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Fostering Reflexivity through Integrative Approaches of the Sciences and Arts: Insights from a Transformative Real-world Lab with a Permaculture Intervention in Northwest Germany

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"The fruits of our efforts and endeavors often show up only after a time lag. Sometimes they do not appear at all, or not in the expected place or imagined form." (Haarman/Schroer 2022: 43)

Zusammenfassung: Vor dem Hintergrund sich verschärfender sozial-ökologischer Krisen nimmt dieser Beitrag die Komplexität von Transformationsprozessen in den Blick und hinterfragt lineare Nachhaltigkeitskonzepte. In Bezug auf kollaborative Arbeit mit einer Künstlerresidenz wird untersucht, wie Permakultur mit ihren offen formulierten Ethik- und Designprinzipien als ‚boundary object' transformative Prozesse unterstützen könnte. Ziel der Studie ist es, (1) das Potenzial integrativer Reallabor-Ansätze für sozial-ökologische Transformationen aufzuzeigen, (2) die Anforderungen zu analysieren, die sich aus ihrer zeitlichen und methodischen Komplexität ergeben, und (3) zu beleuchten, wie gärtnerische und soziale Praktiken der Permakultur Transdisziplinarität und Gemeinschaftsbildung fördern können. Über die Erläuterung ethnographischer und kollaborativer Vorgehensweisen zeigt sich dabei, dass die Integration von wissenschaftlichen und künstlerischen Herangehensweisen in konzeptionellen, methodischen und praktischen Dimensionen erfolgt, welche hier als heuristisches Modell vorgeschlagen werden. Die Ergebnisse verdeutlichen, wie kommunikative Fähigkeiten, Offenheit und Geduld entscheidend sind, um unterschiedliche Perspektiven zu verhandeln und gemeinsame Nachhaltigkeitspraktiken zu entwickeln.

Abstract: Against the backdrop of intensifying social-ecological crises, this paper examines the complexity of transformation processes and questions linear concepts of sustainability. Relating to collaborative work with an artist residency, the study investigates how permaculture — with its openly formulated ethics and design principles — can serve as a boundary object to support transformative processes. The study aims to (1) highlight the potential of integrative real-world lab approaches for socio-ecological transformations, (2) analyze the demands arising from their temporal and methodological complexity, and (3) explore how permaculture's gardening and social practices can foster transdisciplinarity and community-building. Through elaborations on ethnographic and collaborative procedures it shows respectively, that the integration of scientific and artistic approaches occurs across conceptual, methodological, and practical dimensions, which are proposed here as a heuristic model. Results underscore that communicative skills, openness, and patience are crucial for negotiating diverse perspectives and developing shared sustainability practices.

1. Introduction

The concept of sustainability — rooted in concerns about ecological limits (Meadows et al. 1972) and social inequality — has been debated internationally since the 1987 Brundtland Report and the 1992 Rio Conference. Over the following decades, different conceptions of sustainability have developed across society, and various paths for sustainability transformations have been proposed, called for, and applied (Henkel 2016). However, even after global adoptions of the UN's 2030 Agenda proclaimed in 2015, alarming data and forecasts on socio-ecological grievances persist (IPCC 2023, FAO et al. 2022, UN 2015). A feeling of stagnation sets in, urging a search for new ways of understanding and meaningful action, which may not lead to overcoming the current crisis, but possibly to a more satisfactory way of dealing with it (Musch 2021, Huning et al. 2021). In this regard, exploring and negotiating a diversity of framings of what-is and what-ought-to-be appears crucial, including efforts to find common strategies to engage with the "wicked problems" (Rittel/Webber 1973) at stake. Many scholars question technocratic views on sustainability that regard it as a problem solvable through technological innovations as well as political and economic measures (Mediavilla/Garcia-Arias 2018, Weber 2017). Particularly, postmodernist (Latour 1994), decolonial (Escobar 2018), political ecology (Dietz 2018), feminist (Haraway 1988), and more-than-human studies (Steiner et al. 2022, Ingold 2006), claim to acknowledge a plurality of more-than-rational dimensions and the need of integrating different worldviews, forms of knowledge, and rationalities to tackle the current multiple crisis and establish common grounds for cooperation.

Several approaches in the arts and sciences seek to sensitize for and integrate diverse perspectives by creating spaces for encounter, experimentation, and education that can foster reflexivity toward complex sustainability issues (Herzog et al. 2022, Kröger et al. 2022). While the sciences are requested predominantly for their capabilities to analyze, monitor, and advise transformation processes, the arts are frequently called upon for their emotionally and aesthetically affecting potential (Rivera 2022, Bentz 2020, Grunwald 2015). Nevertheless, as we argue, the two disciplines have the potential to embrace each other's work within *integrative approaches* based on mutual engagements on *theoretical*, *methodological*, and *practical dimensions*. Transdisciplinary projects are considered ideal "spaces of possibilities" (Kagan 2015: 1), facilitating such engagements and collaborative learning processes. Such spaces demand transparency, deep reflexivity, and negotiation (Defila/Di Giulio 2018). Real-world labs are regarded as a particularly suitable framework for transdisciplinary engagements with sustainability transformations, enabling the joint production, integration, and social transfer of knowledge (Wagner/Grunwald 2015, Lang et al. 2012). Following Schneidewind et al. (2018) in their framing of real-world labs by Anthony Giddens' (1986) theory of structuration, reflexivity is understood as a key element. Within the given setting, intentional actors are confronted with different, sometimes even contradictory, perspectives and enter reflexive learning processes that become crucial to the frameworks and project's maintenance. Furthermore, departing from a 'systems view' that understands systems as "groups of interacting, interdependent components that form a complex and unified whole" (Kagan 2013: 96) and avoids linear thinking, we acknowledge that grasping their complexity requires a consideration of multiple logics (Nicolescu 2007, Lazlo 1996).

In this paper, we discuss (1) the potential that integrative approaches within real-world labs can unfold for socio-ecological transformations, (2) what demands such transdisciplinary approaches raise, given their complexity and temporality, and (3) how the social and gardening practice of permaculture can facilitate engagements with transdisciplinarity, sustainability, and community-building. In the following, we elaborate on diverse forms of knowledge, understandings of sustainability, real-world labs, and backgrounds of permaculture. We then present our case study, an artist residency in the town of Schöppingen, in a rural area of Northwest Germany, that offers scholarships for international artists (so-called fellow artists).

