



Transdisciplinary Principles at Work in Latin America: A Comparative Analysis of Participatory Research Tools

Luisa Galindo , Estrella Chávez  & Paul Cisneros 

Red de Investigación Participativa en América Latina, Instituto de Estudios Ambientales de la Universidad Nacional de Colombia (IDEA); Instituto de Antropología Universidad Veracruzana, Xalapa, Veracruz; Colorado State University

Accepted: 7 July 2026 / Published online: 31 July 2026

Alternautas is a peer reviewed academic journal that publishes content related to Latin American Critical Development Thinking.

It intends to serve as a platform for testing, circulating, and debating new ideas and reflections on these topics, expanding beyond the geographical, cultural and linguistic boundaries of Latin America - Abya Yala. We hope to contribute to connecting ideas, and to provide a space for intellectual exchange and discussion for a nascent academic community of scholars, devoted to counter-balancing mainstream understandings of development.

How to cite: Galindo L. Chávez E. Cisneros P. (2026), Transdisciplinary Principles at Work in Latin America: A Comparative Analysis of Participatory Research Tools. *Alternautas*, 13(1), 239-273, DOI: 10.31273/1h15hk69.

University of Warwick Press
<http://www.alternautas.net>



Luisa Galindo¹, Estrella Chévez², Paul Cisneros³

Transdisciplinary Principles at Work in Latin America: A Comparative Analysis of Participatory Research Tools

Abstract: There is limited understanding of how transdisciplinary research (TDR) tools used in Latin America contribute to the implementation of transdisciplinary principles, such as Effective Communication, Knowledge Co-Production, and Long-Term Impacts. This gap matters because, as transdisciplinary approaches become more widely adopted, scholars have increasingly criticized the misuse of TDR methodologies for perpetuating colonial relationships, including knowledge exploitation and the exacerbation of power imbalances. By expanding understanding of how specific TDR tools provide the conditions needed to achieve these principles, transdisciplinary researchers in Latin America can make more informed decisions when selecting tools. In this study, fifteen research tools documented in the repository currently being developed by the Network for Participatory Research in Latin America (Red de Investigación Participativa en América Latina, Red IPAL) were characterized using an analytical framework based on eight categories and guiding questions concerning participants' level of engagement. Subsequently, a deductive analysis was conducted to evaluate the extent to which these research tools contribute to the implementation of each principle. The characterization of the studied tools revealed a typology ranging from highly technical, data-dominated tools to narrative-based and accessible ones. Different levels of engagement were identified across the tools. The evaluation of the three principles showed that

¹ Luisa Galindo holds a Ph.D. in Environmental Conservation, with a specialization in Watershed Management, from the University of Massachusetts Amherst. She is currently a researcher at the Institute of Environmental Sciences at the National University of Colombia and collaborates with researchers from across Latin America through the Latin American Participatory Research Network (Red de Investigación Participativa de América Latina, Red IPAL). ORCID: <https://orcid.org/0000-0002-9668-5483>

² Estrella Chevez is a post-doctoral research fellow at the Institute of Anthropology of the Universidad Veracruzana. ORCID: <https://orcid.org/0000-0002-9344-9311>

³ Paúl Cisneros is Research Associate at the School of Sustainable Futures at Colorado State University. ORCID: <https://orcid.org/0000-0003-0562-283X>

effective communication depends on how tools are implemented within relational, epistemic, and political contexts. Knowledge co-production was found to be highly sensitive to the use of appropriate boundary objects and to the level of trust generated through communicative and interrelational processes. The discussion of the conditions needed to produce long-term impacts highlighted that trust and full participant engagement throughout the research process are pivotal. This study calls for more intentional tool selection in TDR in Latin America. It emphasizes the importance of formats that support accessible language, feedback loops for collective planning, and iterative capacity-building, while also embedding mechanisms to track post-project effects and strengthen more equitable research spaces.

Keywords: Transdisciplinary research tools, Research tools repository, Knowledge co-production, Effective communication, Long-term outcomes.

Introduction

Transdisciplinary research (TDR) is a methodological approach (Merçon, 2021; Streck & Schenatto da Rosa, 2024) that integrates scientific knowledge with local or traditional knowledge to address complex problems. Transdisciplinarity transcends rigid disciplinary academic boundaries and proposes that knowledge generation should result from a co-production process involving the participation of actors in defining the research problem, designing the methods, and interpreting results that can guide action (Bernstein, 2015; García, 2011; Lang et al., 2012). Thus, distinct epistemic, social-organizational, and communicative entities are integrated to define context-specific problems and propose solutions (Lang et al., 2012). The methods and tools used in TDR are characterized by their role in integrating diverse forms of knowledge and perspectives (Ayala-Orozco et al., 2018; Merçon et al., 2018). These methods and tools should facilitate the exchange of ideas and ensure respectful dialogue, as well as democratic and collaborative interactions (Alatorre et al., 2016; Hensler et al., 2024). Tools in this context are often regarded as structured procedures, activities, or instruments designed to facilitate participation, knowledge integration, learning, deliberation, co-production, or decision-making among diverse actors.

This is of particular importance in Latin America, where the integration of knowledge takes place in the context of deep inequalities and power differentials (Merçon, 2021; Streck & Schenatto da Rosa, 2024). In this region, TDR has been practiced in the context of historical and ongoing struggles of Indigenous, Afro-descendant, peasant, and marginalized communities, for whom participation in knowledge production is inseparable from demands for territorial rights, justice, and decolonization. High levels of socioeconomic inequality, weak institutional responsiveness, legacies of extractivism, epistemic colonialism, and persistent tensions between state agencies

and local communities constitute the backdrop against which TDR tools are deployed (Merçon, 2021; Streck, 2020).

These conditions influence the practice of transdisciplinary research, negatively affect the legitimacy of co-produced knowledge, and have the potential to deepen pre-existing unequal relationships in the territory. Therefore, one central concern is whether in Latin America, transdisciplinarity and other participatory research approaches are practiced as a way to perpetuate exploitative relationships or to help transform the conditions that sustain power inequality (Merçon, 2021; Streck & Schenatto da Rosa, 2024). Participatory research is a relational and political process through which the community affected by the problem under study engages with academics as knowledge holders and co-producers (Lang et al., 2012). The meaningful involvement of diverse social actors in TDR research is only accomplished if there are mechanisms and conditions for recognizing the voices, experiences, rights, and capacities of diverse participant actors as legitimate, while seeking to reduce unequal power relations. In turn, the meaningful involvement of participants in TDR increases the chances for effective communication, knowledge co-production, and long-term impacts in the involved territory (Lang et al., 2012; Schaffner et al., 2025).

This study examines how fifteen research tools contained in the Red IPAL's research tools repository, available online (<https://redipal.org/repositorio>), align with the transdisciplinary principles of Effective Communication, Knowledge Co-Production, and Long-Term Impacts. The study assesses whether attributes of these tools are coherent with transdisciplinary principles and, therefore, whether their use in transdisciplinary research in Latin America could contribute meaningfully to transformational transdisciplinary work. This work was accomplished by first performing a characterization of the tools. For this purpose, eight categories of analysis were used, along with a discussion on the levels of participant involvement found in each tool, to produce a baseline highlighting attributes and patterns among tools. Secondly, an evaluation was performed to discuss whether or not the studied tools promote conditions needed to accomplish the selected transdisciplinary principles. This evaluation was preceded by a literature review on each principle.

The next section presents a conceptual background on how tools used in transdisciplinary research are distinguishable, defines the aforementioned transdisciplinary principles and identifies some of the conditions needed to fulfill each principle. Later, the methodology section introduces the research tools repository used in this study, and details the process used to accomplish the two objectives mentioned before. Next, the results are presented, highlighting patterns in the eight analytical categories. The discussion section evaluates whether the studied tools offer the conditions necessary to accomplish the principles, along with additional findings. Finally, the conclusions synthesize the main contributions of the

study, emphasizing implications for designing and documenting TDR tools and outlining priorities for future research.

Conceptual background

Tools used in TDR must facilitate respectful communication, democratic interactions, and mutual acknowledgment between academic and non-academic actors (Merçon, 2021; Schaffner et al., 2025). Such tools should facilitate the integration of multiple forms of knowledge (scientific, local, practical, and normative) around complex real-world problems. They are not ends in themselves, but means to enable communication through the exchange of experiences and knowledge. Overall, TDR tools can be seen as participatory instruments for knowledge co-production that have the potential to expand the chances for collective action.

These tools support different phases of the TDR process, including joint problem framing, knowledge co-production, and societal reintegration of results (Lang et al., 2012; Norström et al., 2020; Pohl et al., 2010). Since transdisciplinary projects are complex and require multiple actors, stages, and capacities, tools can be used alone or in combination with other tools to ensure knowledge co-production, data collection and analysis. Thus, these types of tools are often multidisciplinary in origin.

