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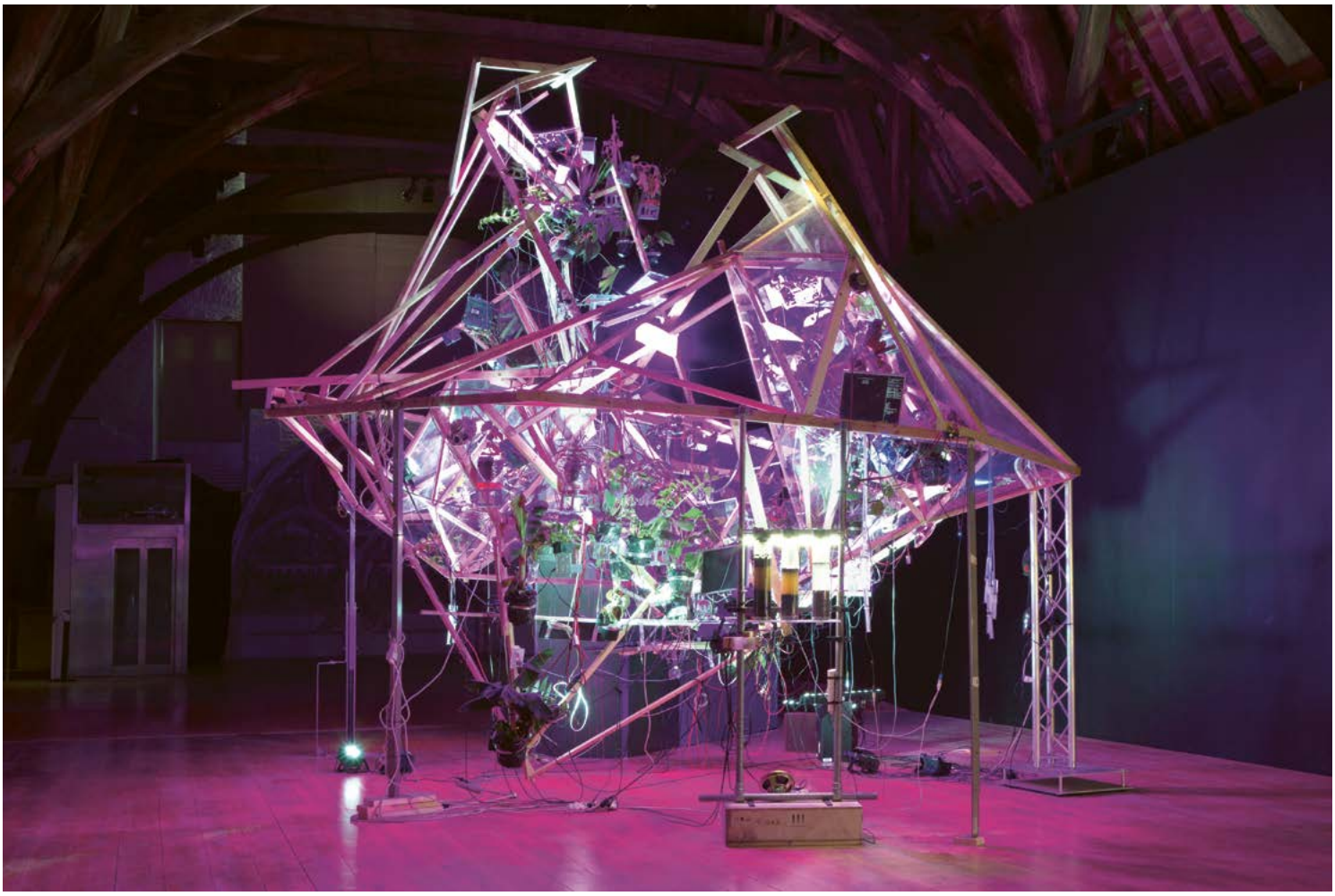

FOCUS CREATING SPACES AND CULTIVATING MINDSETS FOR TRANSDISCIPLINARITY

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The role of transdisciplinarity in building a decolonial bridge between science, policy, and practice

Research that focuses on changing problems of poverty, inequality, and food security may not always listen to what people who live in areas with sustainability problems need in order to make those changes. In our analysis of development research projects, we reflect on the challenges of participation faced by different actors in transdisciplinary science. For a decolonial turn, people need to be involved in making decisions about resources, research topics, and how to use knowledge.