This residency has initiated several interventions to transform its institutional infrastructure and culture towards greater 'justice' and 'sustainability' since 2021. We provide insights into our conceptualization of the artist residency as a real-world lab and the introduced interventions. We then discuss the potential and challenges of our real-world lab approach, focusing on the institution's engagement with permaculture and our collaborative 'real-world interventions'. Furthermore, we highlight how the institution's *process-oriented approach* to *sustainability* has fostered reflexivity and non-hierarchical collaboration, promoting an *actor-centered approach within transdisciplinary real-world labs*. Drawing on empirical data from fieldwork, the final aim of this paper is to elaborate on the potential and challenges of transdisciplinary and integrative engagements to foster reflexivity for transformation processes.

2. Integrating plural worldviews and forms of knowledge

Looking at academic debates on knowledge production throughout the past two decades, the belief in scientific knowledge as an objective superior form of rationality has been challenged. Correspondingly, debates on transdisciplinarity and transformative science have highlighted the importance of transcending the disciplinary boundaries and rationalism of classic science by integrating perspectives and demands from broader society into processes of knowledge production (Renn 2019, Nicolescu 2007). Local knowledge (Avilés Irahola et al. 2022), worldviews (Steinhäuser 2020), and interwoven knowledge (Ingold 2016) have been increasingly proclaimed as essential dimensions of how the world is perceived. The question of an adequate integration of worldviews and rationalities that could facilitate common solutions and transformation paths seems to impose itself, as the hands-off approaches and technocratic 'business as usual' have proven to be insufficient for the complex tasks ahead (Wagner/Grunwald 2015, Singer-Brodowski/Schneidewind 2014). Therefore, it has become widely accepted that cooperative and integrative modes of interaction are indispensable for the transformations to be brought about (Steiner et al. 2022, Renn 2019, Dieleman 2008). The arts are considered a highly dynamic field, holding great transformational potential for society (Herzog et al. 2022, Kröger et al. 2022, Kagan 2012). Specifically, this refers to the arts' abilities to engage in complex processes, while keeping "open the ambiguities, ambivalences, contradictions, and sometimes chaotic dimensions of reality, rather than leveling them into a coherent logical system" (Kagan 2015: 4). The arts are proclaimed to be promising for opening 'more-than-rational' perspectives and fostering reflexivity through creative imagination and perspective-taking (Bentz 2020). As Rivera (2022) points out, the sciences' systematic-ordering capability differs from the arts' atmospheric-building and sometimes even anti-systematic approaches, which could be supplementary within a common perspective. Integrative approaches between the arts, sciences, and broader society—realized in transdisciplinary research projects, interventions, or university courses—can help to bridge their epistemological-conceptual and methodological-practical gaps and can give creative and innovative impulses for socio-ecological transformation processes (Singer-Brodowksi et al. 2022, Kuni 2021). Settings like real-world labs are proposed as incubators, representing institutionalized spaces for experimentation that can serve as educational environments (Beecroft et al. 2018, Schäpke et al. 2018, Wagner/Grunwald 2015). Within, reflexivity is being taken as an "important mechanism of change" (Dieleman 2008: 7) that must be fostered globally and throughout society, being addressed in terms of, i.e., "transformative literacy" (Singer-Brodowski/Schneidewind 2014). The integrative engagement with sustainability transformations, diverse forms of knowledge production, and one's own contributions to issues of (un-)sustainability are considered parts of an important process fostering literacy by enabling one to read, interpret, and reflect information on societal transformation processes and to participate in these (Schneidewind et al. 2018, Singer-Brodowski/Schneidewind 2014). Especially

within the context of knowledge production, we emphasize integration as an ideally reciprocal process mutually enacted within real-world labs to create spheres for common understanding and action, and to transgress disciplinary boundaries.

3. Negotiating sustainability transformations

Among the different currents of thought on socio-ecological transformation and sustainability research, breaks, inconsistencies, and conflicts shape scientific analysis and debates (Henkel 2016). Especially the co-existence of theories of sustainable modernization and growth next to degrowth appears to represent a challenging plurality of worldviews, knowledge, rationalities, and future imaginations that are often conflictual in aims, visions, and strategies. Beyond this, decolonial thinkers like Escobar (2018) even stress how deeply attached and reliant people are to scientific constructs in their everyday existence, thinking in their terms, acting upon them, and living in structures—such as political and educational systems—holding their constructions in place. In this regard, the issue of finding common pathways to more sustainability and justice appears as an inherently complex and 'wicked' one, demanding to "change the systems of reference which produce these problems [of unsustainability]" (Nicolescu 2007: 158). The UN's Agenda 2030, for instance, often translates sustainability into measurable goals achievable through technical solutions and economic incentives (Mediavilla/Garcia-Arias 2018, Weber 2017). But scholars like Dieleman (2008: 7) argue that „key change agents in sustainability, such as politics, science, and consultants, fall short in stimulating sustainability because they are too analytical, too much working within existing boundaries and functional rationality, and are too less touching upon emotions, intuitions or visions". Therefore, he suggests viewing sustainability as a process encompassing people's desires, future expectations, fears, visions, lifestyles, and identities. He describes sustainability as inherently more-than-rational, involving diverse emotional, imaginative, and sensory ways of connecting with our 'inner' and 'outer' worlds. Such perspectives are a crucial challenge for transdisciplinary research, especially when addressing complex issues like sustainability and transformation processes in collaboration with the arts and actors outside academia. Correspondingly, it is being proclaimed that fostering socio-ecological transformation processes requires not only knowledge but also communicative competences and skills that address the existing pluralities (Renn 2019). Real-world labs as complex and integrative spaces of possibilities can bring diverse perspectives into dialogue by facilitating encounters, negotiations, and common practices, fostering a deeper understanding of each other. However, it is precisely this openness that makes the validity of transdisciplinary research within the framework of real-world labs contestable. Hence, they must consider the sufficiency of their methods facing the given circumstances and question the quality of initiated processes and respective results with accuracy, ideally in a transdisciplinary mode. Within our research approach, we aimed to achieve this by summarizing, presenting, and discussing our understanding of the artist residency's transformational process and its challenges during fieldwork, evaluative talks, and writing. It shows that such procedures demand openness, flexibility, and patience from all involved, constituting complex and time-intensive challenges, which demand integrative, process-oriented, and actor-centered instead of linear approaches.

