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Tentative Theses on Transformative Research in Real-World Laboratories

First Insights from the Accompanying Research ForReal[1]

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Real-world laboratories are growing in popularity promising a contribution to both: the understanding and facilitation of societal transformation towards sustainability. Baden-Württemberg substantially funds real-world labs as part of the initiative “science for sustainability”. To facilitate learning with and from these so-called BaWü-Labs, they are supported by accompanying research conducted by two teams. This article presents first insights and theses on real-world labs as a research format, based in particular on the work of the accompanying research team ForReal. The team supports the labs in their realization and in providing general insights, e.g. by learning from related international research approaches and dialog with international experts, and analyzes suitable quality features and methods (the latter together with the University of Basel team). The theses presented here put up for discussion first insights on real-world labs as a transformative research approach and reflect on them from a theoretical perspective. They illustrate the relevance of a goal-oriented use of methods and present learning processes as core characteristics of real-world labs. The theses were formulated based on discussions with the BaWü-Labs, exchange in international contexts as well as a thematic literature review.

Reallabore sind ein zunehmend populäres Forschungsformat, welches dazu beitragen soll, eine gesellschaftliche Transformation in Richtung Nachhaltigkeit sowohl zu verstehen als auch zu gestalten. Baden-Württemberg fördert

Table 1: Overview of accompanying research on BaWü-Labs

Title	Linking, understanding, continuing real-world laboratories[2]	ForReal – Accompanying, systematizing, and transferring research in real-world laboratories[3]
Common goals	1. Supporting and interconnecting the real-world laboratories in order to facilitate the implementation process and mutual learning, developing transferable insights, and embedding the labs into national and international networks. 2. Gaining insights into real-world laboratory processes, in particular with regard to applied methods, quality features, and transdisciplinary knowledge integration (Schäpke et al. 2015).	
Complementary roles and focuses	• Facilitating dialog and mutual learning amongst the different labs (e.g. in the form of discussion forums). • Supporting inter- and transdisciplinary processes in different labs, e.g. via on-demand consultation. • Developing integrated insights from the labs on topics of mutual interest (e.g. methods or epistemology).	• Providing structured and practice-oriented inputs, e.g., on international good practice and research methods related to real-world labs. • Providing space for national and international exchange beyond the BaWü-Labs in the form of workshops and conference series as well as publications and blog-entries.
	• Common goals: Developing integrated insights into methods and quality features of the BaWü-Labs, formulating recommendations for research policy.	
Conducted by	University of Basel, Program Man-Society-Environment (Mensch-Gesellschaft-Umwelt, MGU), Research Group Inter-/Transdisciplinarity[4]	Leuphana University of Lüneburg[5], ISOE – Institute for Social-Ecological Research[6] and Wuppertal Institute for Climate, Environment and Energy[7]

Source: Own compilation

Reallabore unter dem Titel BaWü-Labs substantiell im Rahmen der Initiative „Wissenschaft für Nachhaltigkeit“. Um ein Lernen über und von Reallaboren zu ermöglichen, werden diese von einer Begleitforschung bestehend aus zwei Teams unterstützt. Der Beitrag stellt erste Einsichten und Thesen zum Forschungsformat Reallabore vor, welche besonders auf der Arbeit des Begleitforschungsteams ForReal basieren. Dieses unterstützt die BaWü-Labs im Umsetzungsprozess sowie in der Gewinnung von übergreifenden Erkenntnissen, u. a. durch Bezugnahme auf international vergleichbare Formate und Dialogveranstaltungen mit (inter-) nationalen Expert/innen, und identifiziert und analysiert spezifische Qualitätsmerkmale und – gemeinsam mit dem Team der Universität Basel – besonders geeignete Methoden. Die Thesen stellen vorläufige Erkenntnisse über Reallabore als Format der transformativen Forschung zur Diskussion und reflektieren Reallabore aus theoretischer Sicht. Sie verdeutlichen die Bedeutung zielorientierter Methodennutzung und thematisieren Lernprozesse als ein Kerncharakteristikum von Reallaboren. Sie wurden gewonnen aus Diskussionen mit den BaWü-Labs sowie aus Beobachtungen und Diskursen in anderen internationalen Zusammenhängen sowie einem thematischen Literatur-Review.

1 BaWü-Labs and the Accompanying Research

As a new research setting, real-world laboratories (“Reallabore”) are attracting increasing academic and political interest (Wagner et al. 2016). They are spaces where transdisciplinary research is conducted, often in order to promote sustainability. The goal of this research is to experiment with potential solutions to sustainability challenges, aimed at contributing to societal transformation and providing scientific insights. The Federal State of Baden-Württemberg is currently funding 14 real-world labs (Wagner/Ertner 2016). As this research initiative produces insights of potential relevance for researchers and practitioners beyond Baden-Württemberg

and Germany, this text will present some early lessons learnt from this program in English.

