A. Henkel | S. Berg | D. I. Mader | A. Müller et al.

Dilemmas of Sustainability. On Relevance and Critical Reflection in Sustainability Research

A Guide

Nomos

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Introductory remarks

We are currently living in the Anthropocene. Whether one belongs to those who agree or to those who do not like this term – a crucial question is whether and how the future can become a good age, good for the environment as well as for our fellow human beings. Can future development, despite many fears to the contrary, not also become a *good Anthropocene,* a time of "peace with nature", as Klaus-Michael Meyer-Abich wrote already in 1984, as well as of justice among people and between generations?

As presumptuous and illusory as this may currently seem in the face of multiple crises, setbacks in efforts to establish a multilateral and just world order, and the diverse resistance to substantial climate protection: this is precisely the goal of the guiding principle of sustainable development. According to the well-known definition of the Brundtland Commission, development is sustainable "if it meets the needs of the present without compromising the ability of future generations to meet their own needs" (cf. Hauff 1987, p. 46, our translation). Because this utopia of a just human culture is inconceivable without "peace with nature", the guiding principle of sustainable development fits the vision of a good Anthropocene.

Yet how can we make progress along the way? How can things be changed that have been developing over decades, sometimes centuries: infrastructures and technology, business models and value chains, but above all cherished habits and beliefs? Answers remain controversial and full of conflict. How simple it would be if there was a clear definition, a kind of recipe for sustainability, a checklist that merely had to be worked through so that everything would come to a good end.

As we know, there is no such recipe. Instead of lamenting about it, however, it is important to understand this situation as a challenge that corresponds to the *conditio humana.* This includes the openness of the future and the realisation that the future depends on decisions made today. A recipe for a good Anthropocene would be convenient but also somehow unworthy: not appropriate to the freedom and responsibility of the people, and mere execution without freedom to shape the future. Rather the indeterminacy and openness of sustainable development are precisely what encourage active and creative shaping of a good future, however arduous this may be.

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Of course, freedom must not end in arbitrariness, and openness must not end in endless disputes or helplessness. To spell out sustainability again and again without a fixed recipe, to relate it to contexts and new situations, to carry out complex considerations in a comprehensible and transparent way, not to succumb to the pressure of interest groups and lobbyists – all this is highly demanding and often exhausting.

The authors of this guide have set out to systematically support precisely this, a thoughtful but non-prescriptive pathway towards more sustainable development. No supposedly ready-made solutions are offered, as is so often the case when it comes to sustainability. They do not proclaim what needs to be done urgently. Instead, their goal is to support the ongoing search for viable solutions by systematically explaining the difficulties that inevitably stand in the way of this quest – difficulties that are due to the subject matter and its complexity and not to the inability of science, politics, business or civil society. This guide does not relieve anyone who wants to commit to sustainability from thinking for themselves but aims to serve the contextual and creative search for good solutions – support for individual thinking, empowerment of the many who set out on the pathway of sustainability.

As the title already indicates, this is done on the basis of dilemmas of sustainability. This may sound unwieldy or academic, but it makes it immediately clear that in the field of sustainability, any desire for simple solutions is misplaced. Indeed, anyone who waits for or relies on simple answers has already lost the struggle for sustainable development. Theory is needed, but it must serve practice and not become an end in itself. The guide makes clear how theoretical reflection can be useful in practical terms. Thus, abstract thoughts can develop into very practical questions, dilemmatic structures and criteria as to what to pay attention to in efforts for sustainability and transformation. The guide presents, I would say metaphorically, a systematic and comprehensible map of the many difficult questions that are relevant to efforts for sustainability. Due to the tensions, a simple recipe for sustainability cannot exist. Precisely for this reason, however, the tensions are decisive for an open and good shaping of the future, or, to take up the idea at the beginning, of a good Anthropocene.

This guide faces up to the toils of the plains (*Mühen der Ebene*, Bert Brecht) and avoids offering quick solutions. This approach corresponds to the *conditio humana* in the 21st century: no rash reduction of complexity but rather reflected and informed action amid complexity. Or in the terminology of the guide itself: it is not a matter of coping with or overcoming

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the dilemmas but of living and acting wisely within them. To this end, the guide is a timely, perhaps overdue handbook which I hope will be widely received!

Armin Grunwald

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Inhaltsverzeichnis

Foreword 13

1. Introduction: Why another guide? 15

2. Instructions for use 23

3. Sustainability and dilemmas – Theory for practice 25

3.1 Sustainability – Analytical understanding of sustainability 25

3.2 Dilemmas – On the basic structure of practical dilemmas 27

3.3 Dilemmas – Determinations of dilemmas of sustainability 29

3.3.1 Conflicting goals as a potential cause of dilemmas 29

3.3.2 Conflicts of time as a potential cause of dilemmas 29

3.3.3 Conflicts of interest as a potential cause of dilemmas 30

3.3.4 Conflicts between different forms of knowledge as a potential cause of dilemmas 30

3.3.5 Conflicts between different understandings of sustainability as a potential cause of dilemmas 31

3.3.6 Conflicts over responsibility as a potential cause of dilemmas 32

3.3.7 Dilemmas as a touchstone for the feasibility of norms of action 33

3.4 Early recognition: areas of tension with potentials for dilemmas 33

3.4.1 Implicit assumptions in the project context 34

3.4.2 Cooperation and participation in inter- and transdisciplinary research projects 36

3.4.3 (Transdisciplinary) research in structures of funding and science 37

3.4.4 Research in the context of social framework conditions 39

3.5 Clarification: Strategic assertion and denial of dilemmas 40

3.6 Processing of dilemmas: Between win-win and trade-off 42

3.6.1 Two basic prerequisites for overcoming dilemmas 43

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3.6.2 Processing of dilemmas at the level of obvious objective conditions for action (technical solutions) 45
3.6.3 Processing of dilemmas at the level of obvious subjective premises (justification of trade-offs through rules of prioritisation) 45
3.6.4 Processing of dilemmas at the level of underlying objective conditions for action (change of fundamental social institutions and structures) 46
3.6.5 Processing of dilemmas at the level of underlying subjective premises (change of fundamental values and norms) 46

4. Metacriteria of sustainability 49

4.1 Metacriterion 1: The understanding of sustainability used in the project is reflected upon with regard to its possibilities and limitations. (Block A) 50

4.2 Metacriterion 2: The description of the problem and the objectives are reflected upon by all participants as a framework for action. (Block B) 53

4.3 Metacriterion 3: The forms of knowledge underlying the project with their opportunities and limitations are reflected upon. (Block B) 55

4.4 Metacriterion 4: Basic decisions and implicit assumptions are reflected upon in the project. (Block B) 58

4.5 Metacriterion 5: The processes and possible tensions of inter- and transdisciplinary cooperation are reflected upon. (Block C) 60

4.6 Metacriterion 6: The policies with regard to time in the project are reflected upon. (Block C) 63

4.7 Metacriterion 7: If attributions of responsibility exist, they are actively reflected upon in terms of their justification, their limitations and their effects. (Block C) 65

4.8 Metacriterion 8: A use of the term “dilemma” is actively considered. (Block A) 66

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5. Additional guiding questions for funding organisations 69

Literature 73

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Foreword

This guide emerged from the collaborative project "Dilemmas of Sustainability between Evaluation and Reflection", which was funded by the Ministry of Science and Culture of Lower Saxony and the Volkswagen Foundation from 2019 to 2023. We are very grateful for the generous and always supportive funding, even through the unpredictability of the pandemic. With the funding line on Science for Sustainable Development, synergies and continuities have emerged across various thematic aspects of sustainability, to which this project is also deeply committed. We would also like to thank the reviewers, whose questions and suggestions provided important impetus for further development right up to the end.

In addition to numerous individual publications, the work on this project has produced two publications that are complementary to each other and are both published in parallel by the Nomos Verlag: the anthology "Dilemmata der Nachhaltigkeit" (Dilemmas of Sustainability), which is primarily aimed at a specialist scientific audience – and the present guide, which uses the results of the project to reflect on dilemmas of sustainability for other projects and their funding. This English version of the guide is the translation of the original German publication "Dilemmata der Nachhaltigkeit: Zur Relevanz und kritischen Reflexion in der Nachhaltigkeitsforschung" (ISBN 978–3–7560–0367–9, available open access here: Dilemmata der Nachhaltigkeit: Zur Relevanz und kritischen Reflexion in der Nachhaltigkeitsforschung – Nomos eLibrary (nomos-elibrary.de)).

We would like to thank the participants of the scientific conference on the dilemmas of sustainability in the summer of 2021 at the Carl von Ossietzky University of Oldenburg which took place online. Their contributions provided impulses for the further development of this guide. We are pleased that many of these contributions have been compiled in the aforementioned anthology.

We would also like to thank the members of the Advisory Board who have accompanied the project from the beginning: Alfons Bora, Katharina Block, Stefan Böschen, Uta Eser, Armin Grunwald, Marc Hübscher, Martin Kowarsch, Fred Luks, Thomas Melde, Nils aus dem Moore, Monika Müller, Georg Müller-Christ, Michael Opielka, Martina Padmanabhan, Werner Rammert, Bettina Schmalzbauer, Uwe Schneidewind, Imme

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Scholz, Maren Schüpphaus and Dagmar Simon have, in the context of advisory board meetings, impulse papers on dilemmas of sustainability as well as participation in the project's scientific conference, contributed to the development of this guide.

Finally, and most importantly, our thanks go to Thomas Jahn, Nicole Karafyllis and Daniel-Pascal Zorn for their contributions to the discussions in the project. These joint discussions helped to advance the project as a whole and provided important impulses for the development of this guide.

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1. Introduction: Why another guide?

General acceptance of sustainability

Sustainability is socially established as a concept and a requirement. A simulation model originally designed for the preservation of resources and associated discourse (Meadows/Meadows et al. 1972) was already expanded in the Brundtland Report to include the objective to combine ecological, social and economic goals in such a way that corresponding resources should also be available to future generations (Hauff 1987). At the latest with the adoption of the *Sustainable Development Goals* (SDGs) by the United Nations in 2015 the legitimacy of this objective and the heterogeneity of the associated goals became widely recognised across societal actors (Pfister/Schweighofer et al. 2016). The broad consensus and high level of acceptance became clear at the 2015 World Climate Summit in Paris, where representatives of politics, business and various sectors of civil society were able to find common ground on at least one internationally valid agreement with sufficiently ambitious climate targets.

Sustainability as an empty signifier?