4. Real-world labs as spaces of possibilities

Approaches of real-world labs — more commonly framed as 'Living Labs' in English — have raised attention in the last two decades, bringing up lively discussions about their construction, aims, potentials, dangers, and methods (Parodi et al. 2023, Defila/Di Giulio 2018, Beecroft et al. 2018, Schäpke et al. 2018). Representing simultaneously a research framework and a place where research takes place, their recognition as spaces for experimentation, imagination,

and cooperation — or spaces of possibilities — reached common ground. However, their definition appears quite diverse, mostly alternating slightly in language, focus, and conditions. In our framing, real-world labs are characterized not only by their transdisciplinary and distinctively transformative orientation but also by their long-term facilitation, which appears necessary to engage sufficiently in and with transformation *processes* and their *relevant actors*. In this sense, their delimitation is a constructivist act and can be applied in, for instance, urban or rural neighborhoods, regions such as biosphere reserves, sectors such as companies or value chains, institutions such as universities, or transformation initiatives such as ecovillages (Wagner/Grunwald 2015). Within, problems are jointly identified to develop common research questions. These questions are deliberately open and can be further adapted during the joint research process. Different kinds of interventions — called 'real-world experiments' — are initiated in a participatory mode, and are scientifically accompanied, analyzed, and evaluated with a variety of methodological tools, such as interviews, focus groups, or surveys (Beecroft et al. 2018). Through this participatory process, it is ensured that the research is not only theoretically and methodologically sound but also practically relevant and aligned with the actual needs and challenges of society (Gerhard/Maquardt 2017). Still, Beecroft et al. (2018) suggest real-world labs to regularly check and adjust: the propriety of considered problems and topics; the propriety of their spatial and temporal dimensions; and the propriety of the included actors and their roles. Workshops and discussion groups for visionary processes are approaches to establishing dialogue with interested and relevant people. Consolidations of such visionary processes can then help to broaden knowledge and actively foster transformation processes (Alcántara et al. 2018).

The German Advisory Council on Global Change (WBGU 2016: 512) defines real-world labs as "scientifically designed spaces of collaborative sustainability research involving intervention", foregrounding their *scientific pre*-construction and an orientation toward sustainability and transdisciplinarity. In contrast, proclaiming *collaborative* and *processual* constructions, another definition describes them as *societal* arrangements constituted by the interactions of people, their specific environments, and social and institutional entanglements (Wagner/Grunwald 2015). More precisely, Parodi et al. (2023) link real-world labs to a set of *nine constitutive interrelated characteristics*, namely: (1) (transformative) research orientation, (2) (action-oriented) design and transformativity, (3) normativity and sustainability, (4) transdisciplinarity and participation, (5) civil society orientation, (6) model character, (7) long-term facilitation, (8) laboratory character and experimental space, and (9) education. In all these approaches, transdisciplinary and transformative orientations toward sustainability are considered essential aspects. However, Defila and Di Giulio (2018) note that the process of goal-setting is challenging due to the interaction of not only overarching common goals but also discipline-specific and individual ones. As we argue, poly-logical tensions unfold within such complexities (Kagan 2013; Nicolescu 2007), whereas the negotiation of common goals appears a 'wicked problem', which can never be ultimately solved, but must be re-solved repeatedly (Rittel/Webber 1973). Dieleman (2012) argues that the purpose of spaces of experimentation—even if they are organized around certain problems—is not necessarily to solve an issue but rather to engage with and learn from it. Respectively, Alcántara et al. (2018) point out how gaining a consensus shouldn't be considered the overarching aim in real-world labs and respective visionary processes, as integrating different forms of knowledge wouldn't automatically lead to a coherent vision. Rather, a mutual understanding and compassion for different demands and needs related to transformational issues should be foregrounded. Additionally, as Huning et al. (2021: 1596) remind us, "strategies, stakeholders, roles, and outcomes may change during the research process, leading to new directions and detours that were unpredictable in the beginning". Therefore, the delimitation of goals and the scope of real-world labs can be understood as flu-

id and processual. Thus, they build on the continuous identification of problems, the flexible inclusion of relevant actors, the reflection and acknowledgment of research conditions, and finally, the proposition, negotiation, and integration of concepts, methods, and practices. As we elaborate on for our case study, this demands from all involved actors to be flexible and capable of learning and adjusting — including, for instance, their concepts, methods, behaviors, time-schedules, priorities, and expectations of their environment and its transformation (Beecroft et al. 2018). Already, the engagement of people in extraordinary activities, such as real-world experiments, can appear a challenge, given the circumstance that they are already concerned with their everyday life and are not just available.

5. Permaculture as a boundary object for engagements with sustainability

Permaculture is a globally widespread gardening and social grassroots movement. It draws inspiration from indigenous knowledge from Tasmania and is based on three ethical principles: CARE FOR THE EARTH, CARE FOR THE PEOPLE, and FAIR SHARES (Holmgren 2017, Mollison 1992). These ethics and an additional 12 design principles (see Table 1) are applied not only to gardening but also to structuring social interactions within communities. Although these principles are openly formulated, they intend to have a consensual normative character of what is considered good and right, comprising the values of degrowth positions in sustainability discourse. In the scientific community, permaculture did not receive much attention until recently and is still not treated very often. Nevertheless, Holmgren (2017) promoted permaculture as an 'integrative science of Design' that avoids linear thinking and entails a complex 'systems view' inspired by scientists such as Howard T. Odum (1971) and James Lovelock (1979). Veteto and Lockyer (2008) placed permaculture within environmental anthropology (human-environmental interactions) and political ecology (resistance to current globalization trends orchestrated by capitalism). Framing the movement as "sort of a natural laboratory wherein potentially sustainable solutions are experimented with", they promote it as a possible response to the problem that "critiques of current approaches to development are [too often] unaccompanied by viable solutions" (Veteto/Lockyer 2008: 53). Newer approaches relate permaculture to the more-than-human studies (Jhagroe 2024, Kallio/LaFleur 2023), aligning with Macnamara's (2014: 1) call, that "[t]he goal of permaculture is to create harmony with ourselves, between people and with the planet", fundamentally contained in the three ethical principles mentioned above. However, the 12 design principles allow for in-depth perspectives and reflections on what this can mean concerning human and more-than-human communities (Henfrey 2018, Veteto/Lockyer 2008).

1. SMALL AND SLOW SOLUTIONS	7. APPLY SELF-REGULATION AND ACCEPT FEEDBACK
2. OBTAIN A YIELD	8. CREATIVELY USE AND RESPOND TO CHANGE
3. OBSERVE AND INTERACT	9. CATCH AND STORE ENERGY
4. USE EDGES AND VALUE THE MARGINAL	10. PRODUCE NO WASTE
5. DESIGN FROM PATTERNS TO DETAILS	11. INTEGRATE RATHER THAN SEGREGATE
6. USE RENEWABLE SERVICES AND RESOURCES	12. USE AND VALUE DIVERSITY

Table 1 – 12 Principles of Permaculture Design (Holmgren 2017)

These principles situationally invite to share imaginative thinking spaces, inspiring, for instance, reflections on scientific knowledge production. Engaging with the principle 'INTEGRATE RATHER THAN SEGREGATE' blurs the boundaries between scientific disciplines and invites a rethinking of what it means to act as a researcher. To 'USE EDGES AND VALUE THE MARGINAL' can take one further into questioning hegemonies as well as the accuracy of participative research methods—for who is included and who is left out in academic approaches? Or, as Bell et al. (2017) might say, what methodologies could be conducive to not taking a hegemonic attitude of domination over the subject under investigation? Giving

rise to imagining a science beyond the human/nature dichotomy (Latour 1994), this could mean exploring and considering the demands of more-than-human worlds in research practice. Concerning feminist critiques, it could also mean to develop a "critical, reflexive relation to our own as well as others' practices of domination and the unequal parts of privilege and oppression that make up all positions" (Haraway 1988: 579).

