Turning the tide

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Governance and politics of transdisciplinary experimentation for sustainability transitions

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TURNING THE TIDE

Governance and politics of transdisciplinary experimentation for sustainability transitions

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ACCOUNT

Chapters 3-10 are based on articles that have been published, or are pending minor revisions, in international peer-reviewed journals.

Chapter 3: **Kok, K.P.W.**, Loeber, A.M.C., & Grin, J. (2021). Politics of complexity: Conceptualizing agency, power and powering in the transitional dynamics of complex adaptive systems. *Research Policy*, *50*(3), 104183.

Chapter 4: Tschersich, J.*, & **Kok, K.P.W.*** (2022). Deepening democracy for the governance toward just transitions in agri-food systems. *Environmental Innovation and Societal Transitions*, *43*, 358-374.

Chapter 5: Den Boer, A.C.L., **Kok, K.P.W.**, Gill, M., Breda, J., Cahill, J., Callenius, C., ... & Broerse, J.E.W. (2021). Research and innovation as a catalyst for food system transformation. *Trends in Food Science & Technology*, *107*, 150-156.

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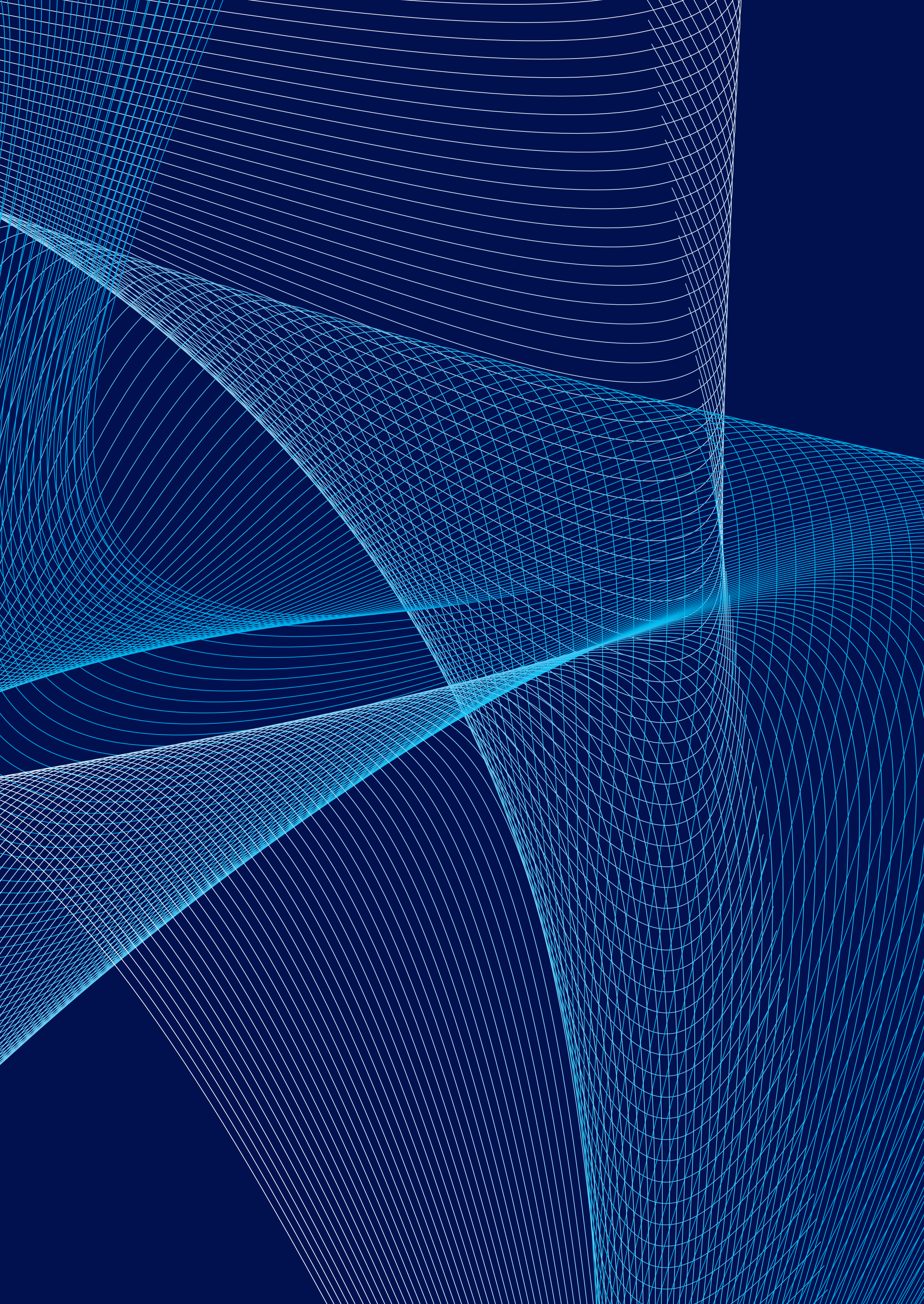
* shared first authorship.