This general acceptance of sustainability, however, brings with it a fundamental difficulty: as sustainability refers to heterogeneous objectives, and different social groups define and claim "sustainability" for themselves, the term becomes increasingly blurred. This already becomes clear in the above-mentioned SDGs, as there are partial contradictions between them and their underlying goals (Koehler 2016, Stevens/Kanie 2016, Nielsson et al. 2018). Sustainability threatens to become an *empty signifier that is in* many respects connectable. As a "black box", however, it can simultaneously be strategically filled and concretised in many ways, e.g., with initiatives on the bioeconomy (Gottwald/Krätzer 2014) and on geoengineering (Galaz 2012) but also with demands from cultural sciences to abolish anthropocentrism (Ribot 2014), or with a turn towards posthumanism (Badmington 2000). At the same time, the vagueness of the term opens the door for doubts regarding the legitimacy of sustainability – critique of sustainabili-

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ty projects and transformative research then ranges from accusations of "*green washing" by* purely profit-oriented interests to accusations of "transdisciplinary solutionism" (Strohschneider 2014, Wehling 2022). Critique of the concept of the Anthropocene, which is dominated by technology and the natural sciences (Bonneuil/Fressoz 2016), or critique from countries of the Global South and from gender research, which see strategies for affirming long-established, discriminatory dualisms (North/South, man/woman) behind "sustainable development" (Simon-Ku mar/MacBride-Stewart et al. 2017, Henkel/Bergmann et al. 2018: 147), also go in this direction.

Resulting challenge for sustainability projects and their funding

This overall constellation of, on the one hand, a great acceptance of sustainability and, on the other hand, an equally great diversity of understandings and criticisms of sustainability is fundamentally problematic for all those who want to make a positive contribution to sustainability themselves – i.e., for all those who plan, implement or finance sustainability projects. Sustainability as a discourse and as a social concern does bring important ethical dimensions into everyday consciousness (preservation of ecological resources and ways of life, fair distribution of wealth, non-discriminatory treatment of each other, etc.). However, sustainability itself does not offer any clear specifications and criteria as to which of these demands should be translated into standards, how they should be weighed, and by means of which measures they should then be mandatorily achieved for which dimension. In every effort to make a positive contribution to sustainability, misunderstandings, negotiation processes, conflicts and dilemmas are therefore inevitable as to whether, to what extent and with regard to which aspects a concrete measure or a research project can meaningfully claim the designation "sustainable". At the same time, precisely these disagreements and practical dilemmas can be used to assert interests or serve as an invitation to shifting responsibility for one's own problematic actions (cf. Henkel/Bergmann et al. 2018: 147f).

Analytical understanding of sustainability as a "third way"

Two obvious responses to these challenges are to either abandon the concept of sustainability altogether or to develop a concept of sustainability

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that is as clear-cut as possible and operationalisable, and to use it as a guide for action. With this guide, we choose a third way. In doing so, we assume that "sustainability" has an irreplaceable orienting function despite the known difficulties. At the same time, for the purposes of this guide, we do not assume a specific concept of sustainability. Instead, we take an analytical understanding of sustainability as a basis. In the context of this guide, the term sustainability does not refer to specific properties or qualities. Rather, it refers to a discourse that spans different definitions, concepts and objectives, as has been the case since the 1970s under keywords such as sustainable development or sustainability. What these heterogeneous terms have in common is the assumption of a coupled relationship between society and nature, the premise of a temporal development and the assumption of a transformation potential of knowledge. The analytical understanding of sustainability proposed here refers to this thematic definition without preferring a concretisation as a specific understanding of sustainability itself. Rather, it contains a multitude of possible substantive concretisations and formulations of objectives without defining one understanding in advance as the only valid one. It thus describes a kind of corridor in which conflicting or even contradictory operationalisations are possible.

Aims of the Guide

Against this background, *this guide* provides the opportunity to reflect on the understanding of sustainability used in each case and thus to concretely determine the specific contribution as well as the limitations it entails.

As a heuristic for such a reflection, we resort to dilemmas of sustainability. The heterogeneous objectives, time policies, forms of knowledge, actors and their interests gathered under the umbrella of sustainability quickly come into conflict with each other and turn into seemingly unsolvable dilemmas: every concrete attempt to implement "sustainability" (in certain respects) then leads to a foreseeable violation of "sustainability" (in other respects) and thus has unsustainable consequences. Our proposal is not to understand dilemmas of sustainability merely as unsolvable obstacles to action that have to be circumvented conceptually. Instead, we advocate using dilemmas in a productive way as a heuristic for reflecting on the problems of sustainability. This requires *dealing with areas of tension for the early recognition of dilemmas, the clarification of a possible strategic use of dilemmas and the processing of dilemmas in sustainability research.*

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Dilemmas of sustainability

Dilemmas are situations in which actors have to choose between several bad alternatives, cannot change the conditions of the situation, and cannot carry out a hierarchisation of the given alternatives. To act in spite of these conditions eventually requires unjustified, arbitrary action (Mader 2023). *Dilemmas of sustainability exist because of the contradictory nature of relevant objectives, forms of knowledge involved, actors involved, valid time policies and normative orientations.*

Every understanding of sustainability provides orientation in dealing with these dilemmas. *However,* this orientation looks different depending on the focus of the understanding of sustainability – sustainability as post-growth is oriented differently than sustainability in the sense of the three-pillar model or sustainability as climate neutrality. This in itself gives rise to tensions that can manifest themselves as practical dilemmas. *Above all, however*: no matter what orientation a concrete understanding of sustainability provides – the orientation remains at the level of subjective preferences and cannot fundamentally expand the external conditions for action, i.e., the available options. Regardless of the concrete understanding of sustainability, the dilemmas of sustainability can therefore remain – the arbitrary action required under such conditions of dilemmas in sustainability research merely turn out differently.

Early recognition, clarification and processing of dilemmas

Dilemmas are understood here as an instrument with a heuristic, analytical and operative function. Given the above-mentioned ambiguities of a heterogeneous sustainability discourse and the potential conflicts in view of specific areas of tension in the context of sustainability, this instrument serves to reflexively strengthen one's own ability to act. This can be achieved through *early recognition, clarification and processing of dilemmas:*

Early recognition of dilemmas: in the field of sustainability, there are many areas of tension and contradictions. It is important to reflect on these at an early stage with regard to potential dilemmas. In this way, the view is widened in advance for possible tensions, difficulties or requirements for negotiation. Thus, the emergence of dilemmas can potentially be avoided before a problem or conflict occurs. The instrument of dilemmas helps to intellectually focus areas of tension, etc..

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Clarification of dilemmas: when it comes to sustainability, dilemmas are often claimed in order to justify certain strategies of action as a way out or to criticise others as inadequate. A falsely claimed dilemma can be just as problematic as denying that dilemmas actually exist. The analysis of dilemma as an instrument helps to be sensitive to such strategic conceptualisations, to reflect on them critically and thus to gain greater sovereignty of action and decision-making.

Processing of dilemmas: even with early recognition and successful clarification, dilemmas of sustainability can block situations of action and decision-making. This can happen regardless of which concrete objective is being pursued as sustainable. The instrument of dilemmas helps to avoid the inability to act by reflecting on, organising and acknowledging negative implications of positive action. The realisation that win-win situations may not be available can help to act responsibly nevertheless.

Target group of the guide

Against this background, the guide presented here is directed at those projects and project funders that aim at sustainability while taking scientific knowledge into consideration. In addition to transdisciplinary projects (Hirsch Hadorn/Hoffmann-Riem et al. 2008, Bergmann/Jahn et al. 2010, Jahn/Bergmann et al. 2012, Lang/ Wiek et al. 2012) or living labs (Schneidewind/Scheck 2013, Schäpke/Stelzer et al. 2017, Wagner/Grunwald 2019), these include all those projects that incorporate theories and methods from the natural sciences, engineering, social sciences or humanities to research or promote sustainability. This guide provides such projects orientation in dealing with dilemmas of sustainability.

Metacriteria of sustainability

Against this backdrop, it is important to reflect on possible conflicts arising from different understandings of sustainability; to reflect on possible real-world problems represented in research, such as those emerging due to different interests, limited resources and manageable time horizons; and to visualise possible negative implications of a sustainability that is intended to be positive as well as the limitations of any understanding of sustainability. Metacriteria of sustainability serve this purpose.

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Metacriteria of sustainability are criteria for thinking about sustainability research and the use of the term sustainability. They make it possible to reflect on areas of tension in the context of sustainability, to clarify the talk of dilemmas and to deal with practical dilemmas. This requires three things:

Firstly, explaining *one*'s *own understanding of sustainability and* thus revealing the standard that orients action under areas of tension and conditions of dilemmas.

Secondly, to disclose which *concrete contribution to sustainability* has been achieved with the decisions thus made.

Thirdly, to reflect on the *unintended and negative consequences of the* decisions made – which unsustainable effects are accepted as a trade-off for one's own positive contribution to sustainability. In short, this would mean to account for whether and to what extent dilemmas of sustainability are actually present.

The reflection by means of meta-criteria of sustainability thus allows to operationalise the instrument of dilemmas and thus to support early recognition, clarification and processing of dilemmas.

The basis of this guide

This guide is based on the interplay between an empirical examination of dilemmas of sustainability in sustainability research (Müller/Berg 2023) and a conceptual-analytical examination of dilemmas of sustainability in the literature (against the background of knowledge and processing of different understandings of sustainability). Although developed in the course of dealing with projects and programmes in this field, this guide can be used whenever projects or funding directed at such projects describe themselves as being aimed at sustainability.

In accordance with this general and fundamental orientation, this guide is intended as a supplement to guidelines of project evaluation. While such guidelines focus on planning, implementation and completion of projects in terms of quality criteria, this guide aims to reflect on particular challenges that the standard of sustainability entails. This applies not only but also to transdisciplinary projects. Transdisciplinary projects are already characterised by a high level of reflection on the special challenges of this type of project, for which independent evaluation guidelines are available (cf. in particular Bergmann/Brohmann et al. 2005). This guide

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complements the literature and aims at reflecting on the understanding of sustainability, the contribution and the respective trade-offs of sustainability as well as the early recognition, clarification, and processing of dilemmas.

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2. Instructions for use

This guide comprises *two main parts*: firstly, definitions and background knowledge on sustainability, tensions and dilemmas, and secondly, general and specific metacriteria of sustainability with guiding questions for reflection that can be applied to concrete sustainability (research) projects.

In the third chapter, the *analytical understanding of sustainability* used here is explicated. Then, the concept of the practical *dilemma* with its two components of norms and conditions of action is summarised and related to sustainability: for the *early recognition of* areas of tension with potentials for dilemmas, for the *clarification of* strategic assertion and denial of dilemmas, and for the *processing of* practical dilemmas that nevertheless exist, especially in research. This serves as background information "from theory for practice".

The subsequent fourth chapter contains *meta-criteria* for reflecting on areas of tension and possible, associated dilemmas of sustainability. They are divided into eight metacriteria which operationalise questions guiding reflection that are categorised into three systematic blocks:

Block A: Metacriteria 1 and 8 aim at reflecting on dilemmas of sustainability and the *initial and final reflection on* one's own understanding of sustainability.

Block B: Metacriteria 2, 3 and 4 aim at reflecting on project planning. The focus here is on the *subjective component of the norms of action of* dilemmas of sustainability.