In these regards, permaculture can be a useful cornerstone to get involved with diverse actors and can even provide a "basis of transdisciplinary methodologies" (Henfrey 2018: 1) that "contribute[s] to a *shared repertoire*, a range of communal resources, writing, routines, rituals, and ways of doing things" (Ingram et al. 2014: 9). This goes in line with the need to support communicative competences and skills and to create non-hierarchical spaces for collaboration, as elaborated in the sections above (Renn 2019, Beecroft et al. 2018, Defila/Di Giulio 2018). Or, as a fellow artist told us in reflection of his work within a gardening project: "*There is an equality that we can never achieve outside of the garden, because we interact through the soil, through the plants, there's another way of taking care*". In terms of transformative research, these thought experiments and practices can contribute to overcoming barriers and create a tangible common approach to the issue. Therefore, we argue that permaculture holds the potential to serve as a "boundary object" (Star/Griesemer 1989) to facilitate dialogues and common engagements with socio-ecological issues, fostering integration and community-building. Star and Griesemer (1989: 388) introduced the concept of *boundary objects* as a necessity to manage diversity and cooperation throughout different social worlds, criticizing the myth that scientific cooperation would derive from a "consensus imposed by nature". They define them as "objects which are both plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites" (Star/Griesemer 1989: 393). Ingram et al. (2014: 13) refer to permaculture as a boundary object that helps to facilitate coordinating dialogues and practices within communities of practice, offering a "space for debate and differing interpretations". Respectively, we argue that permaculture-related thought experiments can help to find a common language and orientation within discussions, providing a framework open to creative associations and flexible adjustments.

Conversely, Haney and Morrow (2024: 100) argue that "[p]ractitioners of permaculture are likewise embedded within the system of inequality and social stratification created by capitalism and colonialism". In fact, in a comprehensive global survey, Ferguson and Lovell (2015) found that over 90 percent of permaculture practitioners are white. Even if, by the ethics and principles, permaculture could be considered as a framework inherently oriented towards sustainability, such as (community) resilience and waste reduction (Henfrey 2018), one should also be careful not to presuppose a sustainable impact within its various applications. Many permaculture projects and interventions differ drastically in the framework's application, often embodying compromises in terms of a holistic sustainability perspective. Furthermore, Holmgren (2017) describes permaculture as a system requiring a lot of information and design efforts, making it intensive in development and maintenance. Arguing for permaculture as a viable path to sustainability, such findings and demands deserve careful attention in order not to generalize and overestimate its transformative potential. Nevertheless, many permaculture projects make deep contributions to building resilient communities that are committed to producing healthy food and healing the relationship with the Earth (Roux-Rosier 2024, Stodulka 2020). Still, we consider sustainable living in communities to be not a state but rather a social practice that must be constantly re-actualized, constituting a 'wicked problem'. Jaeger-Erben (2022) reminds us here that, even in communities compatible with concepts of social and ecological sustainability, knowledge hegemonies and stereotypes can persist, as their normativity contains an exclusionary character. As we will see in the following chapter, the intervention of establishing a permaculture-inspired community garden sup-

ported the goal of community-building and 'softening the borders', promoting non-hierarchical ways of relating to and negotiating sustainability (see Domagala 2022, for a related short film).

6. Exploring the transformation process and realizing the real-world lab

We started our research separately in 2022 from our disciplinary perspectives, following a request from the artist residency's management to our university to accompany its ongoing and self-initiated transformation process towards more 'justice' and 'sustainability'. We both pursued an ethnographic approach, exploring the interactions between humans and more-than-humans in the practice of gardening and farming, and focusing on the artist residency's transformation process and respective potentials for collaboration. In shaping this publication together, our backgrounds in landscape research, sociology, and anthropology have led to prolonged yet fruitful negotiations, which attentive readers may perceive as subtle shifts of tone woven through the text. Exploring the possibilities for suitable accompanying research, we first focused on the artist residency's socio-ecological embeddedness (Grundmann 2018), history, structure, and transformational aspirations. A shift in the artist residency's management had induced a reflexive process concerning its position within the cultural sector's engagement with sustainability and social inequality, as well as the implications of these issues for residency programs. Before, the institution had experienced around 30 years of creating a protected space in which fellow artists could develop their work with minimal disturbances from outside. In doing so, the artist residency was critically perceived as a 'village within the village', marking its physical and historical prominence within the rural municipality as well as local concerns for transparency and participation. Transforming its institutional structure and culture, the artist residency now faced the twofold challenge to, on the one hand, formulate its transformational vision and, on the other, explore local perspectives on the institution. This had the twofold aim of promoting mutual exchanges: the fellow artists would experience local knowledge as an enrichment of their stay and work, and citizens could partake of the transformation process and get in touch with the international fellow artists.

Within our fieldwork, we simultaneously applied an ethnographic approach (Madden 2010), engaging with the staff, fellow artists, visitors, garden, and surrounding landscape. We employed focused and in-depth walking interviews, occasional encounters, analysis of documents (homepage, flyers, publications), and participant observations, including gardening and artistic activities. In this exploratory phase, we began to focus on two aspects: (I) to map the residency as a collective actor and real-world lab suitable for research on sustainability transformations in and through the cultural sector (Kreß 2022), and (II) to observe the suitability of the permaculture intervention to foster multispecies community-building in the garden, as well as to inspire the institution's transformation process by social permaculture (Steinhäuser 2022). For the latter, we conducted in-depth conversations with the staff and the 15 fellows while walking, being in their studios, or during their exhibitions. We elaborated with them on what kind of community such a garden could spark and what goals such a community would pursue. At a certain point in the conversation, we presented the 12 design principles printed on individual pieces of paper and invited them to sort and relate the principles to the ongoing transformation process of the artist residency.