LIST OF ABBREVIATIONS

ANT	Actor Network Theory
CAP	Common Agricultural Policy
CAS	Complex Adaptive Systems
CoP	Community of Practice
CSA	Coordination and Support Action
CSO	Civil Society Organization
CTA	Constructive Technology Assessment
DG RTD	Directorate General for Research and Innovation
DG AGRI	Directorate General for Agriculture and Rural Development
DG SANTE	Directorate General for Health and Food Safety
DLA	Dynamic Learning Agenda
DoA	Description of Action
EC	European Commission
EU	European Union
EU-TT	EU Think Tank (of the FIT4FOOD2030 project)
FAO	Food and Agricultural Organization of the United Nations
FIT4FOOD2030	Fostering Integration and Transformation for FOOD 2030
FNS	Food and Nutrition Security
FPC	Food Policy Council
GDPR	General Data Protection Regulation
H2020	Horizon 2020 Funding Scheme
IPCC	Intergovernmental Panel on Climate Change
MLP	Multi-level Perspective
MS	Member State
NGO	Non-Governmental Organization
NSA	Nutrition Sensitive Agriculture
NCD	Non-communicable Disease
R&I	Research and Innovation
RMA	Reflexive Monitoring in Action
RRI	Responsible Research and Innovation
SCAR	Standing Committee on Agricultural Research
SDG	Sustainable Development Goal
SNM	Strategic Niche Management
SPA	Social Practice Approaches
STS	Science and Technology Studies
TIS	Technological Innovation Systems
TM	Transition Management
ToC	Theory of Change
UN	United Nations
UNFS	United Nations Food Systems Summit
WHO	World Health Organization



P

Prelude: What is science anyway?

I have considered many different ways of "opening" this thesis. When my PhD work suddenly started to come to a conclusion, I reckoned it would be most fitting to open with the beginning: I wanted to begin this thesis with a story about the beginning of the thesis. The starting point, from which I departed. The seed. That one particular thought, place or moment in time, that gave rise to the writing of this book. But thinking about it more and more, I realized I had a problem.

There was no starting point.

Not one single starting point at least. Thinking about "the beginning" in 2022, I could not help but notice that my ideas now are different from those in 2018, when I started working at the Athena Institute to do my PhD. Very roughly speaking, my PhD is about *science* and *politics*. So, over the last couple of years, my thoughts have been scattered across different ideas about these concepts. Thoughts about their relationship emerged, yet mostly pointing to the absence of coherence and congruence in this feast of the mind. I have been confused more often than I had moments of clarity. However, the realization of *evolving thoughts* triggered a chain of memories. Different memories of particular episodes about science and politics involving moments that made me think 'otherwise', and that join hands to form a journey.

EPISODE 1: THE ATLAS AND THE FROGS (2002)

My childhood was a happy one. I grew up in Amstelveen, which is a suburb of Amsterdam, with two wonderful parents (shout out to Wim and Truus) and my rabbit Freddie. We were healthy and short of nothing. I realize this is a fortunate and privileged starting point, yet, this context is important because it is here where the first episode takes place.

One of my rather vivid childhood memories involves a peculiar picture in the *Wolters Bos Atlas.* It was published 20 years ago, in 2002. I was eight or nine years old. The picture was (though I did not recognize it as such at the time) a scenario matrix, containing four scenarios on what the landscape in the Netherlands could look like by 2030. I liked topography. On the *Windows95* school computers we would play a game where you had to match the country flags to the location of that country on the map. We were fanatics. One scenario in the picture caught most of my attention, because it had by far the most green in it, and that meant nature! I was fascinated by this image, mainly because I liked the idea of lots of nature and large animals roaming through the Netherlands. I do not remember being aware of the concept of "*politics*" at that age. However, it was clear to me that the people 'in charge' better had to make sure that we got as much green on the map as possible. When I was older, I figured the green scenario required strong government interventions and steering, whereas the messy and (in my view) *ugly* scenarios in hindsight seem to have gotten the upper hand…

That same year, I did get a clearer idea of what "*science*" was. Although I had already known a bit about it: my Dad was a chemist at the university, and I liked going there as a kid because the windows were green (at the old UvA *Roeterseiland* building); there were lots of pens and paper to draw with; and he had a desk where I could sit and pick up the phone (leaving behind confused scientists on the other side of the line) when he was off doing some science stuff in a room with lots of glass flasks. Together with two other kids we got our first "science" assignment in elementary school. It involved raising frogs. We took our task very seriously. One sunny afternoon we went to the nearest ditch, armed with buckets and nets, and we gathered as much frog spawn as we could. We put it in a big aquarium in the teacher's lounge, raising several eyebrows. A bit scary of course, but we had an important science project to complete. And after a couple of days (or weeks?) of carefully looking at the aquarium each break, the first tadpoles were swimming around. We did it, we did science! The tadpoles evolved into frogs. Many little frogs. Then tragedy struck, and there came the inevitable day when we forgot to put the lid back on the aquarium and dozens of tiny frogs escaped. I like to imagine that the teachers had a tough time finding all of those little frogs that were happily hopping around in the school. In the end, they probably either escaped or were released back into the "wild". Well, at least we did science for a while, and onward we moved, with new adventures ahead.

For me as a child, science had to do with nature and with things "other than humans". Mostly it had to do with looking at things and being fascinated by it. And whether that involved colored liquids in flasks, or frogs, did not really matter. But for sure, it had to do with the real world, outside our human lives.