The literature mentions various principles that define what makes research genuinely transdisciplinary in Latin America, where underrepresented communities are commonly invited to participate in these types of projects (Hensler et al., 2024; Merçon, 2021). For these communities, knowledge co-production is inseparable from demands for territorial rights, justice, and decolonization (Hahn et al., 2023). Therefore, the transdisciplinary approach used in the context of Latin America challenges hierarchical distinctions between academics and non-academics, the practice of knowledge extraction, and research for knowledge's sake rather than knowledge to transform socioenvironmental conditions. In this context, the practice of transdisciplinary research is political, ethical, and transformative (Merçon, 2021).

This research focuses on three TDR principles: 1) Effective Communication, 2) Knowledge Co-Production, and 3) Long-Term Impacts or local long-term capacity to self-organize and govern shared natural resources. Figure 1 shows some of the most significant conditions necessary for the implementation of each TDR principle as explained below.

These principles could be interrelated in different ways. For instance, a tool that uses communication strategies to obtain data, creates the opportunity for different types of actors to interact. Such a tool, which defines who speaks, listens, translates, mediates, and circulates information, affects how knowledge co-production takes place, and because political arrangements define who has the authority to frame problems, validate knowledge, and shape outputs, the integration of diverse epistemologies could result in outputs that privilege certain interests. In return, all of

this will impact what actions are taken next, which alliances endure, and how much trust actors place in each other. Long-term impacts are therefore influenced by communication and co-production processes. Despite the interdependence between these three principles, here they are treated as analytically distinct.

These three principles were selected because recent TDR literature identifies effective communication and equitable knowledge co-production as essential for integrating diverse knowledges into actionable outcomes (Harris et al., 2024; Schneider et al., 2019). TDR has been criticized for its limited commitment to supporting the means and social capacities that could enable collective self-organization and governance beyond specific projects or interventions.

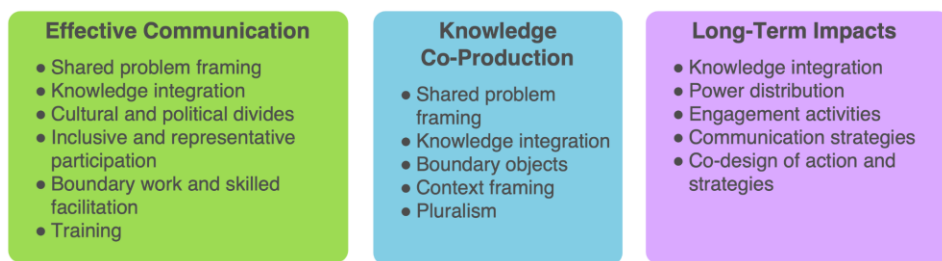


Figure 1. Selected conditions for each transdisciplinary research principle (Source: Authors).

Effective Communication

Communication in TDR is generally defined as the process of knowledge exchange, dialogue, and sense-making that occurs across disciplinary, sectoral, and epistemic boundaries within a TDR community (Orué Pozzo, 2021). Communication occurs by creating shared meaning through information and interaction among stakeholders, mediated by trust and communication mechanisms (Schaffner et al., 2025). Effective communication, then, is the process of fostering iterative interaction among diverse stakeholders to achieve mutual understanding and shared meaning, while overcoming cultural, ideological, and geopolitical divides (Schaffner et al., 2025). Transdisciplinarity is widely understood as relying on communication processes that move beyond disciplinary jargon toward joint problem framing and decision-making (Bartels et al., 2023; Wesselow & Stoll-Kleemann, 2018). To achieve the above, co-creative dialogue is required, positioning communication as a constitutive practice of knowledge production rather than a neutral channel of transfer. Equity is central to these processes, as actors participate from unequal structural positions and possess differentiated capacities to articulate and mobilize knowledge. Latin American communication scholarship underscores

this challenge by highlighting the limitations of vertical knowledge models and the relevance of dialogic, culturally situated, and decolonial approaches (Hensler et al., 2024; Merçon, 2021; Orué Pozzo, 2021).

Communication can be understood as an element within a TDR process or as an outcome. Communication as a process acts as an arena or bridge to manage complexity and social learning (Snorek & Bolger, 2022). It occurs from the beginning and throughout the research process, and is evaluated based on how information is shared, exchanged, and discussed, supporting collaboration and knowledge integration (Hahn et al., 2023). In contrast, communication as an outcome validates the science or knowledge generated as relevant, legitimate, or usable for addressing real-world problems (Hahn et al., 2023; Steger et al., 2018). It is more often assessed at the conclusion or final stages of TDR, and its focus is to identify what was delivered, the reception, the tangible or intangible impacts that emerge from the TDR interaction, and to inform the public about local communities' knowledge and capacities (Hahn et al., 2023). It is expected that high-quality transdisciplinary communication is iterative and reflexive, intentionally designed to foster mutual learning and transformation rather than reinforcing disciplinary or institutional silos (Bartels et al., 2023; Matsumoto et al., 2022). Ensuring these conditions in TDR should result in shareable, accessible, and understandable communicative outputs for diverse audiences. Consequently, research outputs should facilitate such exchanges by supporting equity, genuine participation, and horizontal dialogue among all actors involved.

Knowledge Co-Production

In transdisciplinary research, co-production refers to the collaborative generation of knowledge by teams of academic and non-academic actors throughout the entire research cycle, from problem formulation to the application of results (Norström et al., 2020). Because the co-production of knowledge is shaped by the political, social, cultural, institutional, spatial, and temporal conditions of the project, a clearly framed context is needed. However, “context in transdisciplinary research is a subjective and relational concept whose relevance evolves and changes throughout the TDR process, and whose scope and description can differ drastically depending on how it is defined by different actors” (Tolksdorf et al., 2025, p. 1489). Three commonly identified interdependent dimensions help describe the context of TDR. Outer context factors that surround the TDR project, including political and legal aspects. Inner context factors refer to the TDR project design, process and methods. Finally, spatial and temporal dimensions refer to the historical, fluid and time-bound characteristics of the interactions within TDR projects.

Co-production depends also on the co-definition of problems and shared objectives, as well as on methods that support the integration of diverse forms of knowledge.

These processes are strengthened by inclusive participation, attention to power relations, and skilled facilitation (Djenontin & Meadow, 2018). Tools play a critical role in operationalizing these conditions, as they structure dialogue, shape whose knowledge becomes visible, and influence how meaning is negotiated across epistemic and social boundaries (Gray et al., 2018; Krueger et al., 2016; Paul et al., 2018). When embedded in intentional facilitation and governance processes, participatory tools also function as communicative infrastructures that enable meaningful knowledge exchange and collective learning.

Local Long-Term Impacts

Multiple sources emphasize that one of the most important outcomes of TDR is shifts in stakeholder and policy understandings that enhance mutual learning and the initiation of transformative social processes, rather than traditional academic metrics. The capacity of local actors to self-organize and govern shared resources is considered a core objective rather than a secondary outcome (Alatorre, 2021; Kaiser & Gluckman, 2023; Streck, 2020). Achieving such impacts depends on processes that integrate diverse forms of knowledge, foster sustained interaction among stakeholders beyond project periods, and support the co-design of context-specific strategies and outputs (Djenontin & Meadow, 2018).

Transdisciplinary scholarship emphasizes long-term impact as an end of TDR (Lang et al., 2012; Merçon, 2021), which requires mechanisms and design principles such as early institutional embedding, local use and ownership of data and agendas, polycentric linkages, and power-aware facilitation rather than generalized claims about durable governance outcomes. Building on this perspective, communication is conceptualized as a central mechanism through which TDR tools enable co-production and shape their potential for sustained, locally grounded change.

The growing interest in the practice of TDR in Latin America requires greater responsibility (Merçon, 2021). Transdisciplinarity and other participatory approaches are often used to legitimize external agendas and perpetuate exploitative relationships in academic circles (Streck, 2020). The premise of this research is that by better understanding how TDR tools create the conditions for effective communication, collaboration for the co-production of knowledge, and long-term capacity-building, Latin American researchers can make better decisions when selecting and designing their tools and methods.

Methodology

Based on the research tools repository currently being developed by the Network for Participatory Research in Latin America (Red de Investigación Participativa en América Latina, Red IPAL in Spanish), this study applies two analytical approaches: (i) Characterization of the tools contained in the repository (Table 1); and (ii) Evaluation of whether or not those tools provide the conditions necessary to attain three key transdisciplinary principles.