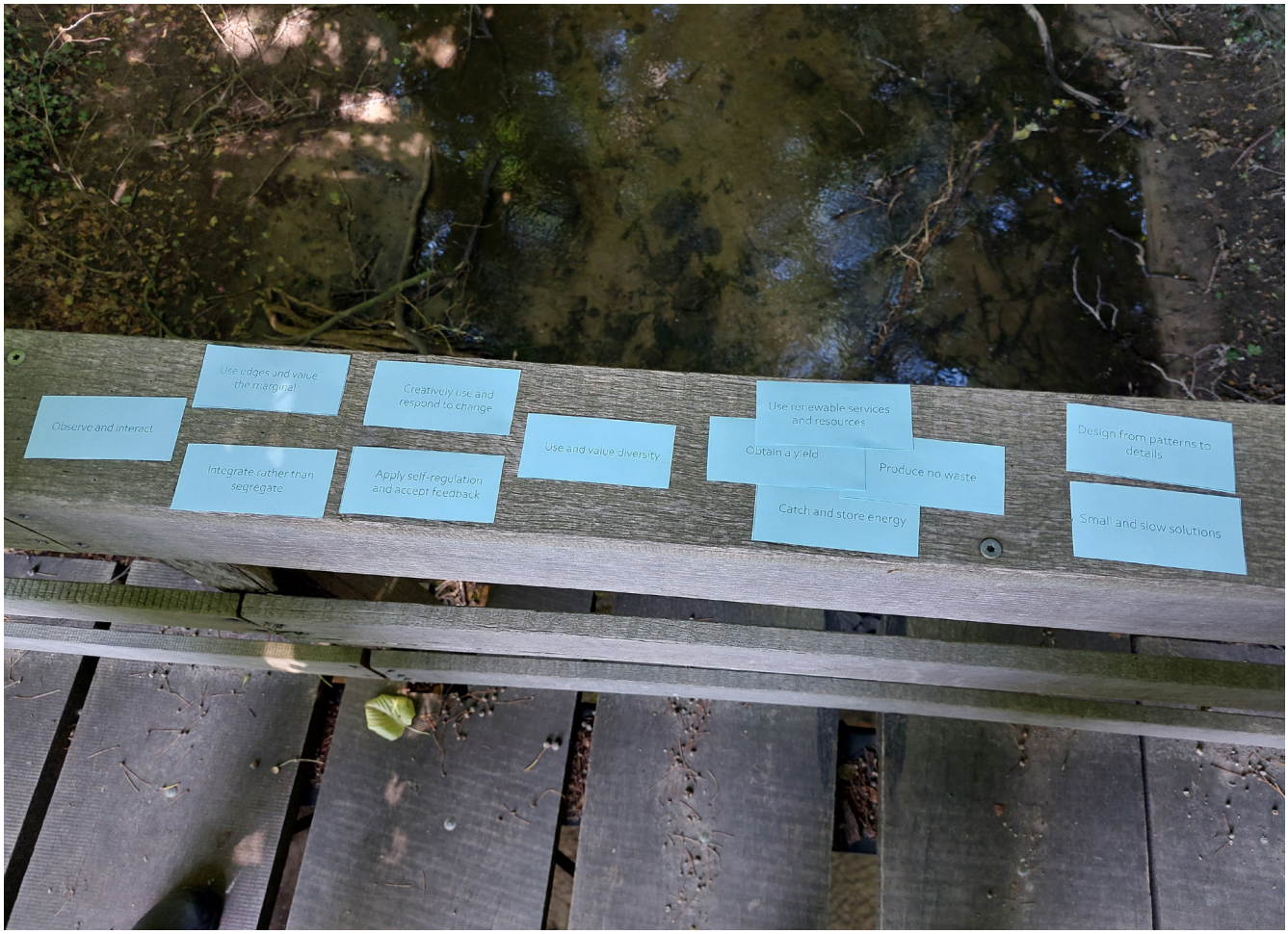

Figure 1: Sorting the 12 principles of permaculture and reflecting on the transformation process of the institution during a walking interview (Photo by C. Steinhäuser, June 2022)

A year after the institution's management's initial request, we invited them to join a Citizen-Science project to integrate the local citizens even more by applying integrative scientific and artistic interventions. This was not at last because the artist residency had demonstrated its willingness to integrate scientists and local citizens in a transdisciplinary mode and to facilitate educational programs. Furthermore, it appeared promising for long-term cooperation because of the institution's stability and, therefore, suitable to generate so-called system-, goal-, and transformation-knowledge (Singer-Brodowski/Schneidewind 2014). Fostering reflexivity represented a general goal of figuring out different visions, expectations, potentials of cooperation, and boundaries of actors possibly entangled in the institution's transformation process. Referring to Rittel and Webber (1973), respective negotiations appear as 'wicked problems' that don't have *the* right solution but must be approached, reflected, and re-solved within different contexts and involved groups.

In 2023, we coordinated jointly with the institution's management two types of interventions in which students of a project-affiliated course of ours also participated. As *one type*, we designed a participatory map to represent the subtle, often unconscious connections that are created by water between living beings. This map was to perpetuate in the project the inspirations from permaculture for community-building between humans and with more-than-humans. The creation of the map involved citizens contributing local knowledge on water sources, use, and care,

as well as perspectives from the international fellow artists. The intervention sought to draw attention to the residency's current opening to the village and would eventually be integrated into the institution's 'Living Library'—a space opened that year for gathering and discussing local knowledge and literature. As a *second type* of intervention, we carried out a 'Vision-Day' and a 'Discussion-Forum' for citizens interested in the institution's work and possible collaborations. The central topics for these interventions were the citizens' perceptions and expectations of the artist residency, potentials and challenges for possible collaborations, as well as obstacles in communication and engagement with the fellow artists.

7. Integrating science and arts within collaborative interventions in the case study

A core element of our collaboration was that the impulses for interventions did not originate from the scientific side—which had defined the setting as a real-world lab—but equally from the artist residency (see Figure 2), which, due to its local embeddedness, maintained closer contact with the citizens and their activities. The artist residency had already opened its doors, inviting to regular art-related events and social gatherings (Dinner, Open Ateliers), and organizing annual programs focusing on different spaces within its facilities. During our accompanying research, such (social) spaces were a 'Community garden and social permaculture', and the 'Living Library'. These spaces enabled encounters (in)between artists, local citizens, scientists, and broader society and facilitated diverse discussions about their potential use, bringing up tensions and reflections such as: Who is allowed to use the spaces, when, and how? How could the artist residency program be aligned with demands formulated by non-artists and within discourses on sustainability? What can be expected from artists and local citizens regarding the institution's transformational aspirations? Who could be involved in informing and realizing those aspirations?