Block C: Metacriteria 5, 6 and 7 aim at reflecting on the implementation of the project. The focus here is on the *component of the conditions for action of* dilemmas of sustainability.

In addition, special meta-criteria are formulated for funding bodies.

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3. Sustainability and dilemmas – Theory for practice

Preceding the metacriteria, this part introduces the concepts of sustainability and dilemma. On the one hand, this serves as a background for the structure of this guide but can also be used for more in-depth information.

3.1 Sustainability – Analytical understanding of sustainability

The social discourse on sustainability in the context of the normative model of sustainable development has been characterised from the beginning by a complexity of problems and a multitude of heterogeneous actors with very different, partly implicit, partly explicit interests, normative orientations, values and knowledge bases. In science alone, the guiding principle of sustainable development is translated into different concepts. Thus, the one-pillar model (ecological perspective), the triple-bottom-line (with ecological, economic and social components), which is referred to most often, as well as a triple-bottom-line, in which, for example, an additional cultural component is added, co-exist (cf. Renn et al. 2007). Grunwald and Kopfmüller (2012, p. 58) speak of a "sustainability model", "more concrete action guidelines" for approaching the model and "multi-pillar concepts" as a basis for this (cf. also Grunwald 2016). The concept of "planetary boundaries" is focused on the global-ecological aspects (Rockström et al. 2009), whereas Schellnhuber and Bruckner (1998) for climate impact research and the German Advisory Council on Global Change (WBGU 2014) describe a general ecological model (see also Keil/Hummel 2006).

Although in the course of the debate a certain basic understanding of sustainable development has gradually emerged on a very general level – oriented along the Brundtland Report and the above mentioned models – this understanding quickly proves to be blurred and potentially leads to conflicts in concrete research processes. Different scientific and non-scientific professionalisations and experiences lead to a narrowing of the problem of (non-)sustainable development and can lead to focusing on or prioritisation of partial aspects with sometimes rather superficial or particular interpretations of the concept of sustainability for the respective practical purpose.

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In the project "Dilemmas of Sustainability" (Henkel et al. 2018), this state of the discourse (only roughly sketched here) has led to the fact that our own research work does not start from one comprehensive definition but from an "abstract-analytical understanding of sustainability" that is determined by three assumptions or premises that can be found – spelled out differently – in most understandings of sustainability (Henkel 2016):

Firstly, the assumption of a coupled relationship between society and nature. This entails the task for sustainability research to – for a critical analysis of hybrid initial problems – first distinguish between 'nature' and 'society'.

Secondly, the premise of temporal development. This raises the question of the continuity of the social development process with the well-known problems of spatial, temporal and social scales and the fundamental, prospectively raised questions of intra- and intergenerational justice, e.g., as a claim to a *good life for all.*

Thirdly, the assumption of a transformation potential of knowledge. This gives science a central significance in its dual role as part of the problems of sustainability and as part of alternative solutions.

This abstract-analytical understanding of sustainability served primarily as an initial heuristic for identifying dilemmas in research projects and their funding and is explicitly not normative. This was important precisely because the guiding principle of sustainable development – and within it, as an object of study, the question of the dilemmas of sustainability – is connected with strong normative assumptions, especially intra- and intergenerational justice.

In this understanding, the concept of sustainability in the context of sustainable development describes a complex situation. (i) Sustainability refers to relations – specifically to social relations with nature – and is thus a concept that is shaped by relations.

(ii) Sustainability refers to the continuity of desirable processes and not to conditions;

(iii) Sustainability depends on knowledge, especially the transformative power of scientific knowledge.

Three fundamental tensions characterising the structure of the problem can be derived for sustainability research from this (Jahn 2012):

Societies depend on natural, ecosystemic preconditions that they cannot generate themselves but in whose (self-)regulation they nevertheless intervene massively. Sustainability research is thus confronted with the hybridity and systemic character of the problems it addresses.

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Temporal and spatial jumps in scale play an essential role in (non-)sustainability but can only be controlled and planned to a limited extent and are closely linked to questions of power and the varying capacity for action of the actors concerned or involved. Sustainability research must take into account different spatial, temporal and social scales and focus on transition effects and path dependencies.

The creative power of science increases. At the same time, it loses its privileged position in the sustainability discourse. Science becomes – among other actors – a participant observer. This makes self-reflexivity in research practice a crucial prerequisite.

Due to the lack of a generally binding definition of sustainability, it can therefore be particularly important at the beginning of a research process to jointly develop a working definition that is valid for the project and appropriate to the specific problem context and the desired alternative solutions.

3.2 Dilemmas – On the basic structure of practical dilemmas

Practical dilemmas emerge when a *decision has* to be made in concrete *situations of action* against the background of *subjective premises* (usually based on real-life problems), but the decision is or appears impossible due to the *nature of the alternatives.* In the case of a dilemma, an actor is faced with two (in the case of a tri- or polylemma, three or more) mutually exclusive options, each of which – measured against the premises – has negative consequences and none of which can be considered with good reasons to be better than the other. In moral philosophy, very drastic thought experiments, such as the so-called "trolley problem" (Thomson 1976) or "Sophie's Choice" (Styron 1980; McConnell 2022) are usually used to illustrate this. Here, the person in a situation of decision-making is always faced with the two alternatives of having to choose between at least two human lives. At the same time, however, this person is confronted with the (implicit) premise of ensuring the survival of all human beings. Yet, the only two possible decision alternatives always lead to the death of at least one person. This, in turn, means that every choice between the given alternatives leads to the violation of the premise.

It is important to note here that practical dilemmas are always conditioned by two sides: firstly, by the *subjective premises or norms of action* that provide the standard for decision-making/action, and secondly, by the

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external conditions of action, which are expressed in the structure of the situation, i.e., the available options.

Practical dilemmas contain contradictions on two levels: firstly, the concrete premise of action (q is a goal to strive for) contradicts the expected consequences of action (a and b; both lead to non-q). An actor in a dilemmatic situation wants to or should do something that he cannot do in view of the existing alternatives. This creates a second contradiction on a higher level. The implicit request in the premise to make a decision and act on the basis of it (assumption that action must be taken) contradicts the simultaneous impossibility of deciding and thus acting (action cannot be justified). Due to this *simultaneity of implicit demand for action* and the *impossibility of deciding on a course of action*, dilemmas can quickly have a paralysing effect. As in a situation of constraint, one is confronted with a set of bad alternatives but is unable to identify the lesser evil. In this respect, dilemmas make one incapable of action.

Dilemmas always refer to *expected* consequences of action which always only occur with a certain probability. Dilemmas are therefore not only dependent on the underlying norms of action but also on the limited and perspectival knowledge of the actors as well as the meaningful framing of their situation. However, this does not mean that they are mere subjective constructions. Actors can be mistaken about the existence of dilemmas. A situation not recognised as a dilemma, just like an unrecognised constraint, becomes apparent in practice in the form of the occurrence of negative consequences. The subjective interpretation of the situation cannot therefore arbitrarily (de)construct negative consequences that will occur in the future, but it decides whether these present themselves to an actor as part of a dilemma.

The basic structure of a practical dilemma is that a single norm of action cannot be realised in the face of existing alternatives. This is the case when, of two (or more) possible alternatives for action, each predictably leads to the violation of a particular norm of sustainability (I shall q; either a or b; a leads to not-q, b leads to not-q; thus not-q). For example, the applicable norm of sustainability may be to permanently preserve biodiversity in a certain area. A dilemma may emerge if, due to climate change, certain species are acutely threatened with extinction and any known intervention in one way or another would lead to the same result, namely, the loss of biodiversity.

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3.3 Dilemmas – Determinations of dilemmas of sustainability

In the context of sustainable development, *six constellations of* dilemmas are frequently encountered. Typical *conflicts* that exist here can cause *dilemmas* if the implied different perspectives are to be implemented at the same time, which, however, is not possible due to the nature of the conflict.

3.3.1 Conflicting goals as a potential cause of dilemmas

Because sustainability is usually a complex norm of action consisting of several interdependent partial norms, one often encounters dilemmas that result from conflicts between two (or more) partial norms or partial goals of sustainable development (dilemmas as results of conflicting *goals*). Here, sustainability as a premise q contains several partial norms (q = q1 and q2), which then in practice can be expressed in several goals that are valid but in *conflict* with each other at the same time. Many of the UN's Sustainable Development Goals (SDGs) are in a conflicting relationship with each other. If the situational conditions are such that the realisation of one goal precludes the realisation of the other goal, a dilemma occurs (q = both q1 and q2; either a or b; a leads to q1 and non-q2, i.e. non-q; b leads to q2 and non-q1, i.e. non-q). For example, large hydropower plants can provide electricity on a renewable basis (SDG 7) but at the same time endanger ecosystems and biodiversity (SDG 15).

3.3.2 Conflicts of time as a potential cause of dilemmas

Secondly, because sustainability always has a temporal dimension, dilemmas often arise between different temporal instances of the same goal of action (dilemmas as a result of *conflicts of time*). The premise q then implies q at several points in time (q = q at T1 and q at T2). For example, a measure to increase the economic efficiency of a company can reduce the economic benefit in the short term (measures increasing efficiency cause costs), contribute to an improvement of the balance sheet in the medium term (the measures pay off), but in the long term result in comparatively increased costs (accumulated negative side effects of the measure become noticeable). In such a case, actors are confronted with the dilemma of

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having to decide between short-, medium- and long-term limitations of the economic benefit. What is economically sustainable from the company's point of view cannot be clearly decided (q = both qT1 and qT2; either a or b; a leads to qT1 and non-qT2, i.e. non-q; b leads to qT2 and non-qT1, i.e., non-q).

3.3.3 Conflicts of interest as a potential cause of dilemmas

Furthermore, in the context of sustainability, one often encounters multi-actor dilemmas that arise from constellations of interrelated actors (dilemmas as a result of *conflicts of interest*). In dilemmatic constellations, *each* individual actor (A, B) can realise their subjectively desired course of action (viewed in isolation, there is no dilemma), but because the different courses of action conflict with each other, not *all* actors can realise their goals (McConnell 2018). The resulting conflict of interests is a dilemma if one sets as a premise that all actors in a constellation should be able to realise their respectively preferred goals at the same time [q = qA (realisation of A's premise) and qB (realisation of B's premise); either a or b; a leads to qA and to non-qB; b leads to qB and non-qA; thus non-q]. Thus, under conditions of scarcity, an officially announced upper limit on the consumption of a particular resource, such as water, leads to the question of who should restrict his/her consumption and to what extent. If this is decided centrally, policy-makers may be confronted with the dilemma of deciding which interest group they want to frustrate and antagonise and to what extent.