EPISODE 2: FROM CLARITY TO CONFUSION (2011-2015)

In 2011, I started my studies in the BSc Bèta-Gamma at the University of Amsterdam, an interdisciplinary program where you could choose specialization tracks (majors) in almost every social and natural science field you liked. I met great people and moved to a student house in Amsterdam-Oost. We studied at *Science Park*, a new campus for the natural scientists built in the Watergraafsmeer in the east of Amsterdam. After the first year I majored in Physics. I was not alone, most of my Bèta-Gamma friends pursued their studies majoring in the natural sciences. The main arguments for doing so: (1) you did not have to leave Science Park, which had become a second home to many; (2) the others were also doing it; (3) if you were able to complete “sommetjes” (*calculations*) rather *okay-ish* during the first year, why not try to get the “most scientific degree” possible, you could always do something else after that; and (4) it was probably interesting. I mean, who does not want to learn the truth about how the universe works and came about, and understand the very nature of things? Thus began some years with a lot of “sommetjes”, on calculus, electromagnetism, cosmology, thermodynamics and quantum physics.

In 2014, I decided to take classes in Political Sciences. I enjoyed the changes this brought along. Not only in content (we had to actually discuss articles, for instance) but it also allowed me to see a bit more of university life than merely the *Science Park* as the Faculty of Social Sciences was in those days located in the historic city center of Amsterdam, and I liked walking around the *Binnengasthuisterrein* and the *Oudemanhuispoort*. There, I felt a bit like the odd one out, not only because I had to travel up and down from Science Park every time and mostly studied Physics, but also because I felt I held rather different beliefs about what science was. One day, we were discussing social constructivism (in a way as if it was an obvious stance to take) and I got angry. Were these people (*they*) suggesting that natural scientists (*we*) were just creating or making up some facts? Did they not realize that if the machine tells you the critical temperature for the anti-ferromagnetic and superconductive phase transitions in a semi-metallic half-Heusler[1] is 1.5 Kelvin, it might actually be a fact of nature rather than a social convention? At *Science Park*, we were doing real science. We were finding the truth! And all right, if the universal truth does not exist in isolation, we were at least approaching it. We were not just merely debating policies or writing essays based on our political preferences!

The problem in retaining my initial stance on the relation between science and politics (or perhaps: with social studies on science and technology) was three-fold. One, I was already made susceptible to arguments from the social sciences in my first year of study which meant that I was becoming soft. Two, I also thought the social sciences, and their focus on politics and societal challenges, were interesting. And three, I eventually also thought the social theorists were right about the entanglement of facts and values, and the consequences thereof for the clear-cut and problematic separation of science and politics. Social constructivism and worse, post-modernism, are attractors. The more you dive into them, the less likely you are to ever escape their structuring grip. I followed a number of rather formative courses on policy, politics and scientific expertise. Espe-

1 This is a particular class of crystalline materials. At Science Park these could only be created by one person, who for some reason ‘knew’ how to craft them. No one else understood how it was done. It was not exact science. Rather, it was (and looked!) like alchemy. It required extraordinary skill.

cially Latour's *Politics of Nature* paved the way for my conversion into the social studies of science. Before I knew it, and whether I liked it or not, I had abandoned positivism and entered the realms of interpretivist approaches.

Toward the end of my BSc I still considered myself to be first and foremost a natural scientist-to-be. Alas, a rather confused one.

EPISODE 3: SCIENCE AND TRANSITIONS (2015-2017)

Journeys are never linear. After taking a dive into the social sciences, I suddenly found myself pursuing a MSc in Physics. It required full-time attention. We felt the "sommetjes" were getting challenging, sometimes in a non-enjoyable way. My track was called Advanced Matter and Energy Physics. It meant about a year of theoretical courses, and then doing a year of experiments in a Lab. The Labs of the Physics groups were located in the heart of the *Science Park*. Most impressive was one large Lab, perhaps 50 meters long, 15 meters wide and about 15 meters high (this is a guess, not a measurement). People called it the "Fish Bowl" because it had glass walls and *Science Park*'s main walking routes passed by at the level of the first floor. It meant that we were constantly on display: a zoo of physicists. People would look down to see if anything was going on, stare at us while eating their lunch, wave insanely or knock on the windows until a physicist looked up. And then wave again, obviously. It was our own *Panopticon*. Some days, if the visitors were lucky, they could see panic-stricken PhD-students running up and down the Lab that feared to have broken extremely expensive machines. Machines that were now hissing, making noises, and had liquid nitrogen spurting out, making its way into the Lab. Surrounding the Fish Bowl was a ring of smaller Labs where the laser physicists would work in absolute "Darkness" to avoid messing up experiments that required light of one very specific wavelength, and that wavelength only. You had to be careful at all times not to bump your head.

During my days at *Science Park*, I spent time in both the Fish Bowl, the Darkness and the spaces in between. I learned two important lessons.