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The role of transdisciplinarity in building a decolonial bridge between science, policy, and practice
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Abstract
Transdisciplinary research is considered to offer contributions of science to sustainability transformations, partly because transdisciplinary approaches aim to increase the relevance, credibility, and legitimacy of scientific research by ensuring the active participation of non-academic actors in research. However, the possible impact of transdisciplinary research on decolonial sustainability science – understood as actively undoing Euro-North American centricity, dispossession, racism, and ongoing power imbalances in inequitable social-ecological systems – and simultaneous response to scientific rigor remain under debate. Thus, this article assesses the contributions of transdisciplinary research projects to decolonial sustainability science based on empirical information. To do so, we analyze a sample of 43 development research projects of the *Swiss Programme for Research on Global Issues for Development (r4d programme)* in Africa, Asia, and Latin America. We found that despite significant differences in approaches, Global-North-dominated sustainability science still has far to go to achieve the decolonial potential of transdisciplinarity, enabling different actors' participation.

Keywords
decoloniality, participation, research for sustainable development, transdisciplinarity, use of knowledge

As the United Nations *Sustainable Development Goals* have become more unreachable (UN 2019), critical sustainability scientists are calling for more just, pluralistic, and inclusive scientific research approaches (Rist et al. forthcoming). Today's sustainability science is often characterized by power asymmetries and a dominance of Euro-North American epistemologies, methods, and research topics (Smith 2018). Several scholars have called for the adoption of relational ontologies, the overcoming of predominant anthropocentrism, and the related separation of the human and more-than-human (Escobar 2019, Rist et al. forthcoming). Decoloniality in sustainability research means addressing historical and ongoing systems of oppression, many of which are related to unsustainable development (Mignolo 2007, Trisos 2021). The latter describes decoloniality in research on sustainability as 1. including different ways of knowing and communicating; 2. acknowledging historically grown dependencies and injustices; 3. decolonizing access to information for interested parties in the Global South, for example, databases and journal articles; 4. giving credit and weight to a diversity of expertise; and 5. enabling diversity and inclusivity in research teams, including perspectives from Global South researchers with epistemologies and sources of information.

As a conceptual clarification, we use the terms "Global South" and "Global North" to describe the historical and current structures of power and oppression on a global scale. The term "Global South" describes countries and places in the world (e. g., countries in Africa, Southeast Asia, or Central and South America) that are in a disadvantaged position, both politically and economically, primarily due to historical accumulation since the Euro- >

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pean colonial era and its continued promotion by the Global North (e.g., Europe and the United States). The countries of the Global North are in a privileged position of power and are often referred to as the "Western world" or the "West" (Bechert et al. 2021). However, this separation is a forced division that limits the understanding of the complexities of interactions between geographies and actors (Ciplet et al. 2015). Both in the Global North and in the Global South, academic and non-academic actors participate in the process of knowledge use, implying that the academic category is not exclusive to a region; rather, it is the recognition of a specific form of knowledge production.

A growing body of research has documented the benefits of such approaches; for instance, diversity in research teams is associated with better research outcomes (Hofstra et al. 2020), and the Latin American method *Diálogo de Saberes* has helped enhance a myriad of locally adapted agricultural solutions in farmer-empowering science practice approaches (Rosset et al. 2019).

Although multi-stakeholder participatory processes are increasingly incorporated into research methodologies, they do not necessarily address the power asymmetries within research projects (Canfield et al. 2021). A global systematic review shows that in climate research about local knowledge, 87 % of studies practiced some form of knowledge extractivism, where research teams applied participatory methods with minimal communal agency for decision-making (David-Chavez et al. 2018). Scholars describe how research processes with local communities are often based on Western science and bring to light the power asymmetries between different forms of knowing (Nagy et al. 2020).