3.3.4 Conflicts between different forms of knowledge as a potential cause of dilemmas

In addition to *scientific knowledge,* whose general validity is based on inter-subjective verifiability and independence from individual interests, other forms of knowledge based on the *experiential knowledge of practitioners*, *indigenous knowledge* or *traditional knowledge* also come together, especially in transdisciplinary projects with a participatory approach. When actors with different forms of knowledge encounter each other, dilemmas can occur – especially when the forms of knowledge lead to different recommendations for action, and it is unclear how content in one form of knowl-

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edge can be translated into the language of the other (incommensurability) (dilemmas as a result of *knowledge conflicts*).

In the context of transdisciplinary research, different *types of knowledge* also play a role: in addition to the commonly developed 'systems knowledge', i.e., knowledge about the functioning of and causal relationships in concrete, real-world systems such as e.g., ecosystems, 'target-' and 'transformation knowledge' also play a role (Hirsch-Hadorn/Hoffmann-Riem et al. 2008, Karrasch/Grothmann et al. 2022). Target knowledge concerns the dealing with targets, e.g., the priorities within the framework of the Sustainable Development Goals. On the other hand, transformation knowledge is concerned with how goals can be achieved on the basis of systems knowledge, i.e., how ecosystems can be designed in such a way that they can withstand future challenges. Especially in transdisciplinary contexts, the integration of such different forms of knowledge poses special challenges (Vilsmaier/Engbers et al. 2015, Hoffmann/Pohl et al. 2017) since not only different logics of scientific disciplines have to be brought together but also forms of knowledge that have to meet other criteria such as practicality, suitability to concrete experiences or traditions and belief systems.

3.3.5 Conflicts between different understandings of sustainability as a potential cause of dilemmas

While conflicting interests as the cause of a dilemma of sustainability can also affect the implementation of a *shared* sustainability goal, dilemmas can also emerge from *different* understandings of sustainability. Among co-workers in the context of projects, in transdisciplinary dialogue or in interdisciplinary projects, there may be agreement on the necessity of sustainability. If, however, sustainability is understood by some participants as reducing CO_2, for example, but by others as reducing the consumption of resources in the sense of post-growth overall, this harbours potential for conflict. In one case, the expansion of renewable energy and the use of nuclear power is desirable as an element of sustainable development, so that the expansion of electromobility can also be pursued. In the other case, only a reduction in energy consumption as a whole can be understood as sustainable, so that a reduction in individual mobility is indicated. A dilemma emerges here under the condition that all concepts of sustainability represented in a project are to be implemented. This can lead to fundamental differences that cannot be resolved through a discussion of the

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negotiated issue itself and that only become apparent in concrete attempts of implementation in the absence of prior agreement.

3.3.6 Conflicts over responsibility as a potential cause of dilemmas

Sustainability is closely related to the *negative effects of progress* in the broadest sense. Accordingly, responsibility in the context of sustainability plays a role in two respects: first, by attributing responsibility for *damage* that has *already occurred* – and second, by attributing responsibility for preventing *future damage*.

Depending on the understanding of sustainability, however, there is a difference as to where such responsibility is seen and to whom it is *attributed* (cf. also Henkel/Luedtke et al. 2018; Henkel 2020). For example, consumers may be viewed as having the responsibility to consume simply less overall, more regional products, less packaged and more vegetarian food – or research and development may be viewed as having the responsibility to develop better thermal insulation, more resource-efficient production processes or energy sources with lower emissions. Like sustainability itself, responsibility can be strategically asserted and denied (cf. Section 3.5: Clarification: Strategic assertion and denial of dilemmas). When responsibility is attributed – whether by an actor himself or by others, whether strategically or not – this changes the *conditions of action*. This is all the more true since responsibility could often be attributed differently in the face of complex circumstances (Bayertz 1995; Heidbrink 2006; Grunwald 2012) but nevertheless implies a strong normative obligation (Henkel/Åkerstrøm-Andersen 2013 / 2014).

When responsibility is attributed, this can itself be both *a conflict* about responsibility *and exacerbate* the above-mentioned conflicts as the cause of dilemmas – for example, by justifying goals or interests with existing responsibility. The *emotionality* often associated with the *normativity* of responsibility also contributes to this. For this very reason, a strategic assertion or denial of responsibility is obvious. *Dilemmas* can emerge from this mixture of ambiguous attribution of responsibility, effects on action and possible emotionality if the attributed responsibility exceeds the capacity to act, if causal factors and perpetrators are excluded from the attribution of responsibility, or if different basic ideas about responsibility emerge from different understandings of sustainability.

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3.3.7 Dilemmas as a touchstone for the feasibility of norms of action

Whether *tensions* between heterogeneous partial goals, between different temporal perspectives of the same goal or between diverging interests or understandings of sustainability of different actors can be *balanced* or whether they lead to practical *dilemmas can* only be seen against the background of certain socio-material contextual conditions. In this respect, dilemmas provide a good touchstone for the feasibility of norms of action under real conditions. Dilemmas can be used to discuss obstacles to action, their causes and ways to overcome them. This also explains their significance in the sustainability discourse.

3.4 Early recognition: areas of tension with potentials for dilemmas

Based on a qualitative, empirical analysis of funding programmes and projects dealing with sustainability research, typical areas of tension in that field can be distinguished in connection with the dilemmas of sustainability described above: such areas can be found in various fields of sustainability research when subjective premises in the form of heterogeneous perspectives of different actors and their socio-material contextual conditions meet. These premises are initially independent of each other as individual logics but must be combined in the context of sustainability research. If several perspectives are to be brought together or realised at the same time, this harbors the potential for typical conflicts and contradictions that manifest themselves in situations of action and can thus become practical dilemmas. This contextual situation characterises the areas of tension. Accordingly, areas of tension offer an increased potential for dilemmas since the negotiation of heterogeneous premises increases the probability that conflicts and contradictions emerge. This in turn can cause a practical dilemma. When critically examining these areas of tension in sustainability research, the metacriteria and reflection questions formulated in this guide offer a good orientation. With them, tensions can be made explicit and their effects on the project work can be reflected upon.

The following typical areas of tension in sustainability research can be derived from the empirical study of sustainability research projects and funding programmes (Müller/Müller 2023) and shall be presented below:

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3.4.1 Implicit assumptions in the project context
3.4.2 Cooperation and participation in inter- and transdisciplinary research contexts
3.4.3 (Transdisciplinary) research in structures of funding and science
3.4.4 Research in the context of social framework conditions

3.4.1 Implicit assumptions in the project context

Areas of tension related to implicit assumptions in the project context can occur when (1) actors in interdisciplinary and transdisciplinary research networks bring in different understandings of sustainability and these are not reflected upon and adjusted to the joint project work, or (2) disciplinary conceptual understandings are assumed to have sovereignty of interpretation. This is due to the fact that each individual, as an actor in the research process, brings his or her own goals, norms, expectations, interests and conceptual understandings into research projects. These implicit assumptions initially coexist as heterogeneous premises and need to be adjusted to each other in order to work on a common research object and to shape a research process that can be participatory. In these negotiation processes, conflicts of goals or interests can occur (see above), the result of which can either be agreement on common research objectives and interests or a practical dilemma.

(1) *The actors* involved *bring different understandings of sustainability into a project, which are subsequently not jointly reflected upon and aligned with the project*. The diversity of understandings of sustainability brought into the project is often accepted as an "empirical fact" and work is carried out openly. If, however, in the course of the project clear indicators or criteria are needed, for example, to determine a transformative potential, those involved in the project reach their limits. At this point (at the latest), it becomes clear in how far understandings of sustainability differ and what is considered sustainable or non-sustainable. However, this also leads to the fact that no agreement can be reached at such a late stage. A project member explains this in more detail:

> "And what are the own criteria as to what is sustainable and what is not? That is why this question will remain unanswered at the project level. Or [...] at least there will be no uniform answer to it. [...] [Depending on]

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> the understanding of sustainability, there will be different answers, and, of course, you can summarise and present them because I think there is simply no way out" (project 9)[1].

(2) Tensions can also arise through the introduction of *disciplinary conceptual understandings* whose meaning is not questioned in the project context and for which no common conceptual understanding is developed. Due to an unspoken variety of understandings when using the same word with different implicit meanings, attributions of meaning and thus also potentials for tensions continue to be present throughout the research process and carry with them a strong potential for contradictions, conflicts and also dilemmas at a later point in the project. Our investigation of the research projects has shown that an early agreement on concepts/terms is particularly important in order to prevent such potential. As the project leader of an interdisciplinary project puts it:

> "Of course, there are always discussions, discussions about understanding and so on. You always have to find a common denominator. It's always a bit of work, but, of course, it's also interesting" (project 17).

However, a high degree of communication and willingness to discuss is also relevant here in order to clarify conceptual understandings and, moreover, to find common ground for cooperation in the project. This was shown in one project:

> "We had relatively long discussions at the beginning: what do we understand by different terms, and we also have very different ideas about them. This requires a lot of good communication" (project 14).

These examples make it clear that an area of tension emerges when, on the one hand, the implicit assumptions are not communicated and are brought into the research process without being reflected upon, so that conflicts or even dilemmas can occur in the further course of the project. On the other hand, an area of tension can also develop as a result of the discussion that takes place about conceptual understandings and implicit assumptions since agreement on common understandings does not always proceed without tense or conflict-laden communication and compromises.

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1 The quotations refer to the interviews with project leaders, project staff and -coordinators as part of the empirical study conducted on research funding programmes and research projects on sustainability in Germany.

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3.4.2 Cooperation and participation in inter- and transdisciplinary research projects

Areas of tension in cooperation and participation occur (1) in interdisciplinary and transdisciplinary research projects due to the focus on social problems, (2) the design of processes of participation and (3) the equal selection of groups of actors. The area of tension of cooperation and participation described below is thus primarily due to the necessity of the inter- and transdisciplinary research process, while at the same time the complexity of this process is increased.

(1) In order to be able to deal with the complex problems in the context of sustainability and to create solutions, sustainability research is often transdisciplinary. In most cases, sustainability research requires *a focus on societal problems* and thus also the involvement of societal actors along with their knowledge and their forms of knowledge in dealing with these problems in order to find solutions. Since the circle of actors involved is thus expanded, the potential for dilemmas of the implicit approaches is increased. This is due to the increased number of individuals involved and the increased heterogeneity of the respective contexts and knowledge bases, normative assumptions as well as the associated subjective premises. Here, too, possible dilemmatic decisions are based on conflicts of goals and interests that can be traced back to the heterogeneous premises in the research network.

(2) If research processes are designed in a transdisciplinary way, there is also potential for conflict in the *processes of participation.* If, for example, there is a lack of motivation and willingness to participate in such processes, this can have an effect on the research process as an external condition for action: depending on the nature of the alternative courses of action, a practical dilemma can be perceived in such situations since the options for action in research processes are limited and alternative ways of implementation must be sought. This becomes clear, for example, in the following quotation by a project member:

> "At the very beginning we tried to make general participation very strong and we had frustrating results. We actually had what has been described in the literature as participation fatigue. [...] We actually underestimated how much people were no longer willing to take part in an event. [...] So we actually had a problem" (project 5).