(1) I spent one year studying phase transitions in glasses in Amsterdam and Boston, in a peculiar sub-field that was called Soft Condensed Matter Physics. It was fun and I would happily chat to everyone about it. We were trying to figure out whether glass was a solid (it sure looks like it, you would say), a liquid (it behaves that way

sometimes when you really zoom in) or something else (who knows?).[2] We made chemical mixtures of extremely small plastic-like particles that ought to resemble atoms and modified them so that they would behave as a glass. Then we would make "3D movies" with specialized microscopy and unleash our models to calculate glass dynamics. It was challenging: the measurements were difficult to perform, doing it 'right' required experience and practical wisdom[3]; the machines were usually not eager to help us; even after extensive encouragement the particles would sometimes not behave as a glass; as everyone's project was the most important one, we had to fight for microscopy-time; and the models were far from perfect so it was difficult to pinpoint results. I wasn't quite sure what the data was trying to tell us. It was difficult data. Being the one most *closely related* to the particles and the data, it was my task to be the interpreter of this man-made Nature. When I had doubts about the nature of Nature we were witnessing, another physicist told me: *"I am sure that what we are looking for is in the data, you just need to bring it out".* And at that moment I remembered Bruno Latour. Our show about glassy physics was simply a reprise of *Science in Action!*[4] How unoriginal. We did not conclusively figure out the true nature of glass.

(2) For about a month, I was helping out a PhD student with making so-called *quantum dot solar cells* in the Darkness. Never mind the exact physics behind it, but the general idea was to put really small bits of photovoltaic material in transparent plexiglass and see whether it could still work as some kind of solar cell. If that works in real-life (which in this month it did not, of course), one could make windows that are transparent, but at the same time serve as solar panels. And that is awesome. Imagine the possibilities for sustainable electricity! At the same time, we had all kinds of exciting lectures on new types of solar cells made from the most exotic materials. These could be more efficient than the normal ones (made of silicon), and thus be more "sustainable". Though in theory they were a couple of percent more efficient, in practice, probably much less so. And here comes the lesson: I started to believe both innovations were not simply going to do the trick by themselves. Not only are such materials often (by)products of exploitive mining efforts in vulnerable ecosystems, they could also leak toxic waste. So what is "sustainability" then? And I wondered: does it really matter if in 20 years' time we would have slightly more efficient solar panels? What mattered was that everyone would put solar panels on their roofs. *Right. Now.*

2 There is a story that windows of old churches are thicker at the bottom than at the top, which could lead one to speculate that the glass slowly flows down after many centuries, for instance because it is not fully solid but a type of liquid. This is not true. It is simply a more stable way of constructing windows.

3 Practical wisdom as 'know-how' is also called *phronèsis* (see Loeber, 2003).

4 See Latour (1987).

EPISODE 4: HELP, THERE IS MORE! (2017-2022)

So my thoughts went back, again, to the social sciences. To realize sustainability transitions, we should (also) focus on politics, governance and all the economic, justice, and socio-cultural dynamics that transitions bring along. Not a very invigorating realization in transition studies perhaps, but I do believe at that time this was not a common way of thinking in the natural sciences, where the tech-fix paradigms still seemed strongly present.[5] Therefore, I went back to the Faculty of Social Sciences once more to study public policy and governance. The faculty had moved in the meanwhile, to Roeterseiland in a brand-new building. There were great lectures and courses. My thesis explored the politics of transitions.

It was over before I knew it. It was June 2018. Summer came, it was a very warm one. I felt as free as a bird.

So, here we have it. The story toward the beginning.

It really begins then, in August 2018. As I will illustrate throughout this thesis, that was definitely not the end of my confusion. Rather, it was the beginning of a whole new episode. Because just as I thought that I had figured out all there was to know about the different sciences, the relation between politics and science and the urgency for sustainability transitions, I joined the Athena Institute at the Vrije Universiteit in Amsterdam.

My new supervisors were coordinating a large EU project on food system transformation. The project (FIT4FOOD2030) forms the central piece of empirics in this thesis. I have worked on this project for two and a half years, until its completion in December 2020. In a series of introductory chats and meetings with the project team, it slowly became clear to me that this project was not a “research project”. Rather, people for some reason kept saying that it was a “coordination project” that meant to support the European Commission (EC) in implementing their policies. So we were organizing with society for society.

Sure, all fine, of course. But I kept wondering…

5 Not surprisingly, because one could consider physicists to be the first line of interpretation between the Natural world and the rest of us. So of course, they speak on behalf of those materials and technologies, and they have a close relation with them. Perhaps even affinity or affection?

If it is not a research project, how can I do my PhD?

"Well isn't that obvious? You do your research while being engaged in this project."

So, in addition you mean?

"No, through the engagement. It goes hand in hand. The project is your data."

Okay, but when will I then get time to do my research?

"You will organize workshops, give training to policy makers, organize project meetings. You will make notes and observe. And have you ever worked with post-its? We work with them a lot. You will learn about the system because you will try to change it. That is why it is called transdisciplinary research."

Sorry, what?

"Transdisciplinary research!"

Help, there is more!