Transdisciplinary research (TDR) attempts to respond to these dynamics with a co-creation approach to producing knowledge in multidisciplinary teams, together with actors that come from practice and policy as co-producers (Bergmann et al. 2012, Schneider and Buser 2018). TDR, as the integration of different forms of knowledge and worldviews (Lang et al. 2012), is used to enhance sustainability transformations in science itself, as well as in policy and practice (Liu et al. 2015, Coggan 2021, Jacobi et al. 2022). TDR aims to address real-world problems and to design transformations for sustainable development (Lang et al. 2012, Bergmann et al. 2012, Liu et al. 2015, Coggan 2021). From this perspective, those who participate in the definition of joint problems can influence the direction of changes: the presence of non-academic actors in research, for example, political representatives, practitioners, non-governmental organizations (NGOs), community leaders, and private sector officials, among others, participate collaboratively with North and South academic actors, providing a chance to incorporate their worldviews, interpretations, and solutions and to enable convergence via more inclusive, creative, and ethical ways of conducting research (Pohl 2008, Trisos et al. 2021).

Max-Neef (2005) coined the terms "weak transdisciplinarity" and "strong transdisciplinarity." While the former allows the comprehension of the powerful positions of researchers in generating, holding, and transmitting knowledge and can be used simply in knowledge co-creation, the latter enables epistemic plurality. Thus, not all forms of TDR are necessarily decolonial. This perspective does not ignore the scientific and knowledge generation capacity of non-academic actors; rather, it broadens the vision of scientific institutions to recognize the multiple forms of knowledge generation as a result of interactions between different actors and these institutions.

A further possible decolonial factor of TDR, beyond the involvement of non-academic actors, is the temporal aspect. Jacobi et al. (2022) showed that the earlier the involvement of non-academic actors, the more the research will relate to the needs of the actors involved and the more diverse their roles will be in the co-creation and use of knowledge. Consequently, a lack of an early co-creation process may restrict applicable solutions in TDR, as opportunities for transformations that depend on knowledge exchanges between science and policy are lost (Clark et al. 2016, Chambers et al. 2021). This is an unresolved problem, as few transdisciplinary projects involve actors from policy and practice from the outset (Zscheischler et al. 2018). The phenomenon of weak involvement occurs within so-called transdisciplinary projects led by academic actors from the Global North and South, as well as in their interactions with non-academic actors from both regions.

In summary, the possible decolonial contribution of transdisciplinary sustainability research originated in the Global North is not well understood. Thus, our study aims to contribute to closing this research gap based on empirical information from 43 research projects from the perspectives of various involved stakeholders. Specifically, we address the following questions:

1. How can TDR mechanisms enable more equitable interactions between involved stakeholders from the realms of science, policy, and practice?
2. What are the possible benefits of TDR processes for decolonial sustainability transformations?

Methods

In an overall synthesis study, we analyzed a sample of 43 research projects from the *Swiss Programme for Research and Global Issues for Development (r4d programme)*, and we sorted by consortia between academic and non-academic institutions and individuals from the Global North and South. The research projects had at least two years of implementation in low- and middle-income countries through multi-stakeholder agreements between actors in science, policy, and practice (Llanque Zonta et al. 2021). They were grouped into five thematic modules: social conflict, employment, food security, ecosystems, public health, and a thematically open module.

We build on two previous synthesis studies of the same research program that reported an increased use of research knowledge in co-creation projects (Jacobi et al. 2022), and the research framing primarily followed the priorities of the research partners in the Global North (Eschen et al. 2021). Our analysis focuses on the mechanisms used in these projects to ensure their

