessing the association between different categorical variables, we used either Pearson's chi-square test of independence or Fisher's test in case the assumptions of Pearson's chi-square test were not met. We also have conducted a Cochran–Mantel–Haenszel test, to infer the conditional association between the relevant variables (satisfaction level and epistemological stance) and other factors, such as the satisfaction level, Tertulia's recommendation, and gender, among others. None of them exhibited statistical significance in this analysis, and for that reason, we have not reported these results.

Regarding the ranking of the statements (from question 28 to 45), we chose to group them into five objectives, following the approach used by Zscheischler et al. (2018) and Tobias et al. (2019). By employing this shared 'success profile' of TD projects, we can compare the rankings obtained in our study with those detailed by Zscheischler et al. (2018) and Tobias et al. (2019). As a result, the 18 statements (questions 28 to 41) were grouped into five objectives as follows:

*Objective 1* Foster a sense of collective problem ownership among participants (questions 28, 33, 37, 40, 44).

*Objective 2* Encourage a broad discussion rather than one focused solely on a single perspective of the problem (questions 35, 36).

*Objective 3* Facilitate agile and constructive interaction between participants with different perspectives (questions 30, 34, 41).

*Objective 4* Enable participants to connect abstract (scientific) knowledge with case-specific (practical) knowledge (questions 39, 42, 43).

*Objective 5* Motivate participants to integrate shared knowledge into their real-world situations (questions 29, 31, 32, 38, 45).

The ranking of the five objectives was determined by considering the position of each statement within its respective objective, divided by the total number of statements included. The Wilcoxon–Mann–Whitney test (since the normality assumption was not met) was employed to examine the differences between the typologies and the ranking of these five objectives.

## Results

### Descriptive statistics

The sample comprises a significant proportion of landowners and land managers (55%), followed by researchers (29%) (Table 3). Over 60% of the interviewees are aged 45 years or older, with males constituting 66% of the sample. Among the respondents, 55% have attained a high level of education, while 28% hold a Ph.D. degree. Their educational backgrounds encompass a broad spectrum, including fields, such as health, humanities, economics, and management. Notably, 77% of the participants possess a degree relevant to the farming sector, such as agronomy, animal production, biology, and related disciplines. Participation in the "Tertúlias do Montado" ranges from 1 to 17 times. We categorized the sample into two groups: those who took part up to nine times (constituting 60%), and those who were more frequent participants (between 10 and 17 times). Regarding epistemological stance, a positivistic worldview was identified in 25% of the sample.

### Evaluation of the initiative "Tertúlias do Montado"

The satisfaction level with participation was high, as indicated in Table 3, with 98% expressing their intention to recommend "Tertúlias do Montado" to friends, colleagues, or family members. Regarding coordination capacity, participants assigned higher scores to organizational and mediation capacities, while lower scores were given to the availability of information, contact with participants, and dissemination efforts.

Approximately 78% of the interviewees believe that it is at least plausible that this initiative plays a role in addressing the current challenges facing Montado. However, it is noteworthy that half of the interviewees (50%) do not discern any noticeable difference in the status of Montado before and after the initiation of the initiative. We also inquired about the takeaways from participants' involvement in "Tertúlias do Montado". These data were collected through both open-ended and closed-ended questions. The findings reveal that the primary benefits derived were new knowledge and the establishment of useful contacts (Fig. 2). Out of the respondents, 45 participants reported the implementation of tangible actions as a direct result of their engagement in "Tertúlias do Montado", with 60% of these responses coming from landowners or land managers. The open-ended questions further