PART I

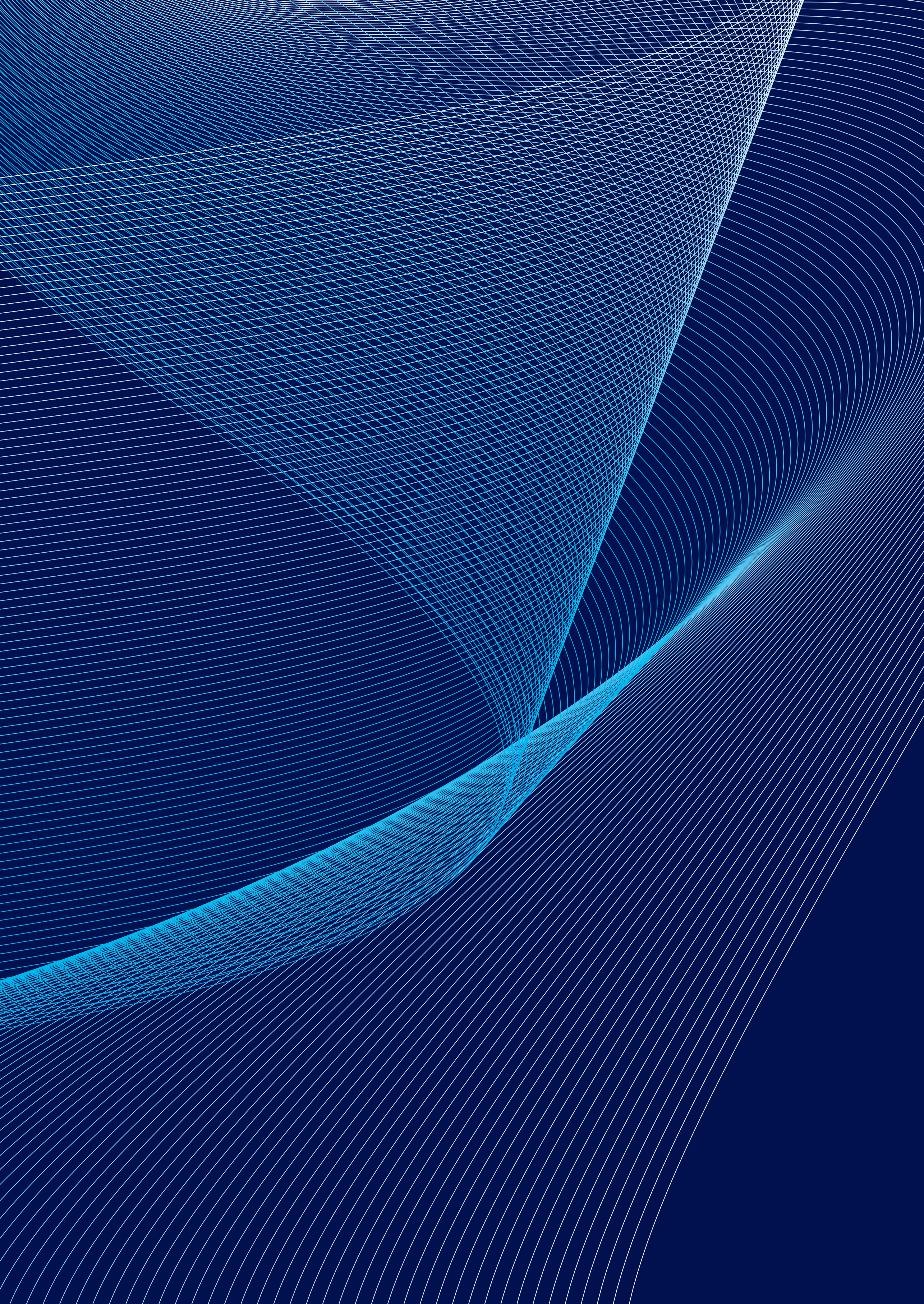
SETTING THE STAGE

“These ambiguities, redundancies, and deficiencies recall those attributed by Dr. Franz Kuhn to a certain Chinese encyclopedia entitled Celestial Emporium of Benevolent Knowledge. On those remote pages it is written that animals are divided into (a) those that belong to the Emperor, (b) embalmed ones, (c) those that are trained, (d) suckling pigs, (e) mermaids, (f) fabulous ones, (g) stray dogs, (h) those that are included in this classification, (i) those that tremble as if they were mad, (j) innumerable ones, (k) those drawn with a very fine camel’s hair brush, (l) others, (m) those that have just broken a flower vase, (n) those that resemble flies from a distance.”

The Analytical Language of John Wilkins
Jorge Luis Borges, 1942

“This book first arose out of a passage in Borges, out of the laughter that shattered, as I read the passage, all the familiar landmarks of thought—our thought, the thought that bears the stamp of our age and our geography—breaking up all the ordered surfaces and all the planes with which we are accustomed to tame the wild profusion of existing things and continuing long afterwards to disturb and threaten with collapse our age-old definitions between the Same and the Other.”

Les mots et les choses: Une archéologie des sciences humaines
Michel Foucault, 1966



1

Introduction

1.1 SCOPE AND RESEARCH AIM

Our world faces an increasing number of interlinked and persistent sustainability challenges that need to be addressed urgently, including climate change, biodiversity loss, soil degradation, deforestation and depletion of natural resources. Related are health and socio-economic challenges such as the rise of non-communicable diseases (for instance because of dietary patterns leading to obesity and malnutrition) and extreme socio-economic inequalities. Scholars have issued stark warnings about our planet's future. The 2019 Intergovernmental Panel on Climate Change (IPCC) report's policy summary states that

> *"[g]lobal warming, reaching 1.5°C in the near-term, would cause unavoidable increases in multiple climate hazards and present multiple risks to ecosystems and humans (very high confidence)"* (IPCC, 2019: 14), whereby *"[c]limate change impacts and risks are becoming increasingly complex and more difficult to manage"* (ibid: 20).