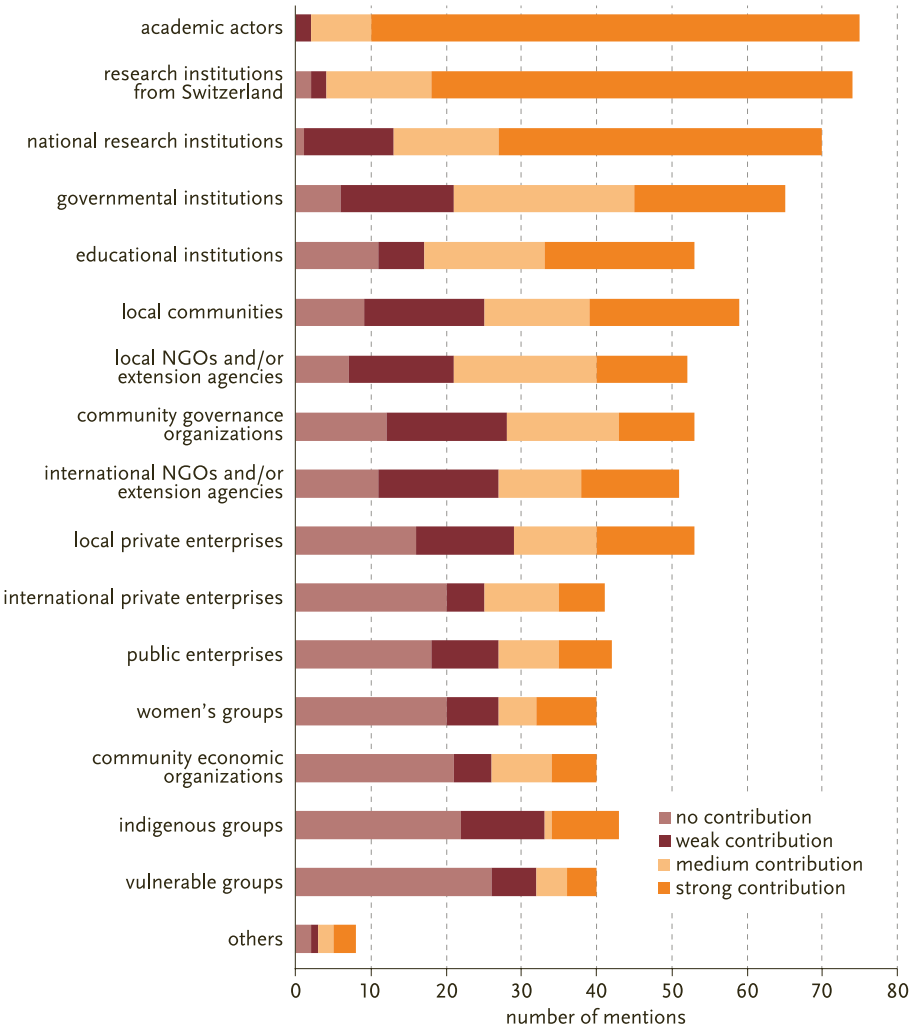

FIGURE 1: Actors' participation in and contributions to the co-creation of knowledge in transdisciplinary research projects. 94 answers from 43 projects.

contribution to sustainability transformations and to determine the type of involvement of non-academic actors from research, policy, and practice. This approach helps us to characterize the projects from the transdisciplinary, decolonial, and transformative perspectives.

Our research includes a portfolio analysis of the research projects in terms of topics, approaches, methods, and actor involvement, as well as an online questionnaire with a quantitative component and complementary qualitative responses, administered to academic and non-academic project partners.[1] The questionnaire covered the project design, including partnerships and the involvement of different stakeholders, as well as details of the project processes. The questionnaire had 23 questions, but in this analysis, we only used a subset of eight dealing with actors' involvement in and the mechanisms for transformation used by the projects, located in section 3 of the survey, called *project processes*. The survey was anonymous; however, we were in direct contact with scientific representatives of the projects who collaborated to distribute the questionnaire across the partner institutions in the project consortia. For the data analysis, we first performed a descriptive statistical analysis of non-parametric ordinal data, which covered the project processes and impacts expressed in transformations in science, policy, and practice, as well as the role of actors in these interactions. To complement this, we coded the qualitative results by category and triangulated the information according to the type of response. The extremes, both the frequency and particularities of each experience, were considered, thus adding substantive explanations to the quantitative data.

Results

Uneven participation of academic and non-academic actors

We received a total of 94 answers to the questionnaire, covering 37 countries. From the portfolio analysis, we knew that all projects applied a transdisciplinary approach to a certain extent, had seed funding for preparation workshops before handing in the full proposal, and included academic and non-academic partners in the Global South, as required by the funding program. The composition of project partners was diverse, including representatives from science, policy, and practice. However, this composition was not evenly distributed. Academic actors were dominant, coming primarily from the Global North from Swiss research institutes more so than from other research institutes, as well as from governmental institutions. Local communities, local and international NGOs, and educational institutions were mentioned by a minority (6 %) of respondents. At around 3 %, the private sector rarely contributed to the respective projects. Further, women, indigenous, and other vulnerable groups were only mentioned as project partners by 1 %.