In support of the BaWü-Labs, an accompanying research group was established consisting of two complementary teams (Schäpke et al. 2015, cf. table 1):

2 Theses on Research in Real-world Laboratories

In this article, we present 14 tentative theses as initial results of ForReal research. They were developed based on a workshop ("Interkolloquium") with BaWü-Lab practitioners and international experts (Wagner et al. 2016) and a debate in one of the meetings of the discussion forums conceptualized and led by the colleagues from the Basel team, a broad literature review on good practices in real-world labs as well as similar research settings (Schäpke et al. in print), and two dialog sessions at the International Sustainability Transitions Conference 2016 (IST2016.org).

The conceptual (section 2.1), practice-oriented (section 2.2) and reflexive (section 2.3) theses on real-world laboratories are of a preliminary nature and invite to reflection, empirical research, adaptation, and complementation:

2.1 Understanding the Role of Real-world Labs for Transformative Research:

(1) *Real-world labs serve the two aims of transformative research: the understanding of sustainability problems, solutions, and processes of change as well as the design, application and testing of solutions.* The understanding of problems serves the design and application of solutions (Grunwald 2015). By developing and testing solutions in the real world, real-world labs (potentially) contribute to governing change – while simultaneously producing scientific evidence and knowledge, e.g. on how, where and why to intervene into a system to facilitate a sustainability transformation.

(2) *Real-world labs emphasize the production of actionable knowledge.* Actionable knowledge can be understood as "evidence-supported guidance for practical application that has been tested in successful efforts to solving (or at least mitigating) a sustainability problem within the defined experimental setting" (Forrest/Wiek 2014).

(3) *Knowledge is generated in two interlinked processes:* First, when solutions for a particular problem are designed and tested in experiments, new insights concerning the original problem develop. Second, the design and testing of solutions in collaboration between researchers and societal actors can reveal insights into (societal) change. Thus, socially robust solutions are developed that are evidence-based and actually work in practice (Wagner/Grunwald 2015).

(4) *Real-world labs apply transdisciplinarity as a core research mode.* Real-world labs adhere to several principles of transdisciplinary research as formulate e.g. by Bergmann et al. (2012), Defila et al. (2006) and Lang et al. (2012). This includes departing from societal problems, collaboration between different disciplines and partners from different societal actor groups in the co-design and co-production of research and knowledge, and the integration of different types of knowledge. Finally, it includes real-world labs to facilitate a double hermeneutic of both scientific research and societal learning. Thereby real-world labs explicitly include the testing of solutions in experiments that potentially directly contribute to change - an aspects that can be located within transdisciplinary research, but is usually not at its core (Wiek/Lang 2016). This particular feature of real-world laboratories may shape the transdiciplinary process of the lab.

(5) *Real-world labs may use collaboration in varying intensities:* A heuristic that differentiates between varying intensities of collaboration can help to design, implement, and reflect/evaluate real-world labs and respective experiments (Stauffacher et al. 2012; Wirth et al. 2014). Depending on the different aims of the respective lab and experiment phases, intensities can range from

mere consultation through collaboration to empowerment of stakeholders. The question of who is (not) invited to participate, to what extend and who decides on this brings up issues of power, legitimacy and ownership (Wittmayer et al. 2014). These are not only relevant to the processes within the real-world labs themselves, but go beyond to include, e.g. transdisciplinary elements of lab creation and funding.

(6) *Real-world labs rely on particular types of experiments as a core research method* (Caniglia et al. under review). Traditionally, scientific experiments focus on the understanding of problems by producing causal knowledge and take place in fully controlled lab settings. Differently, experiments in real-world labs aim to produce transformational knowledge and take place in settings that are only partly controlled. This also differentiates them from fully uncontrolled "experiments" caused by nature (such as natural disasters). Using experiments in this way requires the development of new and adaption of existing experimental methods (see also thesis 8). The functions of the experiments with their potential to foster a transition by creating radical alternative ways of thinking, working etc. need to be taken into account (Nevens et al. 2013).

(7) *Real-world labs should facilitate the adaptation of solutions generated in a specific setting, by enabling transfer and upscaling* (Luederitz et al. 2016). Real-world labs may produce evidence on solutions to sustainability problems. A relevant contribution to societal change is the transfer and upscaling of the developed solutions. This allows stakeholders to use the results of the experiment for formulating solutions to similar challenges, either in other contextual settings (transferability) or in system-wide applications (scalability). Scale- and transferability should be considered in the design of labs and experiments.

2.2 Practicality: Methods, Quality Features and Recommendations

(8) *Real-world labs use goal-oriented methods.* "Traditional" processes of transdisciplinary research (e.g. development of a common problem understanding and framing, common development of solution options) but also innovative areas such as joint experimentation (cf. Bergmann et al. 2012; Wiek/Lang 2016) ask for methods to support the participatory aspects. The specific methods used by the BaWü-Labs primarily support the mutual learning processes and the integration of knowledge from different epistemologies (scientific and societal). Additionally, there are a number of other methods that could be supportive especially in experimental settings, such as methods that allow the common description of and orientation along *boundary objects* (throughout the whole project) (Bergmann et al. 2012, 64f.). This includes the collaborative development and use of conceptual or functional models within the experiments or the combination of a number of experiments, respectively.