Repository of research tools

The research tools repository developed by Red IPAL, available at <https://redipal.org/repositorio/>, was populated by members of the Red IPAL. A call to contribute to the repository was distributed via email from May 10th 2023 to October 7th 2024, using a form with 13 questions (Annex 1). This resulted in 15 entries.

The map in Figure 2 shows the locations where each tool has been applied across Latin America. The web version of the map contains descriptive information and links to associated case studies or publications. The tools in the repository have been used in one or more transdisciplinary projects conducted by members of Red IPAL and have been reported in documents as part of the methods or tools applied in workshops, interventions, or semi-structured interviews. The contexts in which the tools were implemented were described in the publications shared by the contributors but were not included in this study, because each studied tool can be applied to different contexts.

Even though “methods” are regarded as the procedures used to attain the goals of research, and “tools” as the instruments used to develop such procedures, academics often use these terms interchangeably. In this research, all instruments and procedures are referred to as tools.

- 1. Rurality Index
- 2. Economic Games for Collective Action
- 3. Q Method
- 4. Collaborative Video
- 5. Net-Map
- 6. Geodesign
- 7. Shared Stories
- 8. Simos Pack of Cards
- 9. Process Net-Map
- 10. Community Water Counter-Mapping
- 11. Serious Board Games
- 12. Landscapes and Bees Game
- 13. Photo-Voice
- 14. Future’s Collage
- 15. Knowledges Dialogue



Figure 2. Locations where each research tool has been used by researchers who contributed to the repository. Source: Red IPAL

The information contained in the database was directly extracted from the intake questionnaire (Annex 1). Most tools are accompanied by a publication explaining the case in which the contributor applied the tool. Those publications were used as ancillary data for this analysis.

Table 1. List of the 15 research tools contained in the repository

Tool (ID)	Description
Rurality Index (1)	Quantitative rurality index used for zoning and territorial planning.
Economic Games for Collective Action (2)	Workshop-based economic games for watershed collective governance.
Q Method (3)	Opinion-sorting method to map shared and divergent viewpoints.

Tool (ID)	Description
Collaborative Video (4)	Co-produced video documenting community experiences and struggles.
Net-Map (5)	Participatory mapping of actor networks and power relations.
Geodesign (6)	Scenario-building with geospatial models for territorial planning.
Shared Stories (7)	Collective construction of timelines of past events.
Simos Pack of Cards (8)	Card-based tool to prioritize options or scenarios.
Process Net-Map (9)	Process-focused variant of Net-Map, mapping steps rather than static networks.
Community Water Counter-Mapping (10)	Community-led mapping and monitoring of water quality.
Serious Board Games (11)	Board games about territorial management and product exchange.
Landscapes and Bees Game (12)	Board game on agroecosystems and pollinators interactions at the landscape level.
Photo-Voice (13)	Photo-based tool for documenting and discussing local realities.
Future's Collage (14)	Collective construction of desired future scenarios.
Knowledges Dialogue (15)	Facilitated dialogue to weave diverse knowledge on water and conservation.

Source: Authors

Research problems in transdisciplinary projects vary in complexity and given the context, goals, and actors' capacities, not all studies enable the engagement of the participant communities in all stages of the research process. It is because of this that social spaces where actors with limited overlap in access to expertise, require facilitators and boundary objects to help communicate and interpret information to allow for the exchange of knowledge across domains (Stange et al., 2016). This influences the role and involvement of actors in each particular case.

Thus, this study examined what opportunities and spaces of participation each tool offered, and what roles were assigned to the participants rather than evaluating

whether a given tool produced equitable participation or created a genuinely relational and political space of interaction. The authors evaluated and discussed how each tool appeared to allow the engagement of non-research participants, and what kind of communicative and collaborative interactions between them and the researchers or facilitators they appeared to support. This analysis can address the question of how much involvement non-research participants may have in the use of any given tool. It cannot, however, answer whether such involvement was equitable, empowering, or transformative in a specific empirical setting. The concept of participation, as used in this research, is oriented toward assessing how much each tool helps to promote participation, rather than measuring meaningful participation as an achieved outcome.

Characterization of the tools

The process that guided the analysis for the characterization of the studied tools, and that led to the identification of patterns, gradients, and emergent typologies, drew on the methodology used by Ratajczyk et al. (2016) and was performed as an iterative three-stage process for the qualitative analysis and peer-review of documents. First, the authors selected eight categories of analysis (Table 2) based on the literature of transdisciplinary studies in Latin America. These categories relate to elements emphasized across transdisciplinary scholarship, such as: who participates and in which roles, how context is framed, which technologies and media are mobilized, how languages and symbols are used, how dialogue is facilitated, what kinds of outcomes are produced, and what training is required for implementation.

Table 2. Categories and scope of analysis

Category	Scope	Sources
Actors and roles	Identify the type(s) of actors the tool is aimed at, including their roles and degree of participation	Bernstein, 2015; Hahn et al., 2023
Context of application	Describe the geographic or sociopolitical context of the cases in which the tool has been applied	Schneider et al., 2022; Streck, 2020
Technologies used	Describe the technologies or instruments required for the tool to function	Escobar, 2018

Category	Scope	Sources
Means of communication	Describe the means of communication used to convey messages and exchange information	Ayala-Orozco et al., 2018; Orué Pozzo, 2021
Language and symbols	Describe the language, symbols, icons, and other forms of communication (e.g., colors, tokens, coins, numbers, etc.)	Mauser, 2013; Merçon, 2021
Facilitation of dialogue and information exchange	Describe the mechanisms the tool uses to transmit information and promote dialogue and cooperation	Alatorre et al., 2016; Ayala-Orozco et al., 2018; Alatorre, 2021; Merçon et al., 2018; Merçon, 2021; Hensler et al., 2024
Training required	Determine the type of training required to guide the tool's activities	O'Donovan et al., 2021; Kaiser & Gluckman, 2023
Outcomes and their applications or impacts	Identify the outcomes or products and their potential future applications or impact	Kaiser & Gluckman, 2023

Source: Authors

Each author then reviewed the tools in the repository, as well as complementary documents, and documented how each category applied to each tool. Following this individual assessment, the authors compared their notes and held a discussion to resolve discrepancies and reached agreement on a shared description of the tools by category. Throughout this process, the authors discussed the level of participation that each tool allowed based on how engaged the participants were in the use of each tool.

Evaluation of the tools

The evaluation of the tools was performed based on the results of the characterization, rather than on each tool individually. Questions such as the ways in which the tools in the repository offer the needed conditions to attain effective

communication, co-production, and long-term impacts, were discussed. The evaluation also included an analysis of what additional features make tools more desirable for their use in TDR, including attributes that have been found to be important to attain these principles.

Results

This section presents the comparative results of the analysis for the characterization of the 15 research tools in the repository. The eight analytic categories capture distinct aspects of how each tool is designed and implemented. The richest and most comparable information across tools comes from the categories: means of communication, language and symbols, and facilitation, all direct proxies of how communication takes place within a tool. The categories of outcomes, training, context, and technologies had fewer data in the database.

Table 3 summarizes these results under four themes: Main communication forms, which specifies media or formats the tool communicates information; Reported users and roles, that accounts for the actors involved and their roles; Participation and dialogue, which shows the degree and quality of engagement in the implementation of the tool by the non-academic participants, and whether there was meaningful exchange of information, negotiation, and co-production; and Outcomes and longer-term use, that refers to the products or results generated by each tool and their possible future use.

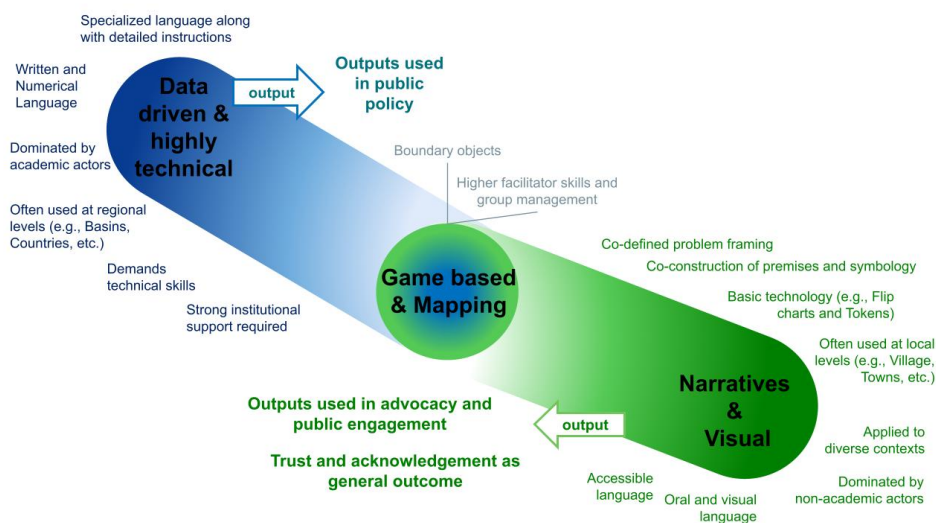


Figure 3. Gradient model of participatory research tools (Source: Authors)

Figure 3 shows how the fifteen tools are arrayed along a spectrum—taking into account gradients or degrees of the variables under consideration—forming groups within that spectrum. For example, tools are grouped around highly technical, data-driven instruments, such as the Rurality Index, to a second group based on strongly narrative tools, such as Collaborative Video, Photo-Voice, Shared Stories, and Knowledges Dialogue. A third group consists of game-based and mapping tools, such as Net-Map, Process Net-Map, Economic Games for Collective Action, Serious Board Games, Landscapes and Bees Game, Simos Pack of Cards, Future's Collage, and Community Water Counter-Mapping, that combine structured interaction among participants with material and visual instruments.