**Table 3** Categories and number of observations (*n*) of the interviewees' characterizations, opinion of the interviewees about "Tertúlias do Montado", and its evaluation

| Characteristics | Variable | Categories | *n* |
|---|---|---|---|
| Interviewees' characterizations | Gender | Female | 34 |
| | | Male | 66 |
| | Age | < 45 years | 35 |
| | | Between 45 and 60 years | 39 |
| | | ≥ 60 years | 26 |
| | Type of connection with the Montado | Landowners/land managers | 54 |
| | | Public administration/non-governmental organizations | 20 |
| | | Researcher | 26 |
| | Education level | Under bachelor's degree | 17 |
| | | Higher education | 55 |
| | | PhD level | 28 |
| | Level of participation | Frequent | 40 |
| | | Punctual | 60 |
| | Epistemological stance | positivistic | 25 |
| | | Postpositivist | 75 |
| Opinion about "Tertúlias do Montado" | Participation in other similar initiatives | Yes | 37 |
| | | No | 62 |
| | Satisfaction level | Very satisfied | 49 |
| | | Satisfied or less than satisfied | 51 |
| | Recommendation to participate | Very likely | 80 |
| | | Likely | 18 |
| | | Unlikely | 1 |
| | "Tertúlias do Montado" contribution to problem-solving in the Montado | Very likely | 24 |
| | | Likely | 54 |
| | | Unlikely | 16 |
| | | Do not contribute/do not know | 7 |
| | Status of Montado without "Tertulias do Montado" | Very different | 5 |
| | | Different | 27 |
| | | Similar/equal | 50 |
| | | Do not know | 18 |
| | Stakeholder groups are missing | Yes | 48 |
| | | No | 44 |
| | Number of outcomes achieved by participants | ≤ 3 | 53 |
| | | ≥ 4 | 47 |
| Evaluation of the coordination of Tertúlias do Montado | Information made available | Very good | 28 |
| | | Good/reasonable/bad | 72 |
| | Organizational capacity | Very good | 71 |
| | | Good/reasonable/bad | 28 |
| | Mediation capacity | Very good | 62 |
| | | Good/reasonable/bad | 38 |
| | Contact with participants | Very good | 38 |
| | | Good/reasonable/bad | 61 |
| | Dissemination capacity | Very good | 40 |
| | | Good/reasonable/bad | 59 |

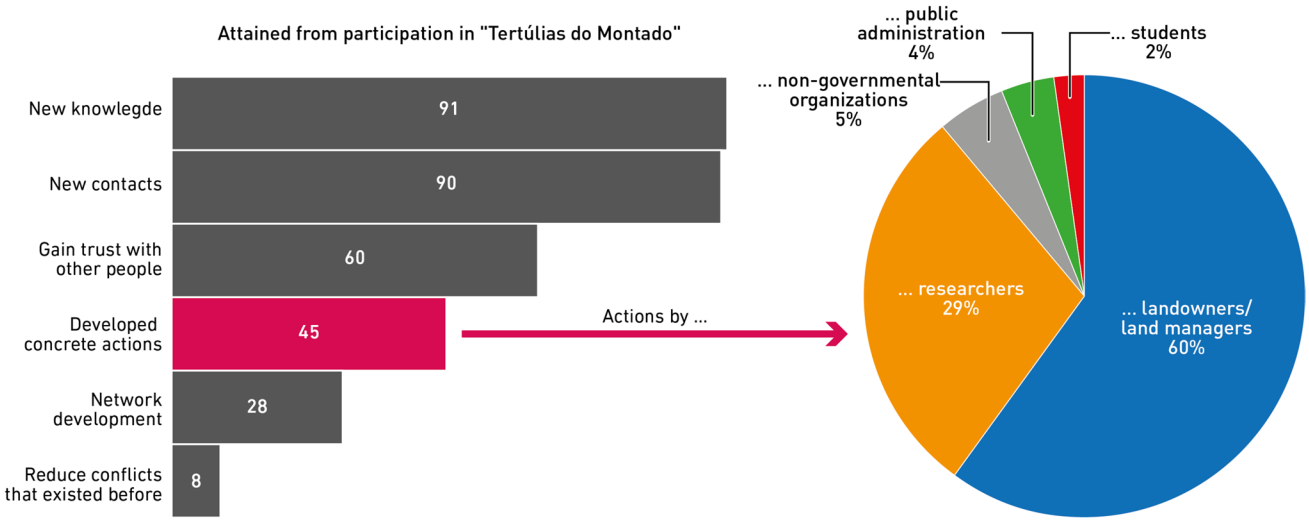


**Fig. 2** The figure on the left shows the quantities of interviewees that reported at least one of the given options of outcomes of "Tertúlias do Montado". The pie-chart on the right relates the concrete actions to the types of interviewees that reported them