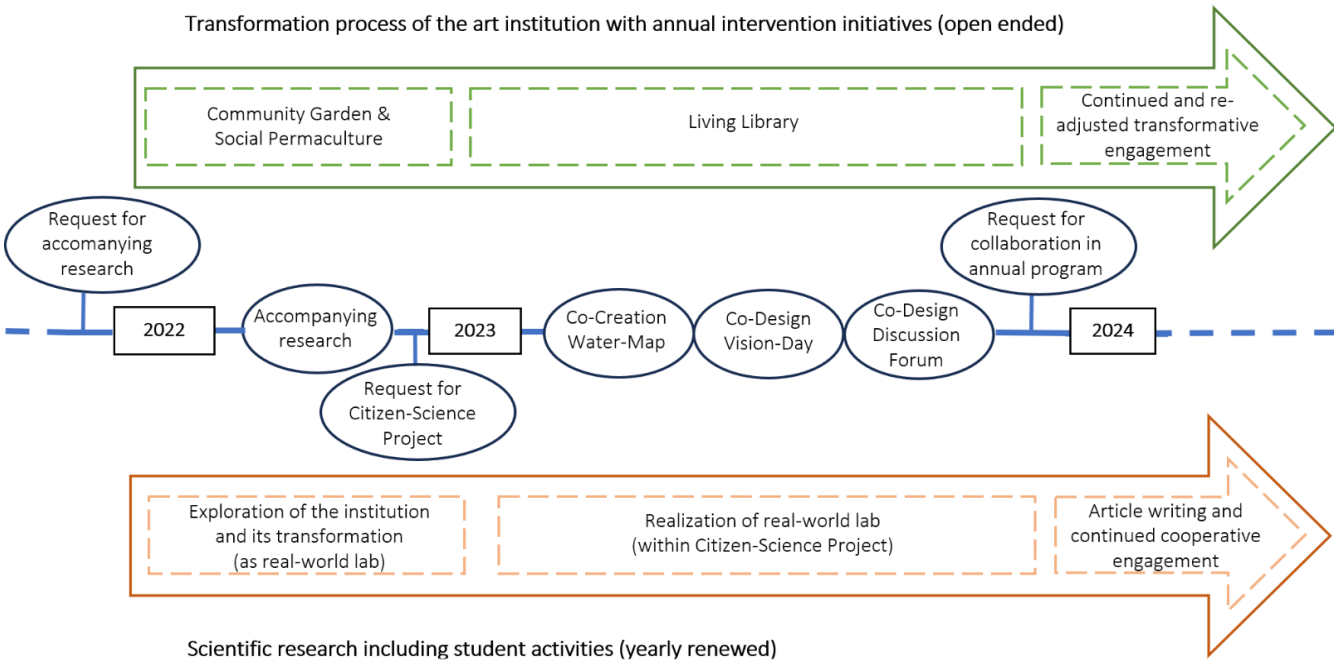

Figure 2: Overview of research and collaborative interventions between the artist residency and the university

The annual program 'Community garden and social permaculture' aimed at applying the principles of permaculture to social interactions within the institution and its infrastructural transformation. In parallel, a community garden was grown on the border of the residency's grounds, where citizens would pass by daily. Applying permaculture principles as an orientation — and, as we argue, as a boundary object — the artist residency linked (more-than-human) community-building with sustainable transformation. Understanding the garden as a "*radically inclusive system*" that could connect "*people that are not necessarily interested in art or in cultural expression*", the artist who initiated the garden stated that he wanted to 'soften the borders' of "*this is private, this is public, this is art, this is non-art*" and promote encounters between different people and the more-than-human world, including plants, fruits, the soil, insects, and bacteria. These encounters in the garden nurtured the reflexive potential of the permaculture principles, and fostered community not only between the fellow artists and residency staff but also with the local citizens and more-than-human world in a non-hierarchical way. Through this integrative approach, raising questions about "What is ecology – also concerning the institution's structure?" or "How is being taken care of one another within and across the artist residency?" were part of engaging collectively in a reflexive process that supported the artist residency in adjusting and pursuing its transformational visions.

By integrating the principles of permaculture into its mission statement, the institution paid attention to its transformation process and attempted to foster responsible and solidaric behavior throughout. However, as a curator of the program in 2022 pointed out, one should be skeptical "*when permaculture is reduced to an instrumental scheme for 'sustainability' […] while the practices 'borrowed' refer to a profound transformation of being in and relating to the world*" (Schroer 2022: 5). Similarly, when asked to describe the transformation process through the lens of the 12 design principles of permaculture, some of the fellow artists were skeptical. Reacting to the principle 'INTEGRATE RATHER THAN SEGREGATE', one fellow artist stated: "*It is beautiful, but it is all like clichés. Who wouldn't agree with that?*". Others were inspired to connect with their 'inner' or 'outer' worlds, as for the principle 'USE EDGES AND VALUE THE MARGINAL' one expressed: "*I was amazed of the things that came out of the unexplored places of myself*". Another proclaimed, "*It is to go beyond this kind of hegemonic structures of what art is*". The effectiveness of the intervention in combining social and gardening permaculture also became evident in the principle 'OBTAIN A YIELD', causing a sensible and reflexive reaction: "*When you watch something grow, in a way you are caring for it, you are watching it, you feel responsible*." Finally, we could witness how our interviews encouraged shared reflections; and regular joint gardening, harvesting, and cooking gradually strengthened a sense of belonging among the fellow artists, which began resonating outside and attracted interest. This resulted in a final vernissage of their art pieces, called 'The Harvest'. Such a shared activity involving all fellows was unusual and indicated that the aim of community-building had begun to bear fruit.

To reach more people, the Vision-Day was embedded within a broader event of the artist residency. Sensitizing for the fields of tension that the institution's transformational aspirations raised, it became clear how the artist residency as a (partly) governmentally funded institution was expected to compensate for the negative developments of rural areas in the last decades (i.e., loss of bars and restaurants) and transform into a culture-touristic- or event-space. It was also highlighted that mostly the same people showed up for the institution's (participative) open events, probably related to a perceived distance towards the institution and its international residency concept. As the coordinating director of the artist residency had explained earlier in an interview, this represented a conflictual tension, making collaborations difficult because possible collaborators wouldn't perceive the institution's transformation towards 'justice' and 'sustainability' with concern for its prior mission to support artists and engage critically with structures of art-production and related residency programs (Figure 3).