Table 3. Results

Tool ID	Main communication forms	Reported users & roles	Participation & dialogue	Outcomes & longer-term use
1	Numerical indicators; tabular outputs.	Researchers, civil society, and government as data subjects or end users.	Low direct participation; dialogue depends on how results are later shared.	Clear diagnostic outputs for planning, but limited evidence of participatory co-interpretation.
2	Oral discussion, maps, colored cards, game boards.	Policy makers, water users, NGOs, local authorities, facilitators.	High, structured participation; strong facilitation of dialogue, negotiation, and feedback.	Co-produced agreements, action plans, and monitoring frameworks; potential to strengthen trust and collective governance.
3	Written “statements”, sorting grids, statistical clustering.	Researchers as designers/analysts; heterogeneous participants as respondents.	Medium participation during sorting; communication quality depends on how results are returned to participants.	Detailed maps of perspectives that can inform dialogue, but few tangible products for communities.
4	Visual and oral narratives, filmed scenes, sound.	Community members as protagonists; filmmakers/researchers as facilitators.	High participation and strong dialogic potential during filming and viewing.	Audiovisual products that build visibility, alliances, and trust; long-term impact depends on follow-up processes.
5	Tokens, drawings, stacked blocks, maps.	Diverse actors (community, NGOs, state) as co-analysts; facilitator guides process.	High, collective participation; the tool itself structures dialogue and reflection.	Network maps as boundary objects that support shared understanding, conflict identification, and debates around shared issues.
6	Interactive maps, GIS layers, simulations.	Experts in mapping plus stakeholders from multiple sectors.	Potentially high, but mediated by technical complexity and facilitation skills.	Spatial scenarios for decision-making: strong policy connection when well facilitated, but high training demands.
7	Written and visual timelines on paper or boards.	Local organizations and community members.	High, inclusive participation around shared memories.	Historical timelines that document context and can feed later planning, though links to decisions are often indirect.

Tool ID	Main communication forms	Reported users & roles	Participation & dialogue	Outcomes & longer-term use
8	Visual cards, rankings, group discussion.	Decision-makers, students, or mixed groups.	Medium participation; exchange mainly among those present in the workshop.	Prioritized options and clearer positions; limited information on how results travel beyond the group.
9	Stepwise process maps, tokens, narratives.	Government, NGOs, civil society involved in a specific process.	High, especially for clarifying responsibilities and bottlenecks.	Shared process maps that clarify pathways and obstacles, supporting implementation and monitoring.
10	Maps, qualitative descriptions, water-quality data.	Local communities, grassroots leaders, researchers.	High within communities; less clear how results are communicated to external actors.	Joint diagnosis of contamination, co-produced solutions, and resistance strategies; synthesis across knowledge systems remains a challenge.
11	Boards, tokens, rules, facilitated discussions.	Indigenous communities and agencies involved in territorial governance.	High participation but often limited diversity of actor types.	Insights into decision logics and trade-offs; products mostly experiential rather than documents.
12	Cards, images, game boards.	Farmers, communities, and researchers.	High, discursive engagement and reflection on shared problems.	Collective learning about landscape–pollinator relations; limited evidence of follow-up actions.
13	Photographs with oral or written captions.	Community members as photographers; researchers as facilitators.	High, especially for local actors; participation of external actors is less documented.	Visual narratives that spark dialogue and can influence agendas when connected to broader forums.
14	Collages, images, keywords on boards.	Diverse stakeholders, often in exploratory or educational contexts.	High, playful participation and co-creation of visions.	Tangible visualizations of shared futures; need for stronger links to planning processes.
15	Oral dialogue, written notes, simple visual supports.	Rural communities, water boards, local authorities, researchers.	High, especially within communities; effectiveness of cross-actor synthesis is less explicit.	Co-produced problem framings and possible solutions; post-dialogue trajectories are not well documented.

Source: Author

Actors, roles, and participation patterns

Across the tools, actors include a wide array of stakeholders: rural and peri-urban civil society, Indigenous peoples, and “*campesino*” peasant communities, urban youth, government agencies at local, regional, and national scales, NGOs, private-sector actors, and academic researchers. In more technical tools such as the Rurality Index and Q Method, researchers play a central role as designers and analysts, while non-academic actors participate primarily as data providers or respondents, with limited involvement in defining questions or interpreting results. By contrast, in tools such as Economic Games for Collective Action, Net-Map, Process Net-Map, Community Water Counter-Mapping, the multiple applications of games, Photo-Voice, Shared Stories, Future’s Collage, and Knowledges Dialogue, community members and other non-academic actors participate actively in generating content, shaping discussions, and constructing shared products.

The analysis also shows that high participation does not always translate into a high diversity of actors. Some tools, particularly game-based ones used in specific local settings, involve intensive participation within relatively homogeneous groups, which can limit the integration of multiple institutional perspectives, even as community voices are strongly present. Conversely, tools such as Economic Games for Collective Action and Geodesign explicitly bring together heterogeneous actors (policymakers, water users, technical agencies, and community organizations), thereby creating opportunities for cross-sector dialogue, though the quality of that dialogue and participation depends on facilitation and on how technical elements are presented. Overall, the evidence suggests that participation and communication “go hand in hand”: whenever a tool or facilitator enables broader involvement of diverse actors, it becomes more feasible to build dialogue in varied spaces that support the exchange of ideas.

Contexts of application and the limits of contextual information

Most tools report the geographic or institutional scales at which they have been used, for example, watersheds, regions, communities, specific rural–urban frontiers, or national-level planning contexts, but seldom provide a thick description of sociopolitical conditions or the characteristics and composition of the team. The Rurality Index, for instance, is applied in Amazonian rural and peri-urban territories for land-use planning and conservation, while Community Water Counter-Mapping focuses on community water governance, and Geodesign is presented as applicable to a wide range of territorial planning situations. However, information about power relations, histories of conflict, or pre-existing organizational trajectories, which are critical for understanding how context shapes communication and co-production, is generally sparse and only found in the ancillary data.

In the analysis, the category “Context of application” is therefore treated as a weak proxy, useful mainly to signal scale (e.g., basin, country, community) and broad thematic domain (e.g., land-use planning, agro-food systems, water quality) rather than as a robust descriptor of enabling or constraining conditions for the application of the tool. The analysis suggests that it is important for researchers to delve into the contextual aspects of the territories they include in their transdisciplinary projects to better choose their tools and adapt their tools to specific sociopolitical and cultural settings.

Technologies, media, and the complexity of tools

The category “Technologies used” overlaps conceptually with “Means of communication” and “Language and symbols.” The tools employ a wide range of technologies, from basic materials such as flipcharts, cards, tokens, hand-drawn maps, and cameras, to more complex infrastructures such as GIS platforms, specialized software (e.g., Geodesignhub, PQMethod).

In many cases, technologies matter less as communication devices between researchers and participants, and more as part of a broader communication sphere in which participants engage with wider publics through films, maps, or digital platforms. Overall, the analysis shows that technology affects TDR by either lowering or raising barriers to participation.

An important pattern emerging is that tools relying on simple, low-tech materials, such as Net-Map, Process Net-Map, Shared Stories, some game-based tools, Photo-Voice, and Knowledges Dialogue, tend to be associated with higher levels of participation and more equitable distribution of roles during implementation. Tools that demand sophisticated technologies or advanced analytical skills, such as the Rurality Index, Q Method, Geodesign, or instrumented water monitoring, can still be participatory but generally require more intensive facilitation and training for both researchers and participants.