Regarding the contributions of individual actors to the projects' aims, those of the Swiss research institutes were most often >

1 Questionnaire for academic project partners: *https://ars.els-cdn.com/content/image/1-s2.0-S1462901121003725-mmc2.docx*, questionnaire for non-academic project partners: *https://ars.els-cdn.com/content/image/1-s2.0-S1462901121003725-mmc3.docx*.

(57.4%) rated "strongest" ("3"), followed by national research organizations (45.7%). Contributions by others were rated much less often as strong, for example, by government institutions (25.5%). Further, local NGOs were most often identified for their medium contribution (rated "2", 23.4%), and vulnerable groups were the least mentioned. The weaker contribution (rated "1") was mostly associated with government institutions (20.2%), community governance organizations (19.1%), international NGOs (18%), and local communities (17%) (figure 1).

Where non-academic actors were involved from the beginning, they participated as "advisors for collecting relevant data and explaining how some practices work at the local level" (NGO representative, Global South). Where they were involved after securing funds, they were mostly co-organizers of the project, for example, "The project focuses on pilot transformation actions, we had the opportunity to elaborate the initiative together with local actors from the beginning" (academic actor, Global South). The lowest level of participation of non-academic actors was in framing the topic and developing the proposal, indicating the limitations of their participation. However, there were promising individual statements, such as, "Research questions were collectively done and agreed upon by consensus by all actors on the research" (non-academic actor, Global South).

Companies, local communities, and local NGOs were described on several occasions as primary sources of information or as implementers: "Research at academic institutions rate scientific knowledge, often based on local indigenous knowledge. Local communities and small local enterprises improve and adapt the knowledge" (academic actor, Global North). Other quotes show rather discriminating academic views of scientists in the Global South: "The North scientists were both more conscient about the issues to tackle and the solutions to be tested while the South ones were not so prepared to do it by themselves" (academic actor, Global North).

Academic actors described how they collaborated with non-academic stakeholders in a participatory way, such as with NGOs, local civil society, local or national private sector actors, and policy makers: "This was an interactive process, starting from the initial workshop with identified local and national actors to periodic knowledge exchange workshops" (academic actor, Global South), as well as in the co-creation process: "This was done collaboratively between researchers located in the South and North but was informed by policy debates at the levels of civil society, NGOs, and policy makers at all levels" (academic actor, Global North).

An indication of eye-level project management could be project adaptability. We asked whether there were changes to project designs or implementations as a result of stakeholder involvement, as well as how these changes looked. For each response, we took the nominal data from the intersection between moments in a project schedule (framing of research questions, proposal development, after securing funding, toward the end, and more than one option) and the types of possible changes. Of those who responded, 51.8% affirmed they did not make changes to their projects, nor did they know whether there were changes or whether changes were only made by scientific actors toward the end. In total, 37% of non-academic actors made changes after funding was secured and 11.1% of stakeholders were involved in changes during various project stages. In addition, 27.7% responded that there were changes to the methods and funding allocations (18%), as well as to the research questions (17%). This result indicates that most academic actors in the Global North made the decision to secure funding before negotiating with their partners. Moreover, respondents mentioned that there were institutional limitations in the beginning, making stakeholder involvement difficult, and most projects involved negotiations exclusive to the academic environment, especially in the allocation of funds.

Transdisciplinary research (TDR) mechanisms for sustainability transformations

We analyzed 19 mechanisms that the projects used, focusing on transformations toward sustainability, as identified in an earlier study (Jacobi et al. 2020). We identified four main mechanisms, two of which were related to participatory activities and dialogue between different actors, for example, "consultation workshops and key informant interviews were organized to involve local stakeholders and policy makers in the process" or "work packages are co-led by a Northern and a Southern partner" (academic actor, Global North), while the other two mechanisms focused

TABLE 1: The four most important mechanisms used in the projects to increase the utilization of project knowledge for sustainability transformation.