uncovered that participants gained new perspectives, values, and perceptions, as well as increased motivation, inspiration, and vision. Moreover, they acquired additional competencies, including an increased ease in engaging with new acquaintances.

In terms of the TD objectives, Table 4, the highest ranking was achieved for Objective 5, which aimed to encourage participants to integrate the shared knowledge into their real-world situations. Conversely, the lowest ranking was observed for Objective 2, which sought to foster a comprehensive discussion rather than one concentrated solely on a single perspective regarding the issue.

## Differences between typology of interviewees (level of participation and epistemological stance)

Table 5 summarizes the results of the associations' tests between the questionnaire variables and the interviewees' characterization considering their level of participation and epistemological stance. Frequent participants indicate higher levels of satisfaction ($X^2_1 = 4.86$, $p = 0.03$) and a higher number of outcomes from their participation ($W = 1774$, $p$ value $\leq 0.001$). Regarding epistemological stance, participants with a positivistic view are more associated with a male participant ($X^2_1 = 7.19$, $p = 0.007$) and researcher ($X^2_2 = 6.33$, $p = 0.042$). This group presents a lower level of satisfaction ($X^2_1 = 3.85$, $p = 0.049$), is more unlikely to recommend the initiative to others ($X^2_1 = 6.85$, $p = 0.009$), and has participated in other similar initiatives ($X^2_1 = 13.40$, $p \leq 0.001$), and there are no differences

**Table 4** Statements to assess TD quality criteria and overall rankings

| Objectives | Number of valid responses | Min | Max | Mean |
|---|---|---|---|---|
| Objective 5<br>Motivate participants to integrate shared knowledge into their real-world situations | 100 | 2 | 5 | 3.93 |
| Objective 3<br>Facilitate agile and constructive interaction between participants with different perspectives | 97 | 2 | 5 | 3.92 |
| Objective 1<br>Foster a sense of collective problem ownership among participants | 100 | 2.5 | 4.8 | 3.80 |
| Objective 4<br>Enable participants to connect abstract (scientific) knowledge with case-specific (practical) knowledge | 100 | 2 | 5 | 3.66 |
| Objective 2<br>Encourage a broad discussion rather than one focused solely on a single perspective of the problem | 98 | 1 | 5 | 2.93 |

**Table 5** Associations between interviewees' characterization, opinions about "Tertúlias do Montado", and "Tertulias do Montado" evaluation with the participation level and the epistemological stance (the *p* value reports to the Qui-square test, and the number of degrees of freedom is easily obtained from Table 3)

| | Participation level | Epistemological stance |
|---|---|---|
| Interviewees' characterization | | |
| Gender | 0.300 | 0.007** |
| Age | 0.340 | 0.059 |
| Link to the Montado | 0.400 | 0.042* |
| Opinion about "Tertúlias do Montado" | | |
| Participation in other similar initiatives | 0.980 | < 0.001*** |
| Satisfaction with the initiative | 0.03* | 0.049* |
| Recommendation of the initiative | 0.160 | 0.009** |
| "Tertúlias do Montado" contribution to problem-solving in the Montado | 0.110 | 0.297 |
| Status of Montado without the initiative | 0.730 | 0.621 |
| Stakeholders are missing | 0.580 | 0.523 |
| Number of results | < 0.001** | 0.200 |
| Coordination of "Tertúlias do Montado" | | |
| Information made available | 0.930 | 0.123 |
| Organizational capacity | 0.750 | 0.028* |
| Mediation capacity | 0.860 | 0.016* |
| Contact with participants | 0.120 | 0.042* |
| Dissemination capacity | 0.170 | 0.006** |