Means of communication, language, and symbols

All tools draw on one or more of three basic means of communication: oral, visual, and written. Tools oriented toward collective workshops and narrative co-production (such as Economic Games for Collective Action, Net-Map, Process Net-Map, Collaborative Video, Photo-Voice, Shared Stories, Future’s Collage, and Knowledges Dialogue) systematically combine oral dialogue with visual supports (maps, images, diagrams, timelines, collages), and only secondarily rely on written

language. In contrast, tools such as the Rurality Index, Geodesign, and Q Method rely heavily on written and numerical forms, with visual representations (tables, graphs, factor plots) primarily designed for analytic purposes rather than for participatory communication.

Several tools exhibit explicit co-created symbolic systems, especially those grounded in social cartography. Net-Map and Process Net-Map employ icons, color codes, and stacked blocks to represent actors, influence levels, and relationships, transforming complex social dynamics into boundary objects that participants can manipulate and collectively interpret. Boundary objects are artifacts that participants and researchers can look at (e.g., photos or maps) or listen to (e.g., oral narrations or voice recordings) together and discuss, even if they come from different knowledge systems. Community Water Counter-Mapping, Photo-Voice, and Collaborative Video create symbolic representations of territory and everyday life, through images, stories, and sound, that carry strong cultural and affective meanings and help reduce noise between emitters and receivers. In some tools, such as games and mapping exercises, languages and symbols are progressively constructed during workshops, allowing participants to embed their own categories and metaphors rather than merely decode pre-given technical terminology.

Tools such as Rurality Index, Geodesign, Community Water Counter-Mapping, and some card-based prioritization methods use technical language without clearly explaining how concepts are communicated or translated for non-researchers. Specialized terms and mathematical language may remain challenging to understand unless facilitators deliberately adapt them. In this way, an association was inferred between the complexity of any given tool and the number of steps required to execute it, as well as the prevalence of technical language. More complex tools tend to use more specialized terminology, which makes them harder to access.

Facilitation of dialogue and information exchange

One of the clearest cross-cutting findings is that all tools, regardless of their technical sophistication, require facilitation, and that the quality of facilitation strongly conditions their effectiveness as communication instruments. In tools such as Economic Games, Net-Map, Process Net-Map, Collaborative Video, Photo-Voice, Shared Stories, Future's Collage, and Knowledges Dialogue, facilitation is explicitly described as guiding dialogue, managing group dynamics, and mediating power imbalances, often through detailed instructions, step-by-step guides, or complementary methods. These tools often include spaces for feedback, collective reflection, and iterative discussion, making facilitation integral to the design rather than an add-on.

In contrast, some tools provide little information about how facilitation should occur, even though it is necessary in practice. The Rurality Index, certain water-

related tools' protocols, and some card-based prioritization tools, for example, mention workshops or presentations but do not specify how discussion is structured, how participants' voices are incorporated, or how conflicts are navigated. The comparative discussion underscores that success as an instrument for effective communication often rests on the facilitator's skills in active listening, boundary work, and dialogue mediation, attributes that are rarely captured in tool descriptions.

Training requirements and implications for accessibility

The category "Training required by facilitators" suggests marked differences in the level and nature of competencies needed to implement each tool. Highly technical tools such as the Rurality Index, Q Method, Geodesign, and instrumented water management tools demand substantial training in quantitative methods, specialized software, and, in some cases, domain-specific knowledge of environmental or planning systems. Game-based tools such as Economic Games for Collective Action and Landscapes and Bees Games require facilitators who understand game theory, public policy, or specific sectors (e.g., water governance, agriculture), and who can manage diverse groups and navigate power asymmetries.

By contrast, tools such as Photo-Voice, Collaborative Video, Shared Stories, Future's Collage, and some dialogue-based tools can be implemented with relatively modest methodological training, although they still require strong interpersonal and facilitation skills. The matrices note that community members can often carry out key steps, such as taking photographs, recording stories, and contributing to timelines or collages, without formal training, thereby enhancing accessibility and ownership. This contrast suggests that simpler, low-tech tools may be better suited for broad replication under resource constraints and lack of training, while more complex tools may be reserved for settings with stronger institutional support and technical capacity.

Outcomes, boundary objects, and hints of long-term effects

Across tools, the category "Outcomes and their applications or impacts" shows that many generate tangible products that serve as boundary objects. These products include indices, network maps, process maps, participatory spatial plans, water-quality maps, audiovisual documentaries, photo narratives, timelines, collages of shared visions, prioritized action lists, and co-produced agreements and strategies, among others. Such objects often serve as shared reference points that participants can revisit, use in negotiations, or mobilize in advocacy and policy processes, even if the tools' descriptions do not always document these downstream pathways in detail.

A recurrent by-product noted across many tools is the strengthening of trust and mutual recognition among participants. Although trust is seldom stated as an explicit objective in tool descriptions, the implementation of tools such as Economic Games for Collective Action, Landscapes and Bees Game, Net-Map, Collaborative Video, Photo-Voice, Community Water Counter-Mapping, and Knowledges Dialogue frequently leads to new alliances, greater comfort in sharing experiences, and improved understanding of others' roles and constraints. In some cases, trust is also identified as a precondition for tool implementation. Collaborative Video in remote communities, for instance, builds on prior relationships to enable intimate storytelling.

However, systematic evidence of long-term impacts, such as sustained changes in governance arrangements, policy uptake, or community self-organization, is generally limited in the repository entries. Some tools clearly generate inputs for policy processes (e.g., Economic Games for Collective Action, Geodesign, Community Water Counter-Mapping, and rurality indices), and others produce narratives and visual materials that can support advocacy and public engagement, but the documentation typically stops at the moment of tool application or immediate outputs. The analysis thus concludes that while many tools have strong potential to contribute to long-term capacity and collective action, the current evidence base only allows for cautious, indirect inferences about those effects.

Discussion

Based on the information obtained from the characterization, it was found that the studied tools exhibit distinct attributes related to communication, co-production, and long-term outcomes. The evaluation of the tools starts with a reflection on these attributes and their relation to the conditions that precede each principle.

Effective Communication

Effective communication, as a core principle of TDR (Schaffner et al., 2025), depends on several conditions including clear understanding of the sociopolitical context, the collective definition of the research problem, knowledge integration supported by adequate research tools, and skilled facilitators capable of bridging cultural and political divides, ensuring equitable participation, and creating an environment conducive to cooperative boundary work. The analysis of the 15 tools shows that not all of these conditions are always met, but can be partially met because of distinctive characteristics of these tools. No single tool provides all the necessary conditions for effective communication; rather, each tool offers particular advantages and limitations.

In this study, tools that facilitate the co-definition of the problem treat the problem as emergent rather than predefined, particularly those that allow participants to negotiate categories in real time and enable the research problem to be reshaped during implementation. There are also tools that presuppose predefined variables, categories, and statements about the central research issue. When the framing of the research problem is fixed by methodological design, communication tends to revolve around interpreting an established structure rather than collectively shaping it. When the problem is not collectively framed from the beginning, the definition of the universe within which the research unfolds remains contested, giving rise to power relationships and governance issues (Norström et al., 2020).

Within the co-production and communication realm, some tools incorporated differentiated roles and promoted higher levels of engagement, leading to more balanced interactions. These tools often relied on low-tech materials such as cards, flipcharts, and tokens, suggesting that technological simplicity can lower communicative barriers. Since technologies influence communication by shaping the semiotic systems through which participants interpret and give meaning to reality, the type of technology used may imply a communication barrier. For example, mapping software operates through symbolic spatial language and typically requires cartographic literacy. In contrast, photographs and oral narratives rely on visual and oral languages that enable participation by actors with varying literacy levels. Although complex technologies do not inherently exclude participants, they can centralize control in technically skilled actors, shift influence toward data keepers and interpreters, and reduce transparency in decision-making processes, potentially affecting governance dynamics.

The effectiveness of communication depends heavily on mediator competencies. Skilled facilitators act as boundary actors by translating jargon, clarifying meanings, balancing power asymmetries, and supporting reflexivity, particularly in technically demanding methods. Tools that provide explicit facilitation protocols offer clearer communicative pathways, for example, Net-Map, Process Net-Map, and Simos Pack of Cards. By contrast, when facilitation guidance is absent, outcomes depend largely on the individual capacities of facilitators. In practice, boundary facilitation work includes translating specialized terminology, ensuring equitable expression of ideas, mediating conflicts, clarifying contested meanings, and fostering collective reflection (Stange et al., 2016). Thus, beyond technical skills, facilitators require soft skills, including assertiveness, attentive listening, and teamwork, as critical communicative capacities that amplify the effectiveness of any tool (Tschirhart et al., 2016). Without these competencies, even well-designed tools do not enable horizontal dialogue (Merçon, 2021).

Overall, the comparative analysis suggests that effective communication in TDR is not an inherent property of the studied participatory tools. It emerges when tools enable collective problem framing and that framing evolves over time. It is strengthened when shared boundary objects are co-created and collectively interpreted. Effective communication, therefore, is less a characteristic of individual tools and more the outcome of how tools are implemented within relational, epistemic, and political contexts.