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(3) Researchers and transdisciplinary research networks also face similar challenges when it comes to the *representative, equal participation of social actors*. For example, a member of a transdisciplinary research project points out:

> "These are good people, they are mostly people who go in with great enthusiasm and with the best thoughts and goals [...]. They take over the representation of other people in order to decide where to go. And the dilemma is, of course, to get the others, the silent ones, to find out what they actually think" (project 15).

Work in interdisciplinary and transdisciplinary research projects poses the challenge that conflicts, contradictions and, eventually, clear dilemmas can emerge in the research process, especially due to the participation of heterogeneous groups of actors or the difficulty of implementing or fairly shaping processes of participation (cf. Bergmann/Jahn 2023).

3.4.3 (Transdisciplinary) research in structures of funding and science

Another area of tension is revealed by transdisciplinary research in structures of funding and science. These include (1) the disciplinary requirements of academic qualification in a transdisciplinary context and (2) the implementation of transdisciplinary cooperation in existing structures of funding. The field of primarily transdisciplinary research in already established disciplinary structures of science described below is fraught with tension because the expectations and the associated framework conditions for funding transdisciplinary research projects in particular run counter to the actual course of events in the projects.

(1) For example, *disciplinary requirements* of academic qualification and scientific publications as external conditions for action in situations of decision-making are in partial conflict with transdisciplinary ways of working. This can lead to practical dilemmas at the individual level since neither the transdisciplinary nor the established, more disciplinary approach in the system of science can be taken into account. Thus, two conflicting norms confront each other. In the projects on transdisciplinary research, a clear contradiction in feasibility then becomes apparent, which is described by a doctoral student as follows:

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> "The requirements of [...] disciplinary academic qualification were often [...] so contradictory [...] to what transdisciplinary work actually means. So to include the perspective of practice or society right at the beginning in the formulation of research questions or in general [...] [of] the problem and the object of study, that does not go well with a very academic approach" (project 11).

(2) A further manifestation of the area of tension can be seen in the *implementation of transdisciplinary research processes in connection with the structures of research funding*. In this case, the structures of funding as external conditions for action run counter to the processes in and expectations of research. The following quotes from research projects illustrate this. For example, one project member mentioned the contradictory logic of research funding to requirements of transdisciplinary projects:

> "I think this is the biggest dilemma for me, [...] we have research funding that is competitive. [...] [T]his competitive logic comes up against the limits of what living labs actually want to do. Namely, to be experimental spaces in which things are tried out. Which can then fail and so on and so forth. And here the funding logic in competitive and strictly time-limited projects is indeed dilemmatic, when research for sustainable development and living labs are actually supposed to help build processes and structures that are oriented towards the long-term" (project 5).

In another research project, the project management referred to the conflictual impact on the ongoing processes in the project in the context of the funding:

> "It has something to do with the funding, that with transdisciplinary projects it is sometimes difficult to write project proposals [...] and you have to say: "What do I want to do? What question? What methods? What do I want to get out of it?" And that transdisciplinary research doesn't always work that way, or that it is sometimes contrary to what transdisciplinary research is and that is also a conflict [...] that runs through the project a bit" (project 14).

The embedding of transdisciplinary research processes in the current structures of the system of science thus creates another typical area of tension, which is accompanied by contradictory demands for temporal, monetary, but also individual resources.

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3.4.4 Research in the context of social framework conditions

The final area of tension that can be derived from the data is related to the social framework in which research takes place. This can be seen in the fact that (1) sustainability research is embedded in the societal context and (2) different processes can lead to conflicts of goals and interests between the actors.

(1) Since individuals do not act in a vacuum, this can lead to dilemmatic situations of decision-making. It becomes clear that research embedded in this *social context* finds itself in the area of tension of having to provide scientific findings for problems of sustainability within the social framework conditions and contribute to political decisions, while at the same time having to negotiate the internal constellations and processes of the project. Accordingly, sustainability research is not detached from social contexts but is directly and to some extent indirectly integrated into them, especially through transdisciplinary research. A connection can also be drawn here to the previous area of tension: structures of science also interact with social, especially economic and political decisions. Accordingly, various couplings emerge that shape the area of tension and immensely increase the potential for getting into actual dilemmas in practical action.

(2) In the transdisciplinary projects studied, *conflicts of interest and conflicting goals of the groups of actors involved* were repeatedly mentioned. For example, cooperation with municipalities was often characterised by the fact that the effects of decisions in the project could also have political consequences and that the course of the project depended on political decisions. One project leader described this as follows:

> "And if the municipal council does not support it, then the project can be scaled down overnight. There was also a time when there was displeasure among the population and it was very clear: you have to find a solution and you have to make sure that this displeasure is gone, because otherwise those are simply all votes" (project 7).

Even within the projects, interests, goals and political views have often developed into an area of tension. In another project it was stated:

> "For some of the colleagues, the question of the transformative potential alone is politically very explosive, yes, a question that should not be followed at all. [...] Exactly, and this results in constant friction in the

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> project, which can also be productive in some way. But I have the impression that there is nevertheless a gap that is insurmountable. You could say that there is a kind of division in the project (...) we can't talk about certain things together" (project 9).

It becomes clear that the social framework conditions as external conditions for action have an impact on situations of decision-making in research processes. There are often fundamental conflicts with respect to goals and interests that can arise in research processes since transdisciplinary research in particular is integrated into constantly changing social framework conditions.

3.5 Clarification: Strategic assertion and denial of dilemmas

If, in contrast to these areas of tension, which under certain conditions *can develop into* dilemmas, we now look at the dilemmas explicitly *named in the* sustainability discourse, it becomes apparent that dilemmas often have a *strategic function.* With the help of the dilemma figure, the conditions of individual and collective agency are negotiated and strategies for solving socio-ecological problems are justified or criticised. The reference to dilemmas of sustainability can be used both to rhetorically close and open up spaces for action – across the distinction between affirmative and negative references to the existence of dilemmas.

Thus, the *assertion of a necessary and under no circumstances avoidable "tragic" dilemma* (Foster 2017) makes all doors in the space of possible courses of action appear closed. If the driving forces that inevitably push beyond the planetary limits are so deeply anchored inside us that we cannot possibly neutralise them in time, then any search for solutions seems hopeless. The dilemma figure here serves the intention of freeing ourselves from illusions and facing the coming catastrophes.

But even the opposite *assertion that there are no dilemmas or that they have already been overcome* can have the effect of closing off the space of possibilities if it is used to justify the lack of alternatives to the status quo or a certain pathway of technological development. Thus, the reference to dilemmas that have been overcome can have the rhetorical function of making exactly one door appear to be open because all others lead to a dilemma. In this framing, only one*'s own* strategy, for example, a certain biotechnology, a more efficient production method or a state measure, can

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save us from an otherwise threatening dilemma (such as the impossible decision between food security or preservation of the ecosystem).

On the other hand, the *denial* has the effect of opening up a space of possibilities if it is used to criticise the rhetorical limitation of the scope of options by referring to a dilemma.

The deconstruction of "false" dilemmas aims to question the often only implicit frame of reference of an alleged dilemma, and thus to point out solutions on a "higher level". For example, the claim that only certain technical solutions lead out of the dilemma of food security and preservation of the ecosystem can be countered with the argument that this dilemma only exists under very specific conditions – such as a certain form of economic growth and corresponding cultural values.

Positions that use the *assertion of dilemmas to point to structural or systemic blockades to the ability to act* also indirectly have the effect of opening up a space of possibility if, at the same time, they want to point out the conditions of possibility for resolving dilemmas at a higher level – be it by changing the norms of action or the social conditions of action. Thus, the reference to the inherent potential for dilemma of certain cultural values or social institutions and structures can make it clear that promising strategies of transformation must start at a very fundamental level because this is the only way to eliminate the deeper causes that repeatedly bring us into situations in which we are confronted with impossible decisions. Dilemmas, such as the "growth dilemma" (Jackson 2017), are thus used here to justify the need for certain structural changes. Insight into their strategic use makes it clear that *dilemmas do not exist in an absolute sense but only within a certain frame of reference*. Whether we are in a dilemma depends, firstly, on the norms on which action is based. This includes, for example, the assumption that the current level of prosperity should be maintained, which in turn contains numerous implicit assumptions (what does prosperity mean? For whom? And when?). Secondly, dilemmas presuppose a certain interpretation of the situation: under which conditions, assumed to be unchangeable, are there only two mutually exclusive and equally undesirable alternatives? And how high would one estimate the risks associated with each of the two alternatives to be, i.e., how likely is it that certain negative consequences will occur? By changing the underlying norms and interpretations of the situation, tensions and conflicts can be rhetorically elevated into dilemmas or, conversely, alleged dilemmas can be rhetorically resolved into manageable tensions and conflicts.

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However, this does not mean that dilemmas are mere subjective constructs. People can be just as mistaken about the existence of dilemmas as about that of all other socio-material conditions for action (Mader 2022). Whether tensions between partial goals, between different perspectives of time or between diverging interests of different actors can be balanced in the context of sustainability projects or whether they lead to dilemmas can only be seen against the background of the real framework conditions of the actors.

Thus, the assertion of non-existent dilemmas can be just as problematic as the denial of real dilemmas. Dilemmas that are falsely asserted can prevent possibilities for action and have a paralysing effect. They can suggest a false lack of alternatives and help to advance certain partial interests. On the other hand, overlooking real dilemmas can create a false sense of security and later prove to be a mistake that we have to pay for with very real negative consequences. Dilemmas can therefore, with critical intent, also be a touchstone for the reality of certain objectives of sustainability: can all the good objectives really be implemented in the form of a possible win-win or do they inevitably lead to dilemmas under real-world conditions and must therefore be adapted?

3.6 Processing of dilemmas: Between win-win and trade-off

Despite early recognition of dilemmas, a potential dilemma can escalate into a real dilemma, and sometimes an alleged dilemma actually turns out to be valid. In cases like these, existing dilemmas need to be dealt with. In various disciplines, an extensive and heterogeneous literature has developed for such questions of the practical handling of existing situations of dilemmas. In social and developmental psychology, for example, Piaget (1986, first 1948) and Kohlberg (1984) and Kohlberg/Kramer (1969) used dilemmas to examine the developmental status of children and young people on the basis of their reasoning strategies (Carr 2012). The approach was applied by Hoff (1992) and Hoff/Lecher (1995) to occupational biographies and the sense of ecological responsibility. In interview situations, people are confronted with hypothetical situations of dilemmas and asked about their strategies for dealing with them. The patterns of argumentation used here mostly apply laws or moral principles and indicate the level of judgement of the respondents.