MECHANISM USED	EXAMPLARY QUOTES FROM THE ANSWERS (ALL BY ACADEMIC ACTORS)
partnership actions/ collective actions	■ transformative actions to improve farmers' position in the milk value chain ■ North and South partners were producing biochar at the Cuban research institution in the presence of farmers
participation of local partners/policy makers	■ members of national and regional advisory groups come from policy makers and partners at the national, subnational, and local levels ■ local partners participated with their knowledge and experiences and skills of location
provision of methods, tools, technologies	■ the project tests different management options for invasive alien tree species at different stages of invasion ■ new models developed to consider the type of data available in developing countries
scientific publications or conferences	■ the research output has been and continues to be published in leading journals and at international conferences ■ workshops and seminars

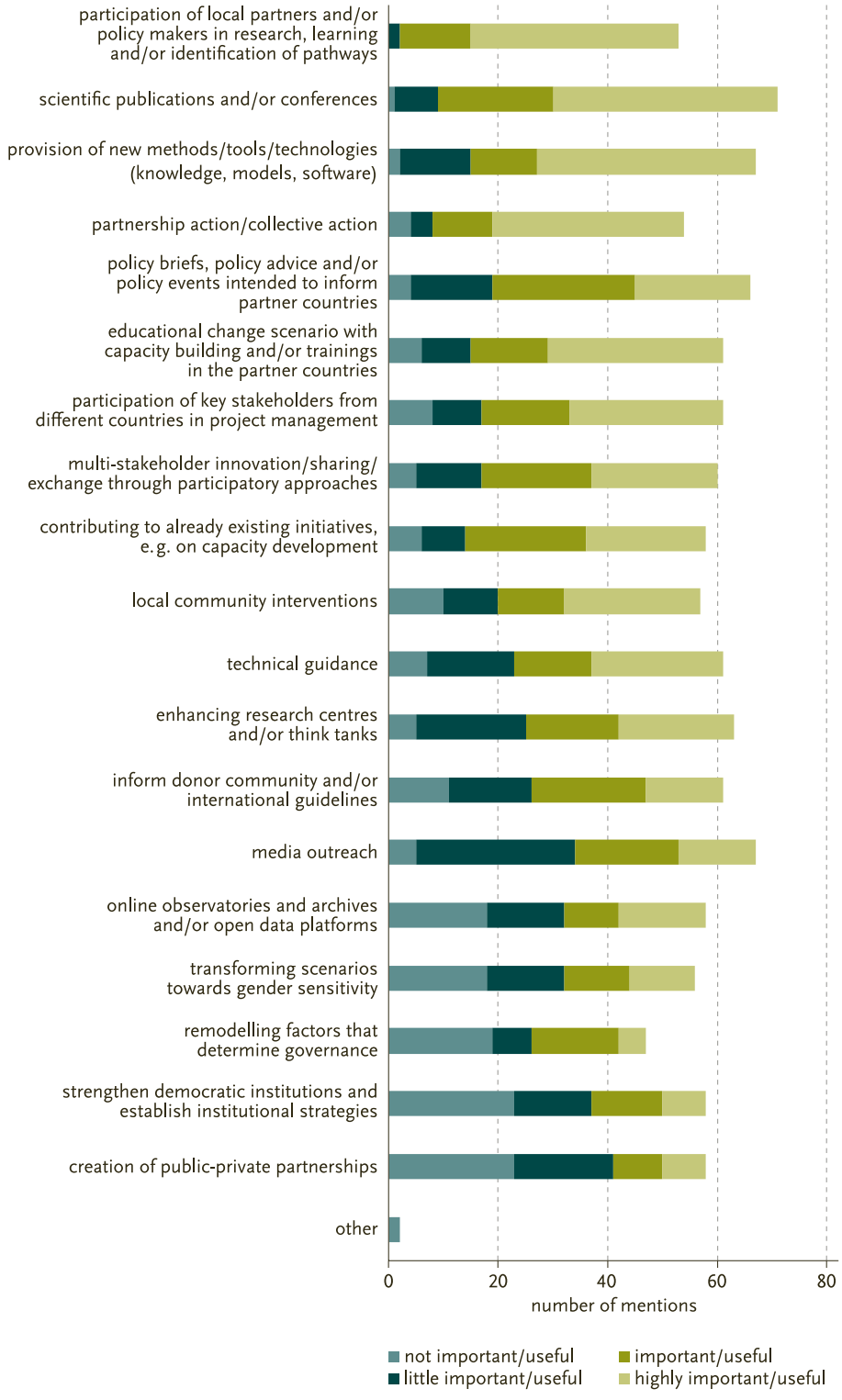

FIGURE 2: Perceived importance of mechanisms for research and transformation processes in the projects. The mechanism list was obtained inductively (Jacobi et al. 2020). 77 answers by academic partners from 43 projects.

on traditional scientific activities, such as the production of new methodologies and peer-reviewed publications (figure 2, table 1).