Figure 3: Perspectives of the participants on the role of the institution during the Vision-Day (Photo by C. Steinhäuser, June 2023)

Having evaluated the Vision-Day within a group discussion, including the artist residency's coordinator and secretary, as well as some of our students, helped to sharpen our understanding and negotiate the goals of the Discussion-Forum beforehand in a co-productive manner. Even if neither intervention involved large numbers of participants, they established a common testing ground for collaboration. They fostered reflexivity not only within the *artist residency* — as it became directly confronted with scientific and broader societal transformational ideas and demands for collaboration — and the *local citizens* — being confronted with the institution's vision and boundaries — but also for us as *scientists* — gaining experience in transdisciplinary practice and learning to facilitate respective encounters. Especially within the Discussion-Forum that was opened by us with a small presentation of our perspective on the institution's transformation and respective challenges, a productive dialogue including representatives from local educational institutions and a local company, as well as fellow artists and local citizens, was successfully facilitated.

8. Creating a common ground within transdisciplinary research groups

To 'soften the borders' by reinterpreting and restructuring the institutions 'inner' and 'outer' space finally helped to integrate ecological as well as broader societal concerns into its transformation process. The garden, through its regenerative capacity and locally adjusted biodiversity, was intended to symbolize connection, health, and complexity. In its physical presence, it persistently reminded one to sustain the application of (social) permaculture principles to the transformation process. Within our framing, permaculture functioned as a boundary object connecting different perspectives on sustainability, facilitating dialogues between them, and inspiring practices that helped to find common ground. Referring back to Nicolescu (2007) and Kagan (2013), this aimed at acknowledging the poly-logical complexity of the institution's transformational process within a broader societal context and helped to non-hierarchically negotiate the frames of reference. As we engaged in an inter- and transdisciplinary mode with each other, we

learned not only about different (disciplinary) ways of engaging with sustainability and societal issues, but also about communicative and collaborative competences, such as being patient, understanding, and flexible. In this regard, an educational environment had been created that fostered transformative literacy by inviting people to learn about each other's perspectives and practices, while helping to situate and articulate one's own standpoint within debates on the artist residency's transformation (Singer-Brodowski/Schneidewind 2014).

In their yearly publication, the institution reflected that "[t]he fruits of our efforts and endeavors often show up only after a time lag. Sometimes they do not appear at all, or not in the expected place or imagined form" (Haarman/Schroer 2022:43). Hence, it would require open-ended processes promoting intuition, patience, and confidence. Observing and participating in this engagement, we — as scientists trying to understand the relations and associations respectively made—were sensitized here too, learning from the worldviews, knowledge, and rationalities proclaimed by permaculture and its adherents. Especially the relational approach proclaimed within, foregrounding a sensitive process-orientation and non-hierarchical ways of relating, inspired our inter- and transdisciplinary engagements and served as a common ground for interaction and dialogue. Permaculture continued to serve as a valuable boundary object for addressing complex questions beyond the garden and community in the 'open spaces' set up during the following years of collaboration (Steinhäuser 2024). The participatory map co-created with students, current and former fellow artists, scientists and local citizens, entailing diverse stories and knowledge on water (places) in the region, became institutionally integrated and is still available at the artist residency, representing a manifestation of an ongoing transdisciplinary engagement and learning process (see https://storymaps.arcgis.com/stories/c75e6145860e421fbde95dcbf04f8947).

Finally, without wanting to overstate the role of permaculture, our interviews and observations revealed how it supported ongoing processes of growth, care, and life in the garden—reflecting a more-than-human understanding of co-becoming, as articulated in Ingold's work. Likewise, the approach of the artist who initiated the garden—treating the soil and the work with plants as a non-hierarchical form of communication—made perceptible a sensibility, resonating with Escobar's (2018) call for relational and pluriversal ways of knowing and being. In this way, an empathetic space for learning and exchange was created. An aspect that constitutes a key prerequisite for effective work in real-world labs.

9. Improving reflexivity in the transformative real-world lab

As Beecroft et al. (2018) state, the potential of a real-world lab is not necessarily self-evident for all actors in its initial phase. It might be difficult to frame *the* problem(s) and respective solutions from the beginning, as "[t]he formulation of a wicked problem *is* the problem" (Rittel/Webber 1973). Likewise, our conceptualization of the real-world lab might at first not have been comprehensible and of value for all involved, as it stemmed only from theoretical exploration. Only as we started to co-design and initiate the Vision-Day and the Discussion-Forum, the framework's potential to create a transdisciplinary space of possibilities that could foster reflexivity and collaboration became increasingly evident. Situating our real-world lab conceptualization within the intersection of the definitions presented above, we understand it as delimited by the nine characteristics proclaimed by Parodi et al. (2023), only taking distance from pinning it down as a space exclusively dealing with *a priori* fixed normative sustainability goals. From a *process-oriented* and *actor-centered* perspective, the formulation of such goals would have to be accompanied by reflections on the understanding of sustainability and its normative implications, as described in the sections above.

Combining the definition proclaimed by Wagner and Grunwald (2015) and the WBGU (2016), we comprehend the real-world lab as both a "societal arrangement" and a "scientifically designed space", high-

lighting the importance of transdisciplinarity and the respective proceedings of co-design, co-production, and co-evaluation. Still, whether and to what extent this kind of engagement is always achieved is questionable and should be part of the processual evaluation during research. Dieleman (2012) reminds us here that, in transdisciplinary projects, researchers tend to think in terms of their disciplines and fields of knowledge. Following him further, we understand that, even if being conceptually rooted in science, transdisciplinarity — and, as we emphasize, real-world labs — should not be reduced simply to a scientific endeavor but acknowledged as an interest proclaimed and actively realized by broader society, too.

Applying the real-world lab framework also attended to Rivera's (2022) call for the establishment of spaces where artists can combine their strengths with others. Still, as others argue more carefully that it would be wrong to oblige artists to adopt a transformative perspective (Kuni 2021), it appeared crucial to stay sensitive and responsive to the artists' perspectives and demands. This tension became particularly clear concerning the artist residency's transformational aspirations, as the coordinator noted in an interview, the difficulty of getting the fellow artists regularly and reliably involved without binding their residency to constricting obligations. At this point, we can say that the aim of transformation within the artist residency, within ourselves, and of our activities in academia has borne fruit. However, as observed by Jaeger-Erben (2022), this occurred with varying degrees of intensity and inclusion of all those involved. Our case certainly did not trigger a collective awareness. Still, several individual connections and broader networks have developed among the artist residency, university scholars, initiatives, and broader society, persistently drawing wider circles.

We focused on the artist residency's transformation process and its engagement with permaculture to illustrate integrative approaches in the arts that foster reflexivity on issues of sustainability transformations. Furthermore, we framed the artist residency as a real-world lab to address the potential of integrative approaches in the sciences with the arts and broader society. In terms of transdisciplinary research, a lack of exchange on practices, experiences, potentials, and challenges has been stressed (Lang et al. 2012: 52). But recognizing the complexity of experimental settings, there are also methodological challenges, such as the context-specificity of research, making it difficult to transfer findings or proceedings to other contexts (Schneidewind 2014). Therefore, strategies for issues within must often be adjusted to the specific context and cannot be generalized. Nevertheless, the given paper presents one attempt to contribute respective insights and foster a productive exchange and dialogue.