Yet, 'managing' these strongly interlinked crises and steering our world toward sustainable development is exactly what is needed. Already in 1972, the *Club of Rome* commissioned a report called *The Limits to Growth* (Meadows et al., 1972), setting in motion debates on the future sustainability of our planet (or perhaps: its future collapse) in relation to the socio-economic and socio-material organization of contemporary societies. A mere 15 years later, the famous Brundtland report (1987: 41) further invigorated academic and policy debates on sustainability by stating that *"sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."* Yet one future generation later, the IPCC considered it necessary to present its starkest warning yet, on the (thus far) inability of our societies to **turn the tide** toward sustainability. So, what now?

Scholars of societal transformation have in recent years shed light on both the dynamics and stasis of complex socio-technical systems, especially regarding transitions toward sustainability (Geels and Schot, 2007; Grin et al., 2010; Köhler et al., 2019). *Transition* scholars characterize transitions as long-term processes of structural systemic change that *"involve far-reaching changes along different dimensions: technological, material, organizational, institutional, political, economic, and socio-cultural"* (Markard et al., 2012: 956).[6] In this light, sustainability transitions research aims to shed light on the how

6 Similar conceptualizations have emerged in *transformations* research, that considers socio-ecological systems and their governance toward sustainability (e.g., Folke, 2006; Gunderson and Holling, 2002).

and why of non-linear processes of "*transformative change*" [7] (Grin et al., 2010; Loorbach et al., 2017).

Scholars emphasize that complex societal sustainability problems and the required transformative change cannot easily be 'managed' through traditional governance strategies (e.g., Kemp and Martens, 2007). Governing transformative change is not a straightforward endeavor. Scholars point out the role of *politics of transitions* (involving notions of power, agency and democracy, and increasingly also justice considerations) as (1) key in obstructing transformative change through vested interests and power relations, as well as (2) crucial in accelerating transitions in *desired directions* through implementing sustainable policies and mobilizing citizens and publics (e.g., Meadowcroft, 2011; Avelino, 2021; Avelino and Rotmans, 2009; Jenkins et al. 2016). Hence, it is argued that for instigating transformative change and to address the politics of transitions, governance efforts should embrace pluriform, adaptive, reflexive and experimental approaches that involve a wide variety of stakeholders in developing and implementing transformative innovations and transition policy pathways (Martens, 2006; Grin et al., 2010; Scoones et al., 2020; Loorbach et al., 2017). At the same time, for science to develop actionable, accountable, democratically legitimate and robust knowledge and innovations that contribute to transformative change, there is a need to involve society (through a diversity of stakeholders and perspectives) in *transdisciplinary* processes of research and innovation (R&I) (Klein et al., 2001; Nowotny et al., 2001; Regeer, 2009). In fact, due to its societal relevance, experimental nature and its focus on contributing to solving societal challenges*, transdisciplinary experimentation* can be seen as a mode of governing sustainability transitions. These considerations raise the question of how we can better understand the governance and politics of sustainability transitions through transdisciplinary experimentation.

The aim of this thesis is to contribute to a better understanding of the governance and politics of sustainability transitions, with a particular emphasis on transdisciplinary experimentation as a promising mode of governance. In addition, the work presented in this thesis has a distinct action-oriented focus, which may help to provide insights and recommendations for practice and governance, and may contribute to help accelerate

7 Throughout the thesis, co-authors and I will mostly use the term *transition*, but we also refer to *system transformation* or *transformative change*. Hence, there will be some interchangeable usage of terminology, as we draw upon both, and aim for enrichment between, the debates in transition and transformation studies. We also try to stick to the phrasing used by the authors whose work we use as much as possible. For an overview on the (etymological and epistemological) similarities and differences between the concepts, originating from their use in different fields, please see Hölscher et al. (2018), and Loorbach et al. (2017).

transformative change through the act of intervention. In this thesis, I[8] present both theoretical and (action-oriented) empirical explorations on the political nature of transition governance efforts. Empirically, my work focuses mostly on food systems and the role of R&I therein. Not only are food systems key systems in the survival of our societies, they are also highly complex and, importantly, significantly contribute to many persistent sustainability problems. On a more practical level, for the past years I was involved in a project that sought to contribute to food system transformation through transdisciplinary R&I. But first, let me present a brief overview of the field of transition studies, that deals with questions regarding systemic and long-term transformative change.