Figure 2 shows the relevance of mechanisms, such as the production of technical guidance documents or the involvement of local actors and policy makers during the project process. Such actions as educational change scenarios with capacity building refer to the transfer of capacities to local actors based on the innovations generated by the projects. In addition, local-level interventions and multi-stakeholder innovations, especially at the level of knowledge co-creation, are mechanisms that link academic and non-academic actors.

The four mechanisms used most in the projects and rated as most relevant by the respondents were associated with participatory strategies (first and second rank) and scientific methods and publications (third and fourth rank) (table 1).

TDR and co-creation benefits for transformative and decolonial science

All academic respondents took note that the project knowledge contributed to transformations, and just over half perceived the projects as transformation processes (52.1%), for example, involving "incredible empowerment and promising career development" (academic actor, Global North), while household farmers and credit cooperatives with "discourses and recommendations may influence policies at different levels but in the longer term" (academic actor, Global North). They mentioned project publications and training materials, the incorporation of methods, student training, inclusion of contents in medical teaching materials, and access to equipment and training. In addition, governmental institutions (71.3%) used project tools to teach sustainable practices or to adopt research project recommendations. The respondents reported lower levels of the use of project results by the private sector (11.7%), and vulnerable groups (e.g., children, disabled people) were only mentioned by 8.5%. Finally, regarding contributions to sustainability transformations, 52.1% confirmed that their >

projects focused on transformations, while 38.3 % indicated they did not know or considered it too early to say. While all non-academic actors were involved in the co-creation of knowledge at some point in the projects, only 8 % of the academic actors indicated to have included non-academic actors in decision-making concerning the project design. While most respondents mentioned the involvement of non-academic actors in the project preparation phase, the majority also indicated that academics from the Global North decided on the research topic, indicating a difference between participation and decision-making.

Discussion and outlook

While TDR in the *r4d programme* has advanced in terms of the participation of non-academic actors, the project mechanisms that enabled more equitable interactions between academic and non-academic actors or between researchers from the Global North and South did so only partially, particularly between those that focus on academic outputs.

The qualitative analysis of our data highlights a dominance of traditional strategies in science, where scientific actors are the most relevant participants. The interaction among science, policy, and practice within transdisciplinary projects relates mainly to the provision of information, the validation of results, the provision of advice, and participation in conducting research. Exceptions were joint project designs, shared responsibility in funding allocation, and a focus on enhancing careers, especially in long-term partnerships.

Furthermore, there was some dissonance between the transdisciplinary approach and how projects were implemented, where the projects were strongly focused on scientific achievements, but the contributions of the academic achievements could not be directly linked to the political or practical sphere.

Lang et al.'s (2012) perspective on increasing options for contributing to transformative science and knowledge co-creation is applicable to this context, especially because it implies a decolonial turn in science. Considering local actors or non-academic actors as providers of information or in validation processes is not enough for more equitable projects or to ensure the legitimacy of processes. The benefits of sustainability science might be diluted when they are not emerging from collective deliberation and participatory processes from the start of the project. This may be one of the major limitations of TDR: research objectives are defined in advance, and as shown in the results, a significant percentage of projects maintained the objectives and method until the end. The requirement of transdisciplinary methods in this type of research encourages the use of more participatory tools. However, the persistence of power asymmetries between academic and non-academic actors remains evident in our results. The link between knowledge use and stakeholder contributions reported by Jacobi et al. (2020) is affected by power relations, which are directly reflected in the institutional structures of the projects, as shown in the section on "uneven participation of academic and non-academic actors". The results also show that the academic actors used knowledge the most, a result that was expected but that puts their transformative and decolonial contributions into question.