For the variable number of results, the *p* value stands for the Mann–Whitney *U* test

*$p < 0.05$

**$p < 0.01$

***$p < 0.001$

**Table 6** *p* Value of the Mann–Whitney *U* test for the objective 1–5 by the participation level and the epistemological division

| TD objectives | Participation level | Epistemological stance |
|---|---|---|
| Objective 1 | $W = 1573.5$, $p = 0.008$** | $W = 1172.5$, $p = 0.06$ |
| Objective 2 | $W = 989.5$, $p = 0.209$ | $W = 676.5$, $p = 0.075$ |
| Objective 3 | $W = 1483.0$, $p = 0.011$* | $W = 994$, $p = 0.218$ |
| Objective 4 | $W = 1438.5$, $p = 0.088$ | $W = 1305$, $p = 0.003$** |
| Objective 5 | $W = 1559.5$, $p = 0.011$* | $W = 1193$, $p = 0.040$* |

*$p < 0.05$

**$p < 0.01$

***$p < 0.001$

between the positivistic and the postpositivistic view in the number of outcomes from their participation ($W = 1011$, $p$ value $= 0.200$). Participants with a positivistic view ranked with lower rank the mediation capacity ($X^2_1 = 5.84$, $p = 0.016$) and dissemination strategy ($X^2_1 = 7.41$, $p = 0.006$) and with higher rankings the organization capacity of the promoters of Tertulia's ($X^2_1 = 4.81$, $p = 0.028$).

Regarding TD objectives (Table 6), frequent participants provide higher ranking to Tertulia's capacity to:

- foster a sense of collective problem ownership among participants ($W = 1573.5$, $p = 0.008$);
- facilitate agile and constructive interaction between participants with different perspectives ($W = 1483.0$, $p = 0.011$);
- enable participants to connect abstract (scientific) knowledge with case-specific (practical) knowledge (with a marginal association, $W = 1438.5$, $p = 0.088$);
- motivate participants to integrate shared knowledge into their real-world situations ($W = 1559.5$, $p = 0.011$).

Positivistic participants gave lower ranks to the capacity to:

- foster a sense of collective problem ownership among participants (with a marginal association, $W = 1172.5$, $p = 0.060$);
- enable participants to connect abstract (scientific) knowledge with case-specific (practical) knowledge ($W = 1305$, $p = 0.003$);
- motivate participants to integrate shared knowledge in their real-world situations (with a marginal association, $W = 1193$, $p = 0.040$)

While a higher rank was found in the replied of the positivist group in regards:

- encourage a broad discussion rather than one focused solely on a single perspective of the problem (with a marginal significance, $W = 676.5$, $p = 0.075$).

No association was detected between the two typologies ($X^2_1 = 2$, $p = 0.16$); this means that different epistemological stances are found in the same order of magnitude in frequent and casual participants.

## Discussion

### Perspectives on TD quality and outcomes

Table 3 illustrates that the average value of the TD quality profile surpasses 3. When we juxtapose our results with similar studies (Tobias et al. 2019; Zscheischler et al. 2018), our means are marginally lower. Hence, it is reasonable to infer that the initiative is adequately fulfilling the objectives of a TD approach, though there is potential for improvement.