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Dilemmas in the form of social dilemmas and the famous "prisoner's dilemma" also play a prominent role in social science and economics literature. Social dilemmas generally emerge in situations in which individual rationality – commonly understood as the self-interest orientation of the actors – leads to collective irrationality or a worse overall outcome for all (Kollock 1998). The prisoner's dilemma represents a typical case under the assumption of incomplete information of the actors involved, which could be solved through communication. Other strategies for solving social dilemmas consist in relaxing the assumption of self-interested decision-making. Empirical research, especially in behavioural economics, has shown that these forms of cooperation or compliance with social norms can also be found in situations of economic decision-making (Ostrom 1998, Patt/Zeckhauser 2000). Forms of information provision in the sense of "nudging" can help to solve social dilemmas as well (Sustein/Reisch 2017).

In part, this literature has the character of a guidebook. On the other hand, it, in part, forms subject-specific ideal types or gives professional recommendations for action. The approach of reflexive analysis of dilemma developed here is an independent one to avoid the *inability* to act. This approach results from the identification of dilemmas of sustainability and areas of tension with potential for dilemmas and thus offers a systematisation of constellations where the capacity to act is blocked. In this context, first, two basic prerequisites for overcoming dilemmas are named. Then, four levels of processing of dilemmas are differentiated. Where approaches to processing of dilemmas exist – whether under this term or as a related issue – reference is made to them in the text.

3.6.1 Two basic prerequisites for overcoming dilemmas

Even a real dilemma does not *per se* have to represent an absolute blockade to action. Even if a dilemmatic situation of decision-making can have an effect of rigidity on individuals, in most cases it turns out that this can be overcome. However, prerequisites are necessary for this, as they were already brought to bear in the early recognition and clarification of dilemmas in sustainability research.

A first basic prerequisite is to be able to take a sufficiently reflexive distance from the immediate situation of action. One is able to recognise and examine the frame of reference of a dilemma only when one has freed oneself sufficiently from the situational pressure to act. Dilemmas often

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only emerge from an urgency to act that is inherent in the perspective of practice, i.e., the perspective of actors who are confronted in *situ* with practical problems for which they seek solutions here and now in order to be able to continue their practice. Under this condition, it is often difficult to gain sufficient distance from the frame of reference that first leads into a situation that seems unsolvable. In order to be able to deal with this frame of reference, it is necessary to take a step back from the immediate practical problem and ask oneself what one's own premises of action actually are and what exactly the broader conditions of action are that have led into the predicament.

The second basic prerequisite for overcoming dilemmas is to actually have the means to change the frame of reference that is responsible for the dilemma.

Depending on the concrete dilemma, the conditions under which it occurs can be more or less far-reaching or profound. Accordingly, the means of finding a way out of the dilemma vary in complexity. Analytically, a distinction can be made between obvious and more profound conditions: the obvious conditions for the emergence of a dilemma can be dealt with within existing social institutions and values and therefore require relatively little social change, whereas the change of profound conditions requires a change in social institutions and values and thus the coordinated action of a large number of actors. If one also takes into account the distinction between subjective and objective preconditions of a dilemma, then four levels can be distinguished analytically as to which ways out of dilemmas of sustainability can be sought: 1. obvious objective conditions for action (e.g., technical solutions), 2. obvious subjective premises (justification of trade-offs through rules of prioritisation), 3. underlying objective conditions for action (change of social institutions and structures) and 4. underlying subjective premises (change of fundamental values and norms). In reality, there is no clear distinction between the four levels but rather complex connections and smooth transitions. The distinction between the four levels should only serve as a guideline as to which adjustments can be made when processing the dilemma.

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3.6.2 Processing of dilemmas at the level of obvious objective conditions for action (technical solutions)

Many of the concrete dilemmas of sustainability that emerge in the practice of sustainable development can be defused, at least situationally, by technical solutions. If, for example, the manager of a company is faced with the dilemma of having to reconcile the goal of increasing economic profitability with certain goals of ecological sustainability (for example, in the sense of reducing CO_2), this can quickly present itself as an unsolvable dilemma: the given goals cannot be realised simultaneously under the given social and technical conditions. An obvious change to the objective side of the frame of reference of the dilemma is to improve the resource efficiency of production, which ideally would turn the mutually exclusive alternatives (to produce *either* more economically profitable *or* more ecologically sustainable) into mutually complementary conditions (a new, more resource-efficient technology is *both* more sustainable *and* more cost-effective). For some dilemmas, this pattern of dealing with dilemmas may offer a sensible way out. Often, however, it turns out to be illusory or even leads to the aggravation of existing problems, which is why it must not be stylised as the universal remedy for all dilemmas of sustainability.

3.6.3 Processing of dilemmas at the level of obvious subjective premises (justification of trade-offs through rules of prioritisation)

One pattern of processing of dilemmas, on the other hand, which starts on the side of underlying subjective premises, consists of introducing rules of prioritisation for dilemmatic situations of decision-making. This strategy has been dealt with in detail by Müller-Christ (Müller-Christ 2007; Müller-Christ 2011; Müller-Christ 2023). The starting point is the observation that often no technical solutions can be found that enable the transformation of a dilemma into a win-win situation. Müller-Christ therefore advocates concentrating on setting the right priorities in dilemmatic situations of decision-making, on the basis of which even difficult decisions can then be *justifiably* made. This includes, in particular, recognising the fact that we cannot always realise all our goals to the fullest extent but often have to accept trade-offs. This proposal of processing thus ultimately amounts to changing the subjective premises of a dilemma in such a way that criteria are introduced for a *justifiable prioritisation of certain partial goals* over

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other partial goals. This strategy can be assigned to the level of obvious premises because it is in principle compatible with maintaining existing goals and the norms on which they are based – in the above example, the orientation towards economic profitability and a certain understanding of ecological sustainability. All that is changed here is the *weighing of* existing partial goals. However, this does not have to exclude a more fundamental change in values but can even advance it to a certain extent. For the prioritisation of ecological sustainability over economic profit in a concrete situation of decision-making has to be justified normatively itself.

3.6.4 Processing of dilemmas at the level of underlying objective conditions for action (change of fundamental social institutions and structures)

Many dilemmas of sustainability have deeper causes that require more fundamental changes in the social framework. One issue with the problem-solving strategies described above is that although they can often resolve dilemmas situationally and thus restore the ability to act in the short term, they do not necessarily eliminate the permanently existing causes that repeatedly lead to comparable dilemmas. For example, the manager's dilemma described above is rooted in the fact that companies on global markets are subject to certain profit pressures that systematically counteract efforts to make production more sustainable time and again. It is therefore not at all at their own discretion to prioritise ecological sustainability over economic profitability if this endangers the economic survival of the company. Only alterations in the broader political and economic framework conditions, for example, international regulations of corporate practices or patterns of consumption, can permanently change the framework conditions of the dilemma. The resolution of the dilemma is thus only possible to a very limited extent at the purely individual level and ultimately requires the coordinated action of many affected actors.

3.6.5 Processing of dilemmas at the level of underlying subjective premises (change of fundamental values and norms)

Finally, a fundamental change of values can also be a way to permanently and generally eliminate the causes of dilemmas of sustainability. In fact,

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changes in socio-structural frameworks and values are very closely related. For example, the effective regulation of economic practices according to criteria of social and ecological sustainability can only be achieved through political decisions that, at least in democratic societies, have to be socially recognised as legitimate and therefore need a foundation of values. These include notions of prosperity and the good life but also of justice and ultimately ecological sustainability. Following the pattern described above, these values can also require a normative decision for trade-offs at the societal level, such as the renunciation of certain technologies and associated lifestyles on the basis of a new understanding of prosperity.

To present the relationship between the two levels in a less dichotomous way: appropriate problem-solving strategies for dilemmas of sustainability to restore the ability to act in very concrete situations decision-making should be formulated in such a way that, when generalised, they contribute in the long term to eliminating the underlying conditions for the dilemma to emerge, instead of merely postponing problems into the future or even exacerbating them.

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4. Metacriteria of sustainability

The aim of this guide is to support scientific sustainability projects and their funding bodies in reflecting on their own respective understanding of sustainability, the project's contribution to sustainability and the negative implications that emerge in view of dilemmas of sustainability. Although contradictions and negative effects are unavoidable, this guide contributes to early recognition of dilemmas, clarification of dilemmas and processing of dilemmas.

The following eight metacriteria with their guiding questions for reflection can be carried out as eight consecutive steps for reflective action in recognising dilemmas of sustainability. They are divided into three blocks that result from the structure of practical dilemmas and concrete dilemmas of sustainability:

Block A: Reflection on the use of the concept of sustainability and the concept of dilemma

With the metacriteria:

1: The possibilities and limitations of the understanding of sustainability used in the project are reflected upon.
8: A use of the concept of dilemma is actively weighed.

Block B: Reflecting on one's own premises for action – project planning phase

With the metacriteria:

2: The description of the problem and the objectives are reflected upon by all participants as a framework for action.
3: The forms of knowledge underlying the project with their possibilities and limitations are reflected upon.
4: Basic decisions and implicit assumptions are reflected upon in the project.

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Block C: Reflection on the conditions for action – project implementation phase

With the metacriteria:

5: The processes and possible tensions of inter- and transdisciplinary cooperation are reflected upon.
6: The policies with regard to time in the project are reflected upon.
7: If there are attributions of responsibility, these are actively reflected upon in their justification, with their limitations and their effects.

All metacriteria are operationalised by means of several guiding questions for reflection. The requirements for working on these questions are specified after the questions. There are also additional notes on how to deal with them.

4.1 Metacriterion 1: The understanding of sustainability used in the project is reflected upon with regard to its possibilities and limitations. (Block A)

This metacriterion is used to deal with the two constellations of conflicting goals and the conflicts between different understandings of sustainability as a potential cause of dilemmas. In the sense of early recognition, they refer above all to the area of tension of implicit assumptions in the project.

Reflection question 1: Is the concept of sustainability used in the project defined?

- Yes, like this: "..."
- Yes, however ...
- No, because ...
- ...

Requirements: It should be explained how the term sustainability is used in the project. Related terms that are proximate to a certain understanding of sustainability should also be included (e.g., sustainable development, post-growth, climate, etc.).

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Additional notes: This question aims at explaining a possibly implicit but not reflected understanding of sustainability. Every understanding of sustainability is accompanied by certain assumptions about what sustainability aims at, how sustainability is achieved, who is responsible for it and what knowledge is used for it and how. These implicit assumptions become clearer with the reflection on the understanding of sustainability. In addition, it may become apparent if several understandings of sustainability are used in the project. If this is the case, this guiding question for reflection provides an opportunity for clarification and agreement. It may be useful to agree on a common working definition for the project (see 3.1).

Reflection question 2: Does the definition used correspond to one of the classic understandings of sustainability?

- Yes, to the approach ...
- Yes, but there are the following deviations ...
- No, but the term can be understood from the context as follows ...
- No, because ...
- ...