A question that arises from these heterogeneous results is how we include the perspectives of non-academic actors in the rigid structure of science, which, contradictorily, promotes transdisciplinarity. From the perspectives of Hansson and Polk (2018) and Levesque (2019), including the epistemologies of non-academic actors demands active participation from initiation of the project, and the scientific evidence we present shows that the participatory issue is complex, because it depends both on the institutional openness of funding agencies to apply other methods of conducting projects and on the political will of those who manage funding in the Global North. Consequently, academic researchers from the Global South with an indigenous background are problematizing and tackling the responsibility of science in the production and use of knowledge to transform colonial practices in science (Battiste 2000). For example, the *Alter-Native* (an international journal of Indigenous Peoples, founded by the Māori Research Centre in New Zealand[2]) incorporated in its publishing requirements ethical codes, such as the approval of research agreements by non-academic actors.

As stated by Chambers et al. (2021), the process of knowledge co-creation requires a careful look at the participation of diverse actors, and, as we see in this study, the type of participation is also relevant, as are the possible shared benefits of participatory mechanisms. We therefore propose to deepen the reflection on colonial relations in transdisciplinary sustainability science. This type of participation defines whether and how certain voices can move from the periphery to the center of decisions (Quijano 2007), and it will have consequences on how funding is managed. Further, it will make transparent who benefits from the research, and it will allow the increased participation of diverse actors in the sustainable development agenda.

The challenge is not only between actors in practice, policy, and science, but also between those in academia. Collins (2021) argues that decolonization is an important step in confronting some of the major weaknesses of contemporary social-ecological research. In addition, funding conditions are determinant: as long as the resources for science come primarily from the Global North, are attached to conditions concerning the research areas and leading scientists, and are depended on by the academic institutions of the Global South, there will be periphery-centered relations within science, and this phenomenon will bring consequences concerning how and who generates innovative knowledge for sustainable transformations.

The stronger transdisciplinary examples in the *r4d* projects show that it is possible to open opportunities for multi-stakehold-

2 Ngā Pae o te Māramatanga, *www.maramatanga.ac.nz*. See also Robson-Williams et al. (2023, in this issue) who discuss how *mātauranga Māori*, Aotearoa-New Zealand's Indigenous and foundational knowledge system, and Western science currently interact.

er exchanges, for example, in placing traditional medicine at the same level as academic medicine. The strongest decolonial aspects (Trisos et al. 2021) can be found in the formation of diverse and inclusive teams and by making knowledge accessible through strict open-access and open-data policies. Other dimensions of decolonization, such as accounting for historical biases and redefining expertise, were not as strongly represented.

Our results partly underline the transformative potential of interactions that move from describing phenomena/providing information to influencing actions within the policy and practice domains. Projects that invested in participatory tools and the negotiation of implementation projects within the overall project, both for the participatory definition of problems and for the collective planning of transformative actions (Rist and Herweg 2016), show how changes can occur through stakeholder empowerment during the project process. This is because they added a component of co-creation, including negotiations that enabled explicit options for collective action, for instance, in terms of changing policies (Llanque et al. 2021).

Imagining options for the future of transdisciplinary science requires reinterpreting the role of non-academic actors in research to build more decolonial bridges between science, policy, and practice. This task includes transforming academic institutions to open more flexible spaces for negotiating research questions, the use of financial resources, the methods to be applied, and the destination of the results in terms of their applicability and their real use.

Conclusions

The predominance of academic actors from the North leading the process of knowledge co-creation in our study is an example of the persistent challenges in TDR, highlighting the need to transform power relations between the different actors in sustainability research between the Global North and the Global South. The predominance of academic actors in transdisciplinary projects has been determined to be an important part of the research, and the diversity of perspectives on these processes ranges from affirming the gradual division of roles between expertise in science, practice, and policy to emphasizing processes, relationships, agreements, and interactions.

The concept of adaptability during interactions may be key to strengthening knowledge co-creation. Changes in the design, as well as in the implementation of a project make it possible for diverse actors to incorporate complexity by sharing perspectives and offering grounds for negotiation. However, North-dominated research still has a long way to go before adopting a strong sustainability framework for a decolonial contribution to science, allowing different forms of knowledge and knowing to come together and to be considered equally.

Transdisciplinarity opens the door for non-extractive relations in knowledge co-creation in a "world where many worlds fit" (Zapatista saying, quoted in Escobar 2019), but this alone is not enough to decolonize research and the use of knowledge; thus, this is a task for the entire academic community.

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