During our collaborations, the integration of different forms of knowledge from various sources and experiences was essential to address transformational issues in an open and non-hierarchical mode. However, this integration posed numerous challenges, not only to negotiate hierarchies, responsibilities, and values but also to build trust for collaboration. The task of integration appeared in threefold interlinked dimensions that are proposed here as a heuristic for transdisciplinary and integrative approaches:

– *Conceptual Dimension (Integrating different forms of knowledge, rationalities, and concepts*): Differences within this dimension were bridged by permaculture as a boundary object, facilitating a common ground and language. Additionally, mutual engagements and understanding were fostered by dialogues and negotiations, as for instance: Local citizens expressed their perceptions of and experiences with the artist residency, sharing their local knowledge, while we, as academic scholars, shared scientific insights on, for instance, socio-ecological transformations and human/nature relations.

– *Methodological Dimension* (*Incorporating various methodologies, including criteria of validity and reliability*): During the collaboration, we stayed constantly open to ideas concerning procedures and results of initiated processes, discussing them frequently. Cre-

ating the participatory map, for instance, unfolded as an intensive engagement, demanding the negotiation of a vision for the project's implementation and result, not least because analyzing, evaluating, and representing data from interviews can be based on very different standards in the arts and sciences.

– *Practical Dimension* (*Considering an awareness of spatial-temporal aspects and people with their varying worldviews and capabilities*): Since the collaboration was initiated by the artist residency and the data collection and interactions mostly took place within its facilities and environment, the scheduling was largely shaped by local routines and events. Some aspects, such as the involvement of students, required adjustments to align with their academic calendar. Bridging language barriers between the international fellow artists and the local citizens presented another considerable challenge. Lastly, involved people had differing understandings of what-is and what-ought-to-be, creating a necessity of negotiating respective understandings.

As we argue, reflecting on such aspects within real-world labs is important for establishing common grounds within transdisciplinary teams, even if it appears time-consuming and often challenging. As research inevitably entails all three dimensions — considering, for instance, the theoretical constitution of methods being practiced by and directed at actual people — the task of integration becomes particularly complex in terms of sustainability and transdisciplinarity (Kagan 2013). By applying an ethnographic approach and proceeding in a process-oriented and actor-centered manner, we were always careful not to prematurely overlay academic frameworks on processes, not to intervene in endogenous initiatives. Being involved in transformative science, we aspire to nurture processes with insights and scholarly theories that we think can contribute to specific transformation processes and their reflection. In contrast to a catalytic science (Renn 2019) that primarily focuses on researching, testing, and structuring transformational designs, we aimed at co-moderating and intervening in transformation processes by introducing a transdisciplinary framework and scientific perspectives (Defila/DiGiulio 2018, Schneidewind et al. 2018).

As during the presented period, the artist residency related to sustainability as a desirable orientation, addressing issues of unsustainability and inequality through permaculture, and as they invited us to accompany their transformational process, it appeared promising to offer and integrate our perspectives accordingly. Grunwald (2015) reminds us that negotiating the role of experts in participative approaches forms a special challenge of transformative science. Confronting this challenge by being careful and open to each actor's perspective helped to perceive, appreciate, and bring into dialogue the plurality of worldviews, knowledge, rationalities, and finally, people relevant to our research and its broader legitimization.

10. Concluding remarks

Through interventions of real-world experiments, we aimed to foster the institution's transformation processes by helping to understand, frame, and persistently re-solve the tensions between its twofold constitutional purpose and its updated mission statement, pursuing more 'sustainability' and 'justice'. Henkel et al. (2019) argue that transdisciplinary spaces can help reflect and make explicit the implicit premises of sustainability discourses and their action orientations. Similarly, Dieleman (2008: 7) suggests that science can improve the „reflexive capital of people and societies". Having drawn on our experiences and insights from research, we proclaimed real-world labs to be a promising framework for fostering reflexivity by facilitating collaborative and educational processes. Here, the promotion of transformative literacy and creative imagination, as well as perspective-taking with the more-than-human world, have been aspects of reflexivity in integrative approaches in the arts and sciences, manifested in collaborative interventions. Having presented the real-world lab approach to the artist residency from

a scientific perspective, it has been continuously enriched by the artistic activities (public exhibitions, open ateliers days) and management's ideas during the iterative transformation process and accompanying research. The artists supplemented our scientific dealings, for example, by subtly mirroring and sensitively delving into current (un)sustainable grievances and processes. Finally, many of the fellow artists focused their artwork more strongly on the more-than-human world and reflected their relationship. Respective engagements with permaculture led to the commonly initiated vernissage 'The Harvest', which contained many metaphors of gardening, while dealing intensively with topics such as the aesthetics of gardening or impressions gained from the local rural landscape.

Acknowledging the plurality of worldviews, knowledge, and rationalities, we stressed the importance of negotiating towards common visions and practices for sustainability. We highlighted that developing communicative capabilities, openness, flexibility, and patience is crucial in inter- and transdisciplinary settings to successfully negotiate and integrate diverse perspectives within the theoretical, methodological, and practical dimensions of (integrative) research. Beginning with accompanying research that developed into the establishment of a transdisciplinary environment for collaboration and education, the real-world lab fulfilled a triple purpose of researching, fostering, and educating about socio-ecological transformation processes (Parodi et al. 2023, Beecroft et al. 2018, Defila/Di Giulio 2018). Still, despite the given potential, we also aimed to be cautious not to impose one's own rationalities and normativity on endogenous processes. The case study demonstrated the complexity and time-intensive nature of integrative and participatory approaches between the sciences, arts, and broader society. By critically situating and elaborating on our real-world lab approach, we gave insights into our construction and procedures, contributing to a structured exchange and offering inspiration for other real-world labs. Advocating a process-oriented and actor-centered approach, we were motivated by the institution's repeated requests for our research, leading to a mutually embraced collaboration and an iterative process. The trust from the institution's management supported our experimental approach, allowing us to test and evaluate possibilities. Concluding, we'd like to turn to a fellow artist's response to the permaculture principle 'SMALL AND SLOW SOLUTIONS', who commented: "*I think, when we try to make big changes too fast, I think people reject it. But if there is a small or gradual change, then people are able to accept. Able to accept or able to adjust to it. I think it [permaculture] is not about nature but in life in general.*"

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