Finally, one key function of effective communication within transdisciplinary work is its ability to address different types of questions (e.g., diagnostic, reflective, planning, decision-making). Depending on the research phase and specific needs, tools support different elements of communication in distinct ways. A tool for TDR not only aims to co-develop knowledge from the early stages of the research but also enables it to respond to questions posed by different groups of actors and find ways to disseminate, thereby serving as a pathway to communicate common concerns.

Co-Production of Knowledge

Empirical work shows that TDR tools prioritizing accessibility and peer-to-peer exchange often travel farther and resonate more strongly in practice in transdisciplinary communities of practice. Low-tech visuals, such as hand-drawn diagrams, may outperform more complex information and communication technologies, as community members are often more receptive to messages and solutions shared by peers. In this way, informal, long-term relational and organizational environments that existed behind a formal TDR project are strengthened (O'Donovan et al., 2021). Knowledge integration tends to support more organic forms of knowledge co-production, and this is highly dependent on facilitation. Facilitation skills play an important role in active listening, dialogue mediation, and trust-building, as they serve as bridges among stakeholders operating from distinct social, institutional, and epistemic contexts (Snorek & Bolger, 2022). Thus, trust and co-production could emerge as outcomes of collaboration during the use of TDR tools, which, in turn, have the potential to shape the depth and quality of knowledge integration, like in the Shared Stories, Collaborative Video, Knowledges Dialogue, and Future's Collage.

Tools such as game-based tools, Future's Collage, and Geodesign enable facilitators to translate complex language and abstract systems into accessible representations, facilitating the co-creation of boundary objects. This co-construction in turn makes it possible for experiential knowledge to coexist with formal analytical reasoning (Hensler et al., 2024; Merçon, 2021). In contrast, tools involving geospatial modeling or statistical analysis, such as the Rurality Index, Q Method, or Simos Pack of Cards, information integration is often completed by researchers rather than through interaction between researchers and non-researchers. When participants are not

involved in interpreting outputs, integration risks becoming a process of knowledge extraction rather than co-creation (Lang et al., 2012), and it demands great care and clear ethics. In such cases, co-production may be participatory at the data-collection stage but risks becoming unidirectional during the interpretation of the information.

Achieving meaningful co-production means that transdisciplinary tools create conditions to collectively share, transfer, and translate experiences and knowledge without requiring full epistemic consensus. However, their effectiveness depends on technical design, facilitation practices, and implementation strategies that together structure dialogue and guide how meanings are negotiated (Pohl et al., 2010). At the project level, tools enable co-production to build interactional expertise across groups, materialize boundary objects, and support bidirectional translation between societal needs and research agendas (Mausser et al., 2013; Stange et al., 2016).

TDR tools also operate as shared reference points. For example, Community Water Counter-Mapping, Geodesign, Future's Collage, or Serious Board Games mediate interaction across disciplinary and knowledge boundaries while maintaining interpretive flexibility. Other empirical studies show that GIS maps can be used as boundary objects to enhance communicative inclusion. For instance, they enable Indigenous and local knowledge to be articulated during decision-making processes (Shaw & Lind, 2022). When tools employed in knowledge co-production enhance credibility, salience, and legitimacy, they are more likely to sustain dialogue that promotes meaningful outcomes, which, in turn, could be used for decision making, to strengthen advocacy, or as policy inputs (Andrews et al., 2024; Steger et al., 2018).

Despite this, the literature raises critical concerns regarding the use of transdisciplinary tools. Projects are not always perceived as genuinely participatory, and tools often fail to integrate stakeholders into key stages such as problem definition, project design, or data interpretation (Hahn et al., 2023). In some cases, tools are treated as ends in themselves, focused on obtaining data rather than as means for knowledge co-production. Therefore, it is important to ensure that TDR tools are guided by shared purposes, and that they are situated and adapted to contextual conditions. While game-based, mapping, and participatory modeling tools are widely recognized as powerful boundary objects and communication devices, researchers need to be mindful of their strengths and limitations. Though evidence suggests that by foregrounding communication as a form of collective sense-making, participatory modeling and role-playing games can enhance social learning, shared understanding, and deliberative quality (Matsumoto et al., 2022; Wesselow & Stoll-Kleemann, 2018), their success as TDR tools critically depends on the quality of facilitation, attention to power relations, and the alignment of tools with specific communicative and governance needs.

Long-Term Impacts

The information contained in the repository and ancillary data provide only a limited basis to assess the tools' long-term impacts. This is consistent with what the broader literature repeatedly flags: long-term impacts are treated as crucial but are only marginally documented (Danielsen et al., 2022; Gray et al., 2018).

In the repository, many tools plausibly enable knowledge integration at the moment, but the available evidence cannot reliably trace whether these integrations endure, diffuse into institutions, or stabilize into shared planning routines after the initiatives conclude. The same limitation applies to co-designed actions, because while some tools generate agreements, priorities, action plans, and monitoring frameworks that, in theory, could be embedded in governance processes, the repository rarely documents whether these outputs were adopted, iterated, or institutionalized once facilitation ended.

Regarding impacts on power distribution, the evidence in the repository is even more indirect. Trust is frequently mentioned as an emergent by-product of the interaction between actors, but entries do not systematically report who controlled aspects such as the tool's agenda-setting, indicator choice, scenario definition, or interpretation, nor whether participation translated into durable shifts in decision authority in water, land, or risk governance. This mirrors the review evidence that co-production can redistribute epistemic and sometimes procedural power when marginalized actors are engaged early and substantively, yet such gains are fragile and commonly blunted by persistent asymmetries or weak state responsiveness, with little long-term tracking of "who decides" outcomes (Brugnach & Özerol, 2019; Danielsen et al., 2022; Krueger et al., 2016).

Although there was considerable clarity regarding the products that each tool was expected to generate, the analysis suggests that these products may do more than serve as final outputs. They may also contribute to the evolution of dialogue among different types of actors and help improve trust, communication, and collaboration between researchers and non-researchers. Importantly, these observations raise the question of the extent to which the products generated through these tools improve living conditions or help resolve socio-ecological issues, and at what level this improvement occurs.

Additional findings

Context is central to understanding why and how transdisciplinary initiatives succeed and fail. The literature is very clear: there are no "off-the-shelf" transdisciplinary methods. In other words, the processes in which tools are used must

be co-designed with careful attention to the specific governance, socio-technical, and knowledge contexts (Danielsen et al., 2022; Gray et al., 2018; Krueger et al., 2016).

Consistent with findings reported by Gray et al. (2018) and Hedelin et al. (2021), the influence of context in the selection of tools for TDR processes is one of the biggest aspects to consider. Context is multi-layered and dynamic, power relations, conflicts, and coloniality are embedded in it (Brugnach & Özerol, 2019; Krueger et al., 2016), and thus, there is a real challenge in capturing enough of it without losing analytic tractability (Raschke et al., 2023). Attempts to systematize context run up against that complexity, but are nevertheless necessary for building a complete understanding of how TDR processes can be supported.

From this perspective, effective transdisciplinary communication depends on the deliberate design of horizontal, context-sensitive communicative strategies that support boundary crossing and mutual learning under conditions of asymmetry. Such strategies should address structural barriers to enable equitable participation.

Conclusions

The study of research tools used in transdisciplinary projects shows that the principles of effective communication, knowledge co-production, and long-term impacts take shape as the combined result of how these tools are designed, adapted, facilitated, and embedded within specific relational, epistemic, institutional, and political contexts. Tools in the Red IPAL's repository vary substantially in the degree to which they enable participant engagement, shared interpretation, collective problem framing, and the production of usable outputs.

The prevalence of information about communication devices and immediate products, rather than relationships, conflicts, organizational trajectories, and political transformations, reveals the tendency of repository records to emphasize methodological steps. It is important to incorporate rich descriptions of the sociopolitical conditions or power inequalities as well, given that they shape communication, and many contributions say little about how meanings are negotiated, which voices are included/excluded, or how alliances are sustained once the project ends.

Despite these limitations, these findings are important for elucidating the strengths and weaknesses of some TDR tools in practice in Latin America. First, they suggest that tools combining simple oral and visual media, co-created symbols, and tangible products that function as boundary objects, enabling clearer communication around shared concerns, can better facilitate horizontal communication and mutual recognition among heterogeneous actors. Second, they suggest that technological

complexity and specialized language can create barriers to participation if they are not accompanied by careful facilitation and deliberate translation strategies. Third, they underline that the promise of long-term impacts remains largely an informed hypothesis. Tools generate maps, indices, agreements, and narratives with high transformative potential, but the repository records only in a very fragmented way whether these inputs lead to sustained changes in governance or in local self-organization capacity.