The lowest ranking of TD objectives was found in the capacity for encouraging broad discussions, as opposed to focusing solely on a single perspective of the problem. As highlighted in various case studies, a significant challenge in TD lies in ensuring the participation of stakeholders to incorporate all necessary perspectives on a subject (Di Lacovo et al. 2016; Edelenbos et al. 2011; Tobias et al. 2019). In a TD context, it is imperative not only to bring together the relevant academic experts, but also to create a discussion culture that contribute to the production of knowledge characterized by legitimacy and responsibility (O'Donovan et al. 2022). Anticipating the participation of every individual capable of providing the missing perspective may be unrealistic. Therefore, alternative methods of ensuring the inclusion of required perspectives or knowledge should be explored. The concept of knowledge brokers, particularly in cases where specific scientific knowledge is underrepresented, might help to fill this gap (Kruijf et al. 2022; Maag et al. 2018). Additionally, the incorporation of perspectives from societal groups that either choose or are unable to participate can be achieved through visual mediums such as images or movies. This aligns with arts-based approaches, which serve to integrate different forms of knowledge (Strand et al. 2022).

An often-overlooked aspect of TD processes is participants' satisfaction. Restrepo et al. (2020) caution that despite the institutionalization of stakeholder participation in TD projects, achieving meaningful collaboration cannot be assumed. The authors emphasize that the level of enthusiasm participants exhibit directly impacts the co-creation of results and subsequent implementation. Our findings reveal significant disparities between highly satisfied participants and less satisfied ones (Table 5). The more satisfied individuals not only identify a greater number of outcomes from their participation, but also assign higher rankings to the TD objectives and engage more frequently. In the design and execution of TD processes, it is crucial not to overlook the dimensions of well-being, emotional engagement, and individual learning. Our qualitative analysis corroborates this insight, as participants described enhanced capacities for action, heightened motivation to explore new approaches, and an increased sense of empowerment in their interactions with others.

These results align with Fritz et al.'s (2019) study, which argues that participation yields effects within the research process and serves as an initial step toward subsequent social impacts. Their research revealed that certain elements often considered secondary (such as network effects) were, in fact, central expectations and motivators for professionals to engage. As Schmidt et al. (2020) highlight, participation offers an avenue for social learning, involving the processes of sharing, negotiating, and self-reflecting on multiple perspectives regarding an issue. This form of learning can yield new networks, foster trust, and lead to well-balanced solutions, potentially contributing to enduring behavioral change, empowerment, and an improved capacity to navigate through change.

Our study supports these arguments, since it underscores that the acquisition of soft skills holds a significance on par with more quantifiable outcomes, such as the percentage of interviewees (45% of the sample) reporting concrete actions toward Montado sustainability due to their participation in "Tertúlias do Montado" (Fig. 2). Consequently, we advocate for greater attention and investment in long-term TD approaches, where the well-being of TD participants is as central as the problem-solving objectives they aim to achieve.

### Impact of participation rate and epistemological stance on TD engagement

Our findings emphasize that commitment and continuity play pivotal roles in determining the level of achievement of TD objectives. Notably, a higher frequency of participation is associated with higher rankings across most TD objectives (Table 6). This effect is particularly pronounced in aspects related to fostering a collective sense of problem ownership, facilitating seamless interaction among participants with diverse thought-styles, bridging abstract (scientific) and case-specific (practical) knowledge, and instilling the motivation to integrate shared knowledge into real-world scenarios.

As previous studies have elucidated, collaborations and prior personal involvement, encompassing that trust is established, mutual understanding cultivated, and lessons are gleaned from working with individuals of diverse

backgrounds, which significantly influence subsequent collaborative efforts and their potential impact (Fritz et al. 2019; McKee et al. 2015). Notably, we did not find studies addressing the influence of intensity and duration in a TD process. The risk of stakeholder fatigue is a prevalent concern, especially when stakeholders are frequently solicited for participation in various participatory endeavors without witnessing tangible outcomes from their involvement (Reed 2008; Schmidt et al. 2020). On the flip side, it raises the question: how long does it take to establish a TD dialogue that proves beneficial for all parties involved?