1.2 UNDERSTANDING TRANSITIONS

In the last decades, the field of transition studies has emerged in order to study long-term processes of transformative change in socio-technical systems (see Grin et al., 2010; Markard et al., 2012; Loorbach et al., 2017 and Köhler et al., 2019 for overviews of the field). A key tenet of transition studies is that it considers these change processes in light of the *complexity* and the *socio-technical* nature of the systems at play. In a complex system, its many interacting components give rise to emergent, self-organizing and non-linear dynamics involving systemic feedback-loops, synergies and trade-offs (Holling, 2001; Foxon et al., 2009; De Haan, 2006; 2010; Cairney, 2012; Oliver et al., 2018; Zhang et al., 2018). Importantly, this complexity does not imply automatic volatility or chaos. Rather, through their self-organizing and adaptive nature societal systems tend to evolve into relative equilibrium states in which their structural and functional properties stabilize. This gives rise to systemic resilience (Oliver et al., 2018; Folke, 2006) or locked-in system states (Geels and Schot, 2007; Geels, 2002; Loorbach and Rotmans, 2010) that are difficult to overcome. These considerations might also help to understand the persistent character of societal problems in complex systems (Schuitmaker, 2012) as systemic configurations tend to reproduce themselves (Grin, 2010, cf. Giddens, 1984)[9]. This, of course, does not mean that systems cannot undergo fundamental change. Rather, analogous to phase transitions in physical and biological systems, complex societal systems can undergo transitions toward another state of relative equilibrium. Preferably, those new system states are ecologically, economically and socially more

8 Most of the work presented in this thesis is collaborative and collective work, as is common in transdisciplinary research. Therefore, I use the pronoun 'we' wherever I refer to collaborative work (such as in Chapters 3-10), and 'I' where I share my own reflections or considerations (for instance at times in Chapters 1, 2, 11, 12 and 13).

9 Critically, and to further complicate matters, recent work has indicated that different societal systems (e.g., energy, agriculture) are often coupled through functional or structural couplings that might reinforce multi-system incumbencies, but which also provides entry points for better understanding transformative cross-system dynamics (e.g., Papachristos et al., 2013; Schot & Kanger, 2018; Kanger et al., 2022).

sustainable. However, the direction of transitions is not automatically sustainable in nature, nor are their outcome states (Røpke, 2012; Antal et al., 2020).

The field has developed a variety of approaches and frameworks for understanding stasis and change in complex socio-technical systems. I will briefly discuss two of them, as we draw upon those most (yet sometimes implicitly) in this thesis. These are the socio-technical approach and the complexity approach[10]. These are not randomly chosen. In a first overview of the field, Grin et al. (2010) sketch three important approaches to transitions. Two of them[11] offer frameworks for understanding mechanisms and patterns in transitions: the socio-technical approach and the complexity approach. Though they are different, they are also complementary in offering different emphases on transitional dynamics.

The first, and perhaps the most prominent framework in the field, was developed within the socio-technical approach and is labeled the 'multi-level perspective' (MLP, see Geels, 2002; 2011; Geels and Schot, 2007; Grin et al., 2010). It emerged in the field by combining insights from Science & Technology Studies (STS) and socio-technical system studies distinguishes three analytical levels: *niches* (where novelties and innovations are localized), *regimes* (that comprise incumbent actors, structures, technologies as well as associated self-reinforcing rules and practices) and the *landscape* (social and physical developments external to the studied system) in which regimes and niches are embedded. These levels span structuration space rather than spatial, geographical or governmental levels and thus represent functional scales (Loorbach and Rotmans, 2010), or degrees in stability (Geels and Schot, 2010; Geels, 2011). Regimes are for example fossil-fuel configurations or conventional industrialized agriculture, whereas niches could include the systemic spaces to develop solar energy, or organic agriculture. Landscape trends then could involve natural disasters (acute shocks and stresses), but also processes of globalization (slow developing trends). Scholars have identified different *transition pathways* through which promising sustainable niches could substitute unsustainable regimes (*technological substitution pathway*), through which regimes reconfigure (*reconfiguration pathway*) or transform (*transformation pathway*) under

10 There are many more approaches that offer understanding of the dynamics of transitions. Prominently, there are social practice approaches (SPA) that draw attention to *transitions-in-the-making* and emphasize micro-scale interactions and politics (e.g., Shove and Walker, 2007; Hoffman and Loeber, 2016); and there are Technological Innovation Systems (TIS) approaches that emphasize the networks and dynamics that bring along, and support, novel technological innovations (e.g., Bergek et al., 2008a; Markard et al., 2015).

11 The third approach does not *"deal so much with transition patterns and mechanisms"* (Grin et al., 2010: 9) but presents a broader socio-political view and highlights a governance perspective. This perspective strongly feeds into our understanding of transition governance and its different characteristics throughout this thesis, and it may be seen as complementary to the other two approaches.

pressure of (a combination of) niches and landscape trends, or when landscape trends lead to de-alignment of regimes and emergence of new regimes (*de- and re-alignment pathway*) leading to radically different system states (Geels and Schot, 2007). Initially, the MLP was criticized for being overly functionalistic and not paying attention to the (micro)politics involved in instigating transformative change (e.g., Shove & Walker, 2010; Smith et al., 2010; Geels, 2011), but these considerations are increasingly taken into account by the scholarly community (Geels, 2019; Köhler et al., 2019).