Taken together, these results indicate that repositories are not a static inventory of instruments, but spaces under construction that reveal the advances and the gaps of TDR in the region. They contribute to making visible the communication patterns that cut across the tools and offer clues about how methodological design, facilitation, and media choices can foster knowledge co-production. At the same time, the identified gaps, especially in the description of contexts, usage trajectories, and post-project effects, point to concrete directions for strengthening available data: incorporating minimum criteria on context, participation in different phases, and impact follow-up, as well as reflective accounts from those who facilitate and use the tools. Deepening these dimensions will allow repositories to evolve into resources that not only catalog tools but also document, in greater depth, the conditions under which these tools effectively contribute to TDR principles in practice.

Acknowledgements

The authors acknowledge Red IPAL and its members for providing the information and materials that built the repository.

References

- Alatorre, G. (2021). Juntos desde la diferencia para cuidar lo común. Aprendizajes de la investigación-acción participativa transdisciplinaria. In J. Merçon (Ed.), *Investigación transdisciplinaria e investigación-acción participativa: Conocimiento y acción para la transformación* (pp. 189–199). Ciudad de México: CopIt-arXives y Red de Socioecosistemas y Sustentabilidad, Conacyt, serie Construyendo lo Común, núm. 2.
- Alatorre, G., Merçon, J., Bueno, I., Ayala-Orozco, B., & Lobato, A. (2016). Para construir lo común entre los diferentes. Guía para la colaboración intersectorial hacia la sustentabilidad. Red de Socioecosistemas y Sustentabilidad (RedSocioecoS), Consejo Nacional de Ciencia y Tecnología (Conacyt).
- Andrews, L. M., Munaretto, S., Mees, H. L. P. & Driessen, P. P. J. (2024). Conceptualising boundary work activities to enhance credible, salient and legitimate knowledge in sustainability transdisciplinary research projects. *Environmental Science & Policy*, 155, 103722. <https://doi.org/10.1016/j.envsci.2024.103722>

Ayala-Orozco, B., Rosell, J. A., Merçon, J., Bueno, I., Alatorre-Frenk, G., Langle-Flores, A., & Lobato, A. (2018). Challenges and Strategies in Place-Based Multi-Stakeholder Collaboration for Sustainability: Learning from Experiences in the Global South. *Sustainability*, 10(9), 3217. <https://doi.org/10.3390/su10093217>

Bartels, W. L., & Furman, C. A. (2023). Building Community for Participatory Modeling: Network Composition, Trust, and Adaptive Process Design. *Society & Natural Resources*, 36(3), 326–346. <https://doi.org/10.1080/08941920.2023.2177916>

Bernstein, J. H. (2015). Transdisciplinarity: A review of its origins, development, and current issues. *Journal of Research Practice*, 11(1)

Brugnach, M. & Özerol, G. (2019). Knowledge Co-Production and Transdisciplinarity: Opening Pandora's Box. *Water*. <https://doi.org/10.3390/w1101997>

Danielsen, F., Eicken, H., Funder, M., Johnson, N., Lee, O., Theilade, I., Argyriou, D. & Burgess, N. (2022). Community Monitoring of Natural Resource Systems and the Environment. *Annual Review of Environment and Resources*. <https://doi.org/10.1146/annurev-environ-012220-022325>

Djenontin, I.N.S. & Meadow, A.M. (2018). The art of co-production of knowledge in environmental sciences and management: lessons from international practice. *Environmental Management* 61, 885–903. <https://doi.org/10.1007/s00267-018-1028-3>

Escobar, A. (2018). Designs for the pluriverse: Radical interdependence, autonomy, and the making of worlds. Duke University Press.

Garcia R. (2011). Interdisciplinarietà y sistemas complejos. *Revista Latinoamericana de Metodología de las Ciencias Sociales*. 1(1) 66-101.

Gray, S., Voinov, A., Paolisso, M., Jordan, R., BenDor, T., Bommel, P., Glynn, P., Hedelin, B., Hubacek, K., Introne, J., Kolagani, N., Laursen, B., Prell, C., Olabisi, L. S., Singer, A., Sterling, E., & Zellner, M. (2018). Purpose, processes, partnerships, and products: Four Ps to advance participatory socio-environmental modeling. *Ecological Applications*, 28(1), 46-61. <https://doi.org/10.1002/eap.1627>

Hahn, A., Kirschke, S., Caucci, S., Müller, A., Benavides, L., & Avellán, T. (2023). Perceptions of transdisciplinary research—A comparative case study from Latin America. *Current Research in Environmental Sustainability*, 5, 100207. <https://doi.org/10.1016/j.crsust.2022.100207>

Harris, F., Lyon, F., Sioen, G. B., & Ebi, K. L. (2024). Working with the tensions of transdisciplinary research: a review and agenda for the future of knowledge co-production in the Anthropocene. *Global Sustainability*, 7, e13. doi:10.1017/sus.2024.11

Hedelin, B., Gray, S., Woehlke, S., BenDor, T., Singer, A., Jordan, R., Zellner, M., Giabbanelli, P., Glynn, P., Jenni, K., Jetter, A. J., Kolagani, N., Laursen, B., Leong, K. M., Olabisi, L. S. & Sterling, E. (2021). What's left before participatory modeling can fully support real-world environmental planning processes: A case study review. *Environmental Modelling & Software*, 143, 105073–105073. <https://doi.org/10.1016/j.envsoft.2021.105073>

Hensler, L., Hernández-Hernández, C. N. A., Molina-Rosales, D., Mesa-Jurado, M. A., & Merçon, J. (Eds.). (2024). Investigación colaborativa desde la diversidad: Entretejiendo experiencias y reflexiones en la frontera sur de México. CopIt-arXives y Red de Socioecosistemas y Sustentabilidad, Consejo Nacional de Ciencia y Tecnología (Conacyt). <https://copitarxives.fisica.unam.mx>

Kaiser, M., & Gluckman, P. (2023). Looking at the future of transdisciplinary research: Discussion paper. *Centre for Science Futures, International Science Council*. <https://doi.org/10.24948/2023.05>

Krueger, T., Maynard, C. M., Carr, G., Bruns, A., Mueller, E., & Lane, S. (2016). A transdisciplinary account of water research. *Wiley Interdisciplinary Reviews: Water*, 3, 369–389–369–389. <https://doi.org/10.1002/wat2.1132>

Lang, D. J., Wiek, A., Bergmann, M., Stauffacher, M., Martens, P., Moll, P., Swilling, M., & Thomas, C. J. (2012). Transdisciplinary research in sustainability science: practice, principles, and challenges. *Sustainability Science*, 7, 25–43. <https://doi.org/10.1007/s11625-011-0149-x>

Mausser, W., Klepper, G., Rice, M., Schmalzbauer, B. S., Hackmann, H., Leemans, R., & Moore, H. (2013). Transdisciplinary global change research: The co-creation of knowledge for sustainability. *Current Opinion in Environmental Sustainability*, 5(3–4), 420–431. <https://doi.org/10.1016/j.cosust.2013.07.001>

Merçon, J. (Ed.). (2021). Investigación transdisciplinaria e investigación-acción participativa: Conocimiento y acción para la transformación. CopIt-arXives y Red de Socioecosistemas y Sustentabilidad, Consejo Nacional de Ciencia y Tecnología (Conacyt). <https://copitarxives.fisica.unam.mx>

Merçon, J., Rosell, J. A., Ayala-Orozco, B., Bueno, I., Lobato, A., & Alatorre-Frenk, G. (2018). Colaboración transdisciplinaria para la sustentabilidad en México: Principales retos y estrategias. In B. Ayala-Orozco & J. A. Rosell (Eds.), *Experiencias de colaboración transdisciplinaria para la sustentabilidad* (pp. 17–48). CopIt-arXives y Red de Socioecosistemas y Sustentabilidad, Consejo Nacional de Ciencia y Tecnología (Conacyt).