Our study underscores that the frequency of interaction among participants significantly influences transdisciplinarity. In our specific case, the findings highlight the advantages of sustained, regular engagement in TD processes. Notably, active, and consistent participants yield greater outcomes and possess a more comprehensive understanding of the approach. While this empirical evidence is derived from a specific case study, it underlines the critical importance of designing TD approaches that encompass a broader perspective, extending beyond the constraints typically associated with the conventional research projects.

Tobias et al. (2019) delved into the prioritization of TD objectives based on participant typology in TD projects. We chose not to segregate the results in this manner, as we did not observe a significant association between these variables; specifically, the rankings of TD objectives and the diverse participant types (such as researchers, landowners, and public administrators). Instead, what emerged as associated with the rankings of TD objectives were the frequency of participation and the epistemological stance of each participant (Table 5).

The positivist viewpoints consistently assigned lower rankings to most of the TD objectives under evaluation. However, in the case of objective 2, despite marginal significant, positivists attributed higher importance to the achievement of a broad discussion, as opposed to one centered solely on a single perspective. Additionally, these participants highlighted as a drawback of the initiative, the lack of depth in the discussions. Further, this group emphasized the necessity of prioritizing an understanding of scientific knowledge over other forms, which were deemed less critical. Consequently, this outcome seems to be tied to an epistemological standpoint where a focused discussion holds greater value than a broad one.

Hansson and Polk (2018) underscore the importance of integrating and valuing knowledge derived from experience, while also critiquing the dominant authority of scientific knowledge. According to these authors, the inclusion of experience-based knowledge reshapes how researchers formulate inquiries, and broadens the array of perspectives on the research subject, thus enhancing its quality and, subsequently, its credibility. Moreover, they stress that the credibility established through the scientific analysis of participants' experiences and practice-based expertise is pivotal. In this context, credibility arises when participants hold an equal stake in the process, and when their practice-based needs are considered equally important as the scientific requirements of the researchers. Consequently, scientific knowledge is also evaluated by its capacity to conceptualize and make sense of practice-based knowledge. This underscores the importance of a TD approach effectively engaging participants with differing perceptions of knowledge creation.

In our case, no association was found between epistemological stance and the frequency of participation. Consequently, both epistemological stances were present among both frequent and occasional participants. This result indicates that different epistemological stances are present in "Tertúlias do Montado". The challenge lies in finding optimal ways to organize the TD interaction, so that everyone derives benefits from it and actively participates in the co-creation of knowledge.

## Conclusions

Transdisciplinarity is not a conventional approach to problem-solving. Increasingly, research aimed at tackling complex societal issues is coming to the realization that disciplinary or even interdisciplinary methods fall short. Efforts must extend beyond the confines of academia, engaging non-academic stakeholders. In this paper, we introduce "Tertúlias do Montado" as a permanent platform for problem framing, now in its eighth year of operation. With a high participation rate and measurable outcomes, we suggest that long-term TD platforms focused on complex sustainability issues can find applicability in other academic settings employing TD approaches.

The evaluation of transdisciplinarity is of paramount importance, especially as it gains recognition as an avenue for addressing societal challenges. Therefore, possessing a set of criteria for assessing TD quality across various stages, from project proposals to outcomes, is essential. Equally crucial are tools that enable participant evaluation. Our study introduces a questionnaire instrument capable of assessing several TD principles, providing a means for cross-verification, and yielding a quantifiable score for a potential TD quality profile, facilitating comparisons across studies. We invite fellow researchers to utilize and adapt this survey to their own contexts.

Our study underscores the impact of participants' well-being on the outcomes of the TD process. Thus, we argue for a proper balance between the goals transdisciplinarity seeks to achieve and the well-being of participants throughout the process. Lastly, we draw attention to the

role of epistemological stance in TD processes and outcomes. Encouraging TD experiences and disseminating the approach are pivotal activities in preparing the ground for effective and efficient implementation.

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**Data availability** The data that support the findings of this study are available from the corresponding author, M.H. Guimarães, upon reasonable request.

## Declarations

**Conflict of interest** The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.



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