Requirements: It should be reflected upon whether the understanding of sustainability refers to one of the dominant sustainability discourses (cf. section 3.3.5). This does not necessarily have to be the case. It should then become clear how sustainability is specifically understood in the project, whether certain assumptions are specifically formulated in the project or whether several understandings of sustainability are implicitly linked or whether the understanding of sustainability emerges from the context.

Additional notes: This guiding question for reflection aims at revealing implicit references to major social discourses and locating them more closely in the sustainability discourse. Through reflection, it becomes clear which implicit assumptions are given or not given by their place in a discourse and which references and demarcations also exist at the level of the actors. This serves the early recognition of possible areas of tension in cooperation and participation, in the context of structures of funding and science as well as in the context of social conditions.

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Reflection question 3: Does the project make clear what contribution it wants to make to sustainability in the project's own understanding of sustainability?

- Yes, ...
- Yes, however ...
- No, because ...
- ...

Requirements: It should become clear which concrete conditions, changes or general results of the project are considered to contribute to sustainability.

Additional notes: This guiding question aims at explaining the goals and interests associated with the understanding of sustainability. At the same time, it becomes clearer what sustainability should look like and which actors, measures, knowledge etc. are required to achieve it.

Reflection question 4: Does the project make clear which trade-offs are accepted, and to what extent does the project's contribution to sustainability hinder other aspects relevant for sustainability?

- Yes, ...
- Yes, however, the following compromises can be found ...
- No, because ...
- ...

Requirements: It should be made clear which concrete conditions, changes and, in general, results are not achieved or hindered by the intended project.

Additional notes: This guiding question for reflection aims at avoiding a possible inability to act due to any dilemmas that may emerge. This is achieved by reflecting on the limits and possible negative implications of one's own project beforehand, so that any conflicts that may emerge in areas of tension have already been reflected upon as a possibility before they occur and can thus be dealt with more easily.

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4.2 Metacriterion 2: The description of the problem and the objectives are reflected upon by all participants as a framework for action. (Block B)

This metacriterion serves to reflect on the relationship between the description of the problem and the objectives in the project, on the one hand, and the underlying understanding of sustainability, on the other.

Reflection question 5: Has an understanding on a common description of a problem taken place between all participants?

- Yes, namely ...
- Yes, it took place, but ...
- No, because ...
- ...

Requirements: Different perspectives on the sustainability problem underlying a project are not uncommon in hybrid teams of scientists and practitioners. As long as no common understanding of the problem has been formulated, the description of goals is hardly possible since these will inevitably differ. In the context of this process, different understandings of sustainability and what objectives should be pursued in this area may also come to light, which can trigger conflicts (dilemmas). In this respect, careful clarification is required, otherwise the subsequent research process is jeopardised. In the course of the project, the description of the problem and objectives should be regularly reviewed to see whether they need to be adapted in the light of new findings.

Additional notes: see section *3.3.1 Conflicting goals as a potential cause of dilemmas*

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Reflection question 6: Are multiple objectives identified in the project?

- Yes, namely ...
- Yes, however ...
- No, because ...
- ...

Requirements: Of course, there can be several objectives in a project. In this case, it is important to ensure mutual support and the elimination of contradictions between these objectives at iterative checkpoints.

Additional notes: see section *3.3.1 Conflicting goals as a potential cause of dilemmas*

Reflection question 7: In the case of several objectives, is prioritisation carried out and what criteria does it follow?

- Yes, prioritisation exists and follows the following criteria ...
- Yes, there is a prioritisation, but ...
- No, there is no prioritisation because ...
- ...

Requirements: If a team agrees to pursue several objectives in one project, they can under certain conditions be worked on either consecutively or in parallel. Such objectives can contradict each other or lead to dilemmas. One way to deal with this is to prioritise between the different goals. Such prioritisation can be done explicitly or implicitly. Agreeing on the reasons for prioritising or not prioritising helps to actively deal with possible dilemmas.

Additional hints: The greater the variety in research questions, objectives and expertise allowed in a project, the greater the potential for conflicts or dilemmas. It may therefore be advisable not only to prioritise goals but also or alternatively to reduce them. However, this must then be made transparent and actively reflected upon.

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Reflection question 8: Do all objectives relate to the understanding of sustainability used?

- Yes, namely ...
- No, the following objectives do not do this because ...
- No, because ...
- ...

Requirements: After agreeing on a working definition of sustainability within the project as well as on a common understanding of the problem and shared goals, it must be examined whether the desired objectives are compatible with the understanding of sustainability. Here, too, the diversity of actors from science and practice plays a decisive role with regard to potential conflicts and dilemmas. It must be ensured that the various goals have been made transparent and accepted by all, and that they neither contradict the understanding of sustainability nor the overall objectives, nor lead to conflicts or dilemmas.

Additional notes: This examination should be carried out taking into account the reflection on the previous guiding questions 1–7. In the case of negotiation processes, an external moderation is highly recommended.

4.3 Metacriterion 3: The forms of knowledge underlying the project with their opportunities and limitations are reflected upon. (Block B)

Since sustainability research projects often bring together different actors as well as different forms and types of knowledge, this metacriterion serves to reflect on the existence of this diversity and how to deal with it (cf. dilemmas as a result of knowledge conflicts). The metacriterion reflects not only on the existence of different forms of knowledge but also on their respective opportunities and limitations and the challenge of integrating knowledge across different forms of knowledge.

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Reflection question 9: Is the project based on different scientific knowledge?

- Yes, namely, ...
- Yes, however ...
- No, because ...
- ...

Requirements: The project involves scientists or practitioners who contribute scientific knowledge from the literature or from their own research. Scientific knowledge is knowledge that meets the criteria of scientific work and quality assurance. Scientific knowledge is typically discipline-oriented and can therefore differ in terms of theories, methods, processing and scientific community.

Additional notes: see section 3.3.4 *Conflicts between different forms of knowledge as a potential cause of dilemmas*

Reflection question 10: Is the project based on non-scientific forms of knowledge?

- Yes, namely ...
- Yes, however ...
- No, because ...
- ...

Requirements: In transdisciplinary projects, forms of knowledge that originate from contexts other than science are also used and integrated. In particular, practical knowledge based on experience or traditions plays an important role here, which can also serve to develop effective solutions to sustainability problems.

Additional notes: Actors other than scientists also produce and represent knowledge. They can play a special role in the project, especially with regard to the integration of different forms of knowledge.

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Reflection question 11: Are different types of knowledge along the lines of systems-, target-, and transformation knowledge (in the sense of transdisciplinary research) included and adjusted to the understanding of sustainability?

- Yes, by ...
- Yes, however ...
- No, there...
- ...

Requirements: Transdisciplinary research projects include both systems knowledge and knowledge about goals/targets and ways to achieve them (target- and transformation knowledge) and bring them together within the framework of their understanding of sustainability.

Additional notes: Focusing exclusively on one type of knowledge jeopardises the achievement of objectives such as contributing to socio-ecological problem-solving for sustainable development.

Reflection question 12: Are possible tensions or contradictions between different forms and types of knowledge reflected upon?

- Yes, by ...
- No, there...
- ...

Requirements: The particular strengths and weaknesses of the different forms of knowledge are reflected upon. Here, criteria can be: generalisability of knowledge, correspondence to real-world experiences, communicability for non-scientific groups of actors, independent verification. Conflicts between forms of knowledge can be eliminated and knowledge integration across different forms (and types) of knowledge in the project can be achieved.

Additional notes: In the context of the dominance of scientific forms of knowledge, non-scientific forms of knowledge often have to struggle with being seen as less valuable or relevant to decision-making. In this respect, it is also important to be aware of forms of discrimination or disparagement.

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The integration of knowledge in transdisciplinary research projects can undergo different pathways and phases. In most cases, it requires a concept or an integrative framework, e.g., through inter- and transdisciplinary concepts such as the ecosystem approach. The existence of such concepts of integration is a suitable indicator of the possibility of successful knowledge integration.

4.4 Metacriterion 4: Basic decisions and implicit assumptions are reflected upon in the project. (Block B)

As mentioned in chapter 3.4, the unreflected adoption of implicit assumptions can lead to tensions in research projects. With the help of these guiding questions, these assumptions can be made visible and accessible through democratic processes of understanding and negotiation in research projects.

Reflection question 13: Are the basic terms of the call for proposals or the project defined and their meaning and significance reflected upon?

- Yes, through ...
- Yes, however ...
- No, there...
- ...

Requirements: The central concepts underlying the project or the call for proposals are examined from different perspectives and discussed in the project network, for example, through the use of transdisciplinary methods of knowledge integration, and thus located in the sustainability discourse.

Additional notes: Terms are embedded in contexts of meaning (theories, scientific approaches, discourses, etc.). Therefore, the same word can have different meanings. Reflecting on the meaning of terms prevents an uncritical adoption of (historically developed) conceptual understandings and coinages, which can otherwise lead to tensions or dilemmas.

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Reflection question 14: Are implicit assumptions of individual disciplines about the research subject disclosed and communicated transparently in the project network?

- Yes, by ...
- Yes, however ...
- No, because ...
- ...

Requirements: It is important to deal with the extent to which one's own disciplinary location and the associated interpretive claims have an impact on the handling of the research object and on inter- and transdisciplinary cooperation. This includes conceptual understandings as well as methodological approaches or academic practices.

Additional hints: This can prevent the occurrence of dilemmatic situations by clearly formulating and communicating one's own perspectives and becoming part of collaborative negotiation processes.

Reflection question 15: Are the normative and motivational foundations of one's own actions and the associated interpretive claims reflected upon?

- Yes, because ...
- Yes, however ...
- No, because ...
- ...

Requirements: As a rule, it can be assumed that team members from science and practice also pursue their own agendas with the research. The personal motives for participating in the research project should be actively addressed and the expectations of the research object, project and collaboration should be communicated.

Additional advice: This can minimise the potential for frustration, strengthen cooperation in the project network and avoid dilemmas through open exchange.

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4.5 Metacriterion 5: The processes and possible tensions of inter- and transdisciplinary cooperation are reflected upon. (Block C)

This metacriterion refers to the areas of tension outlined in chapter 3.4 and deals with the reflection of processes of participation and cooperation that need to be developed in the context of interdisciplinary and transdisciplinary sustainability research. It also provides suggestions for reflection on how to deal with different heterogeneous values, interests and goals in the context of sustainability research projects.

Reflection question 16: Are the criteria for selecting the actors involved reflected upon?

- Yes, by ...
- Yes, however ...
- No, there...
- ...

Requirements: The actors involved have an influence on the course of the project. In this context, the choice of actors involved is selective in view of the large number of possible stakeholders and interested parties. Diversity of the actors involved is fundamentally relevant for the legitimacy – and thus also the long-term success – of the project. Therefore, attention should also be paid to the inclusion of hitherto less visible actors or groups that are different according to socio-economic or gender-related criteria. In any case, it is necessary to reflect on the criteria for their selection and to disclose the justifications.