(9) *Quality features of real-world labs should relate to both the transdisciplinary process (e.g. co-design and co-production) and the design and testing of solutions.* Quality features of real-world labs should address the sensible and reasonable development and/or use of integrative and communicative methods. Also, they have to focus on the complex character of societal transformations and impacts. Moreover, criteria should include scientific quality aspects such as the transferability of results gained in a specific setting and new insights into the problem(s) dealt with.

(10) *Real-world labs provide space for reflection and learning.* Labs can be understood as (potentially transformative) learning environments that can be designed to offer experiential and transformative learning opportunities for all actors engaged in the project, including the stakeholders and, if applied in educational settings, the students (Schneidewind/Singer-Brodowski 2015; Caniglia

et al. 2016; König 2015). This requires an appropriate design of labs, allowing for learning and teaching. Breaking down complexity and tackling challenges in specific real-world settings enables learning and competency development, which, in turn, constitutes an empowerment of participants (Loorbach 2007).

(11) *Research and particularly experimentation in real-world labs raise ethical questions.* Ethical questions regarding research and particularly experimentation in real-world labs concern, e.g. the intended and unintended real-world impacts on the lives of engaged participants and beyond, the selection of sustainability challenges to be addressed as well as of the participants themselves. Ethical questions can – at least to a certain extent – be addressed via codes of conduct, transparency about aims and processes of real-world labs as well as joint ownership between the societal and scientific actors involved (Wittmayer et al. 2013).

(12) *Researchers take on various roles in real-world lab research.* Given the different aims of labs and the multitude of interrelated lab activities, researchers may play various roles in lab research beyond the traditional ones, such as facilitators, knowledge brokers, change agents, and self-reflexive scientists (Wittmayer/Schäpke 2014). Therein, researchers need to balance potentially competing demands in design and practice of research such as scientific rigor and societal relevance. To take on different roles, an adequate self-understanding as a researcher is required, as well as a respective skill-set. The separation of roles might also entail teams of researchers taking on complementary roles. The aspect of facilitation seems particularly crucial in realizing real-world labs and should be dealt with professionally.

(13) *Supportive funding conditions for real-world labs should be established.* Supporting funding and organizational conditions should be established that promote continuity and match the time span of transformative processes addressed in real-world labs, e.g. in terms of prolonged funding periods (Wagner et al. 2016).

2.3 Reflection: Real-world Labs as a Challenging and Fruitful Contradiction in Terms:

(14) *From a theoretical perspective, real-world labs are based on an underlying contradiction:* they provide laboratory space for experimentation while being based in the real world and constituted by participatory processes (Schäpke et al. 2015). Real-world labs can be considered a contribution to the integration of societal demands and knowledge into research processes (similar to the contribution of "Realexperimente" described by Groß et al. 2005) as well as a thought-provoking starter for debates revolving around the role of science in society (Schneidewind 2014). However, this may also overburden real-world labs with expectations and provoke resentments.

3 Discussion and Outlook

Real-world labs constitute a promising setting for transformational sustainability research (Wiek/Lang 2016; Schneidewind et al. 2016). However, an explicit research agenda would help for their further development. This might comprise a clear conceptual or theoretical framing of how real-world labs and their experiments are defined (Wagner et al. 2016), including the underlying methods and quality criteria commonly agreed upon in the respective community. A further research need concerns the embedding of real-world labs in an in-depth understanding of societal transitions in order to capture their specific role in facilitating the transformation process towards sustainability. Finally, the implications of pursuing the double aim of understanding and facilitating change (see thesis 1) – two goals that are traditionally kept rather separate in science – as well as respective possibilities, limitations and trade-offs need to be investigated.

These questions call for systematic research and innovative approaches to turn the

high claims of the research setting of real-world labs into reality. Furthermore, the relation between real-world labs and general characteristics of transdisciplinary research has to be clarified, asking for the specific added value and process qualities realized in the labs. Reflection and discussion will continue in and around the 14 BaWü-Labs, the accompanying research teams, and associated events and workshops (Wagner et al. 2016).

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Notes

1) The "ForReal" team comprises researchers from Leuphana University of Lüneburg, ISOE – Institute for Social-Ecological Research, and Wuppertal Institute for Climate, Environment and Energy.
2) Reallabore vernetzen, verstehen, verstetigen (Begleitforschung Reallabore BaWü); http://bit.ly/1QmT6y4
3) http://bit.ly/1SbsvVi
4) Rico Defila and Antonietta Di Giulio
5) Daniel Lang and Niko Schäpke
6) Matthias Bergmann
7) Franziska Stelzer

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