Matsumoto, Y., Kasamatsu, H., & Sakakibara, M. (2022). Challenges in Forming Transdisciplinary Communities of Practice for Solving Environmental Problems in Developing Countries. *World Futures*, 78(8), 546–565. <https://doi.org/10.1080/02604027.2021.2012878>

Norström, A.V., Christopher Cvitanovic, Marie F Löf, Simon West, Carina Wyborn, Patricia Balvanera, Angela T Bednarek, Elena M Bennett, Reinette Biggs, Ariane de Bremond, Bruce M Campbell, Josep G Canadell, Stephen R Carpenter, Carl Folke, Elizabeth A Fulton, Owen Gaffney, Stefan Gelcich, Jean Baptiste Jouffray, Melissa Leach, Martin Le Tissier, Berta Martín López, Elena Louder, Marie France Loutre, Alison M Meadow, Harini Nagendra, Davnah Payne, Garry D Peterson, Belinda Reyers, Robert Scholes, Chinwe Ifejika Speranza, Marja Spiereburg, Mark Stafford Smith, Maria Tengö, Sandra van der Hel, Ingrid van Putten, & Henrik Österblom. (2020). Principles for knowledge co-production in sustainability research. *Nature Sustainability* 3, 182–190. <https://doi.org/10.1038/s41893-019-0448-2>

O'Donovan, C., Michalec, A. (Ola) & Moon, J. R. (2021). Capabilities for transdisciplinary research. *Research Evaluation*, 31(1), 145–158. <https://doi.org/10.1093/reseval/rvab038>

Orué Pozzo, A. (2021). Thinking about Communication from the Global South. Subjectivities Construction in Latin America: An Overview. In A. C. Suzina (Ed.), *The Evolution of Popular Communication in Latin America*. Palgrave Studies in Communication for Social Change. Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-030-62557-3_2

Paul, J. D., Buytaert, W., Allen, S., Ballesteros-Cánovas, J. A., Bhusal, J., Cieslik, K., Clark, J., Dugar, S., Hannah, D. M., Stoffel, M., Dewulf, A., Dhital, M. R., Liu, W., Nayaval, J. L., Neupane, B., Schiller, A., Smith, P. J., & Supper, R. (2018). Citizen science for hydrological risk reduction and resilience building. *Wiley Interdisciplinary Reviews: Water*, 5(1), e1262. <https://doi.org/10.1002/wat2.1262>

Pohl, C., Rist, S., Zimmermann, A., Fry, P., Gurung, G. S., Schneider, F., Speranza, C. I., Kiteme, B., Boillat, S., Serrano, E., Hadorn, G. H., & Wiesmann, U. (2010). Researchers' roles in knowledge co-production: Experience from sustainability research in Kenya, Switzerland, Bolivia and Nepal. *Science and Public Policy*, 37(4), 267–281. <https://doi.org/10.3152/030234210X496628>

Raschke, A. B., Cockburn, J., Cisneros, P., Ocampo-Melgar, A., Schoon, M., Kelman, C. C. & Srinivasan, J. (2023). Learning from sticky variables in cross-case analyses of collaboration in social-ecological systems. *Ecosystems and People*, 19(1), 2187639. <https://doi.org/10.1080/26395916.2023.2187639>

Ratajczyk, E., Brady, U., Baggio, J. A., Barnett, A., Perez-Ibarra, I., Rollins, N., Rubiños, C., Shin, H., Yu, D., Aggarwal, R., Anderies, J. M., & Janssen, M. A. (2016). Challenges and opportunities in coding the commons: Problems, procedures, and potential solutions in the coding of case studies. *International Journal of the Commons*, 10(2), 440–466. <https://doi.org/10.18352/ijc.652>

Schaffner, U., Rinkus, M. A., O'Rourke, M., Hall, T. E., Eschen, R., & Eigenbrode, S. D. (2025). Addressing communication challenges in transdisciplinary sustainability science: Insights from a case study. *Ecology and Society*, 30(3). <https://doi.org/10.5751/ES-16058-300338>

Schneider, F., Giger, M., Harari, N., Moser, S., Oberlack, C., Providoli, I., Schmid, L., Tribaldos, T. & Zimmermann, A. (2019). Transdisciplinary co-production of knowledge and sustainability transformations: Three generic mechanisms of impact generation. *Environmental Science & Policy*, 102, 26–35. <https://doi.org/10.1016/j.envsci.2019.08.017>

Schneider, F., Aymara Llanque-Zonta, Onintsoa Ravaka Andriamihaja, R. Ntsiva N. Andriatsitohaina, Aung Myin Tun, Kiteme Boniface, Johanna Jacobi, Enrico Celio, Clara Léonie Diebold, Laby Patrick, Phokham Latthachack, Jorge Claudio Llopis, Lara Lundsgaard-Hansen, Peter Messerli, Stellah Mukhovi, Nwe Nwe Tun, Zo Hasina Rabemananjara, Bruno Salomon Ramamonjisoa, Sithong Thongmanivong, Thouththone Vongvisouk, Daovorn Thongphanh, Win Myint & Julie Gwendolin Zaehringer (2022) How context affects transdisciplinary research: insights from Asia, Africa and Latin America. *Sustainability Sciences* 17, 2331–2345. <https://doi.org/10.1007/s11625-022-01201-3>

Shaw, J. & Lind, J. (2022). Researching Local Subjectivities in Contested Contexts: Using Intersecting Methodologies to Understand Large Green-Energy Projects in Kenya. *International Journal of Qualitative Methods*, 21. <https://doi.org/10.1177/16094069221120489>

Snorek, J. L., & Bolger D. T (2022). Can the center hold? Boundary actors and marginality in a community-based natural resource management network. *Ecology and Society* 27(3):41. <https://doi.org/10.5751/ES-13512-270341>

Stange K., van Leeuwen J. & van Tatenhove J (2016). Boundary spaces, objects and activities in mixed-actor knowledge production: making fishery management plans in collaboration. *Maritime studies*. 15:14. DOI 10.1186/s40152-016-0053-1

Steger C., Hirsch S., Evers C., Branoff B., Petrova M., Nielsen-Pincus M., Wardropper C. & van Riper C (2018). Ecosystem services as boundary objects for transdisciplinary collaboration. *Ecological economics*. 143, 153:160. <http://dx.doi.org/10.1016/j.ecolecon.2017.07.016>

Streck, D. R. (2020). Transdisciplinarity as a decolonizing research practice: A Latin American perspective. *Diálogos Latinoamericanos*, 29, 88–100.

Streck, D. R., & Schenatto da Rosa, C. (2024). Decolonizing transdisciplinarity. In Darbellay, F. (Ed.). *Elgar encyclopedia of interdisciplinarity and transdisciplinarity* (pp. 148–151). Edward Elgar Publishing. <https://doi.org/10.4337/9781035317967.ch32>

Tolksdorf, F. L., Weiss, M., Jiménez-Aceituno, A., Frölich, N. M., Amoah, N. A. B., Lam, D. P. M., Grauer, C., Baird, J., Ballnat, C., Horcea-Milcu, A.-I., König, B.,

Pedersen, R. L., Costa, M. M., Manuel-Navarrete, D., Martin, D. A., McGlynn, B., Mehring, M., Mühlthaler, S., Schneider, F., ... Lang, D. J. (2025). Why context matters: understanding transdisciplinary research through the lens of nine context factors. *Innovation: The European Journal of Social Science Research*, 38(4), 1482–1518. <https://doi.org/10.1080/13511610.2025.2527104>

Tschirhart, C., Mistry, J., Berardi, A., Bignante, E., Simpson, M., Haynes, L., Benjamin, R., Albert, G., Xavier, R., Robertson, B., Davis, O., Verwer, C., de Ville, G., & Jafferally, D. (2016). Learning from one another: evaluating the impact of horizontal knowledge exchange for environmental management and governance. *Ecology and Society*, 21(2). <http://www.jstor.org/stable/26270390>

Wesselow, M., & Stoll-Kleemann, S. (2018). Role-playing games in natural resource management and research: Lessons learned from theory and practice. *The Geographical Journal*, 184(3), 298-309. <https://doi.org/10.1111/geoj.12248>

Annex 1 - Questionnaire used to populate the repository of research tools

1. Name of the tool
2. Brief description of the tool
3. Objective of the tool
4. Three keywords that describe the tool
5. Type of information generated by the tool
 - Quantitative
 - Qualitative
 - Both
6. Available links to the project website, if any
7. Available files about the project, if any
8. Include publications related to the tool and/or its use in research, paste link
9. Topics that can be addressed with this tool
 - Water
 - Forests
 - Fisheries
 - Natural resources
 - Food and seeds
 - Biodiversity
 - Rural commons
 - Urban commons
 - Soil or land
 - Knowledge, traditions, and culture
 - Territory
 - Commons in general
 - Education
 - Information
 - Phytogenetic resources
 - Mining and hydrocarbon resources
 - Technology
 - Governance
 - Other, which one?
10. Profile of the group of actors the tool is focused on, select all that apply
 - Government
 - Rural civil society
 - Urban civil society
 - Students
 - Non-governmental organizations
 - Private sector, for example, companies and contractors
 - Productive sector, for example, livestock, agriculture, fisheries
 - Other, which one?

11. Level at which the tool has been applied: City, Town, State, Department, Country, Region, International
12. Advantages of the tool
13. Disadvantages or limitations of the tool