Additional information: see 3.4.2 *Tension between cooperation and participation in inter- and transdisciplinary research projects.*

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Reflection question 17: Are processes of participation designed in an open and participatory way so that barriers are removed from the outset?

- Yes, by ...
- Yes, however ...
- No, because ...
- ...

Requirements: In order to allow access to the research process for as many stakeholders and interested parties as possible, there should be a low threshold for participation. Any obstacles to processes of participation should be anticipated and removed. If relevant groups are not included, this can lead to conflicts and dilemmatic situations afterwards, which endanger the results and legitimacy of the project.

Additional notes: At the same time, broad participation of a large number of actors is a challenge because it not only complicates processes of communication and cooperation but also increases the potential for conflict and dilemma *within* the project. It is therefore important to strike a sensitive balance between broad participation and workability.

Reflection question 18: Is it clear who in the project network contributes which competencies and (professional) resources to achieve the objectives?

- Yes, ..
- Yes, however ...
- No, ..
- ...

Requirements: In the context of the constellation of the project, it makes sense to know the respective areas of competence of the actors involved and to specifically include them in the research project.

Additional hints: This strengthens the appreciation for the common work, facilitates mutual support and can prevent conflicts, for example, over responsibilities.

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Reflection question 19: Are there tensions between the individual objectives of the actors involved in the project?

- Yes, namely ...
- Yes, however ...
- No, because ...
- ...

Requirements: Other actors involved in the project may be directly, indirectly or remotely affected by the project's objectives. Their own objectives and expectations of the research project should be reflected upon accordingly and set in relation to other objectives and expectations in the project network.

Additional information: This is the starting point for an open process of negotiating objectives of the project, at the end of which there are jointly formulated objectives that are supported by all.

Reflection question 20: Are there fixed, regulated communication structures in the project network that enable open, transparent communication between all actors involved?

- Yes, by ...
- Yes, however ...
- No, because ...
- ...

Requirements: There should be fixed communication channels in the project network that ensure a reliable exchange between all participants.

Additional notes: This can prevent conflicts and misunderstandings and enable the research process to run smoothly.

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Reflection question 21: Are there structures or action plans that are used when conflicts or disagreements arise in the project?

- Yes, namely ...
- Yes, however ...
- No, because ...
- ...

Requirements: When problems and conflicts arise, it should be possible to use pre-established consensual mediation structures to address problems productively and work out a joint solution.

Additional notes: Problems in the research process and project network can be manifold and inhibit processes in the project. "Contingency plans" create a framework for dealing with conflicts that emerge and also help to sharpen expectations and communication structures.

4.6 Metacriterion 6: The policies with regard to time in the project are reflected upon. (Block C)

This metacriterion focuses on the different policies regarding time that have to be reconciled in projects of sustainability research. These are the time resources that result from the project's funding period, any fixed-term contracts or long-term structures. The policies regarding time also include the partly different temporal processes, which are conditioned by the inherent logics of social and ecological systems. Thus, in the questions for reflection, the handling of different process phases of all participants are addressed and sensitised to the resources of the respective actors.

Reflection question 22: Are the time resources of the actors involved in the project network known and communicated?

- Yes, namely ...
- Yes, however ...
- No, ...
- ...

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Requirements: It should be clearly communicated and documented which actor can contribute how much time to the project in order to lay the foundation for transparent joint work.

Additional advice: Clearly communicating expectations, including one's own temporal availability, can prevent misunderstandings and frustrations in the project and at the same time signal appreciation for the time of others, thus avoiding conflicts and tensions.

Reflection question 23: Are the time schedules and processes of the project participants coordinated and communicated?

- Yes, namely ...
- Yes, however ...
- No, because ...
- ...

Requirements: The work processes of the individual actors and their integration into institutional structures should be clearly communicated and coordinated within the research network. Changes or delays should be communicated at an early stage so as not to jeopardise research processes.

Additional hints: In addition to the communication of time resources, this can help to prevent tensions or even dilemmas, as the procedures in the research project are coordinated with those of the actors involved. Furthermore, this can ensure that the research process runs smoothly.

Reflection question 24: Are the inherent logics of the interacting systems of the research object considered in the research process?

- Yes, by ...
- Yes, however ...
- No, because ...
- ...

Requirements: The research process should take into account the inherent dynamics and logics of the social and ecological systems under study and consider them accordingly in the timetable.

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Additional notes: As sustainability problems are considered and researched in systemic contexts, the different timelines of individual systems may conflict with the duration of a research project and should be adjusted accordingly.

4.7 Metacriterion 7: If attributions of responsibility exist, they are actively reflected upon in terms of their justification, their limitations and their effects. (Block C)

When responsibility is attributed, this can be both a conflict about responsibility itself and exacerbate other conflicts as the cause of dilemmas. Dilemmas can emerge from a mixture of ambiguous attribution of responsibility, effects on action and potential emotionality. If there are attributions of responsibility, it is therefore important to actively reflect on them. See section 3.3.6 Conflicts over responsibility.

Reflection question 25: Are attributions of responsibility formulated in the project itself or brought to the project from outside?

- Yes, formulated in the project, namely ...
- Yes, brought in from the outside, namely ...
- No, deliberately left out ...
- ...

Requirements: The extent to which responsibility plays a role in the formulation and design of the project should be reflected upon. As attributions of responsibility are part of the conditions for action, it should be considered to what extent this is accompanied by requirements or restrictions.

Additional notes: Attributions of responsibility can be formulated explicitly or implicitly. In addition to the concept of responsibility itself, an indicator for the existence of attributions of responsibility is that goals and concerns are formulated with a particular urgency.

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Reflection question 26: What is the relationship between any attribution of responsibility and the project's understanding of sustainability?

- Yes, there is a direct relationship, namely ...
- Yes, however, it contradicts the understanding by ...
- No, because ...
- ...

Requirements: An understanding of sustainability is often accompanied by assumptions about who is responsible for creating unsustainable conditions and who is responsible for creating sustainable conditions. The project's understanding of sustainability and any existing attributions of responsibility should be consistent with each other.

Additional notes: In answering this question, it may be worthwhile to go through the conflicts mentioned in 3.3 as potential causes of dilemmas and also to consider the possibility of strategic assertion and negation.

Reflection question 27: Are the limitations and possible negative effects of any attributions of responsibility reflected upon?

- Yes, limitations are ...
- Yes, however ...
- No, because ...
- ...

Requirements: It should be reflected upon which conditions have to be given so that responsibility can be taken. This may involve other actors or certain structures.

Additional notes: Again, it is worth considering the types of conflict and the possibility of strategic assertion and denial.

4.8 Metacriterion 8: A use of the term "dilemma" is actively considered. (Block A)

Typical conflicts can potentially be the cause of dilemmas and can occur in areas of tension with potential for dilemmas. In addition, dilemmas can be

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strategically asserted or denied. It is therefore important to reflect on the potential causes of dilemmas, areas of tension with potential for dilemmas, as well as one's own use of the term "dilemma".

Reflection question 28: Is the term "dilemma" used in the research project?

- Yes, namely ...
- No, the term is not used, but ...
- No, because ...
- ...

Requirements: If the term "dilemma" is used, this should be summarised here. In this context, it should be laid open what the term refers to, for example, possible dilemmas in the project or possible dilemmas in the societal area of tension. In doing so, it should also be taken into account whether the term is used synonymously with other terms such as "conflict".

Additional notes: see chapter 3.2 *Dilemmas – On the basic structure of practical dilemmas.*

Reflection question 29: Can a strategic use of the term "dilemma" be identified in critical reflection?

- Yes, namely ...
- Yes, but...
- No, because ...
- ...

Requirements: The term "dilemma" can be used in different ways, for example, to deny dilemmas, to name dilemmas that have been overcome or to refer to systemic contradictions. With this metacriterion, it is important to reflect on which intention is behind this use of the term in the project itself or in reference to use outside of the project.

Additional notes: A strategic use can, for example, aim to justify the lack of alternatives for a strategy of sustainability, to demonstrate the necessity of a

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decision or to expose a given alternative as false. See also section 3.5 above: *Strategic assertion and denial of dilemmas.*

Reflection question 30: Could the term "dilemma" be used meaningfully in the research project to raise awareness of possible tensions or conflicts?

- Yes, namely ...
- Yes, but...
- No, because ...
- ...

Requirements: In the sense of a thought experiment, the term dilemma can be used to describe possible conflicts as potential causes of dilemmas or to sensitise for areas of tension with potential for dilemmas. This can serve to align ongoing decisions in such a way that actual dilemmas are avoided. It can also help to deal with still emerging dilemmas in a knowledgeable way.

Additional notes: Compare chapter 3. *Sustainability and dilemmas – Theory for practice.*

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5. Additional guiding questions for funding organisations

The following guiding questions can also be helpful for funding organisations:

Reflection question for funding organisations 1: Does the (maximum) funding period and the amount of funding allow for a transdisciplinary approach in which time and financial resources are available for knowledge integration, processes of participation and negotiation processes?

- Yes, through ...
- Yes, however ...
- No, because...
- ...

Requirement: The structures of research funding should be oriented towards complex transdisciplinary research processes and create framework conditions for excellent transdisciplinary research.

Additional hints: This reduces dilemmatic situations in research projects, as appropriate structures can prevent conflicts with respect to time and resources in the project network.

Reflection question for funding organisations 2: Are the basic terms of the call for proposals defined and their meaning and significance reflected upon?

- Yes, by ...
- Yes, however ...
- No, ...
- ...

Requirements: The central concepts on which the call for proposals is based are examined from different perspectives and located in the sustainability discourse.

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Additional notes: This prevents an unreflected adoption of (historically developed) conceptual understandings and coinages, which can otherwise lead to tensions or dilemmas. Cf. also the link to metacriterion 4, guiding question 13.

Reflection question for funding organisations 3: Does the call for proposals reflect on the relationship between political goals and the current scientific status and discourse on sustainability?

- Yes, because ...
- Yes, however ...
- No, because ...
- ...

Requirement: Alignment with purely political goals and interests can impede research and the further development of scientific discourse along scientific criteria. The relationship between political objectives and scientific discourse should therefore be reflected upon.

Additional notes: Under certain circumstances, this creates conflicts of interest between funding organisations and researchers. It can inhibit the innovative character of research and lead to difficulties in implementing research projects and should therefore be avoided.

Reflection question for funding organisations 4: Are the evaluation criteria and procedures of applications tailored to the characteristics of transdisciplinary sustainability research?

- Yes, by ...
- Yes, however ...
- No, because ...
- ...

Requirement: The evaluation of transdisciplinary research projects should be oriented towards the quality characteristics of transdisciplinary research. Cf. 3.4.3 (Transdisciplinary) research in structures of funding and science.

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Additional notes: Excellent transdisciplinary research also requires appropriate expertise and criteria in the review of proposals in order to recognise conceptual errors at an early stage and thus avoid problems in the research. Cf. the corresponding guide Bergmann/Brohmann et al. (2005).

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