A second approach is rooted in complex adaptive systems studies and integrated assessment, and can be labeled the 'complexity approach' (Rotmans and Loorbach, 2010; Grin et al., 2010). While drawing on similar concepts as the MLP (such as niches, regimes and landscapes), the complexity approach differs as it places an emphasis on the non-rigidity of these structural levels. For instance, Rotmans and Loorbach (2010) also identify so called 'empowered niches' (located 'in between' niches and regimes) and highlight the importance of the 'support canvas', which is an undercurrent of socio-technical dynamics. Importantly, rather than building an understanding of transition dynamics around analytical structuration at multiple levels, the complexity approach also highlights the multi-phase and multi-pattern nature of transitions. The multi-phase concept highlights that transitions evolve non-linearly through *"alternating phases of both fast and slow dynamics"* (Grin et al., 2010: 126), which helps to describe the direction and speed of transitions. For instance, there is (1) the pre-development phase; (2) the take-off phase where structural changes are instigated and gain momentum; (3) the acceleration phase where these changes become visible; and (4), the stabilization phase where *"the new state of equilibrium is achieved"* (ibid: 126) (cf. Rotmans et al., 2001). The 'multi-pattern' concept then highlights the complex interactions between different systemic *constellations* (niches, regimes, and anything in between, see De Haan, 2010) that together form different dynamical patterns and mechanisms through which dynamics of change emerge. The non-linear dynamics that these interactions bring forth include mechanisms such as variation, selection and adaptation (e.g., De Haan and Rotmans, 2011). In addition, this complexity approach has developed an understanding of the 'fabric' that constitutes the systemic constellations, prominently by De Haan (De Haan, 2010; De Haan and Rotmans 2011) and for instance by Van Raak (2015). This fabric then comprises actors that are active in a constellation as well as cultures (*ways of thinking*), structures (*ways of organizing*) and practices *(ways of doing*).[12]

12 This is slightly different from the structure-agency dialectic as proposed by Giddens (1984) where there are 'agents' operating within, both transforming and re-producing, 'structures' (see Grin, 2010; Schuitmaker, 2012 for considering these notions in the context of transition studies). I will elaborate on the matter of 'structure' (quite literally on the *matter* of it, actually) in Chapter 3 and in Chapter 11.

As such, both approaches offer complementary and important insights into systemic ‘structures’ and the dynamics of transitions. The question then becomes: how can transitions be steered in *desirable* directions, if at all?

1.3 GOVERNING TRANSITIONS

Next to understanding the dynamics of transformative change, an important tenet of the field involves contributing to enacting transitions by focusing on, and even engaging in, processes of governance: which types of governance interventions can best contribute to accelerating transitional dynamics?

Governance is a challenging concept to define. It moves far beyond notions of design and implementation of policies by a coherent and uniform *Weberian* nation state (see for instance Jessop, 2003). Toward the end of the 20th century, and in light of increasing failures of governments and markets in *governing,* such as *“governmental overload, legitimacy crisis, steering crisis, and ungovernability”* (Jessop, 2003: 1) and the need to tackle increasingly complex and “wicked” societal problems (cf. Rittel and Webber, 1973) scholars have explicated the need for governance approaches that are pluriform, interactive, self-organizing and reflexive in nature (cf. Kooiman, 1999; Hajer, 2003). This involves governing through more horizontally organized and hybrid public-private networks in response to grand societal challenges, and thus signifies a shift from “government to governance” (Rhodes, 2007). As part of these approaches, policy scholars and practitioners have advanced approaches such as ‘interpretive policy analysis’ (cf. Loeber, 2003) and ‘deliberative policy making’ (cf. Hajer, 2003). Building on these insights, in this thesis I understand governance arrangements to be the *“ensemble of rules, processes, and instruments that structure the interactions between public and/or private entities to reali[z]e collective goals”* (Termeer et al., 2011: 161).

To realize transformative change, scholars have stressed that we need to combine the abovementioned structural, enabling and systemic (governance) approaches (e.g., Scoones et al. 2020; Grin et al., 2010; Martens and Rotmans, 2005). They have pointed out various promising avenues for transition governance (see Köhler et al., 2019). For instance, the field points to:

- the importance of strategically combining different policy instruments in (sectoral) policy mixes (Kivimaa and Kern, 2016, Rogge and Reichardt, 2016) that could destabilize incumbent regimes toward de-carbonization or support promising niches;
- the role of transformative innovation policies that could support the development of novel innovations that aim to contribute to tackling grand societal challenges and

thus move beyond economic rationalization of innovation (Schot and Steinmueller, 2018);

- the potential for accelerating transitions through intermediaries – private or public organizations or networks – that could bridge the gap between niche and regime developments (Kivimaa et al., 2019, cf. Klerkx and Leeuwis, 2009) and more broadly *"between actors and their related activities, skills and resources in situations where direct interaction is difficult due to high transaction costs, information asymmetry or communication problems"* (Kanda et al., 2020: 451);
- the importance of, and challenges involved with, creating (cross-sectoral) policy coherence regarding policy goals, instruments and outcomes leading to integrated policies that could better support transformative change (Huttunen et al., 2014; Candel and Pereira, 2017); and,
- the ambiguous role(s) of the nation state in either accelerating or hindering sustainability transitions (Johnstone and Newell, 2018).

In addition to this variety of considerations regarding the governance of transitions, another prominent focus of the field regarding governance concerns governing through and by supporting experimentation (Sengers et al., 2019; Luederitz et al., 2017; Köhler et al., 2019; cf. Geels and Schot, 2007; Loorbach, 2007). This *experimental* understanding of transition governance forms the foundation for 'early' governance approaches such as Strategic Niche Management (SNM) or Transition Management (TM). SNM as a governance approach emerged from the socio-technical approach to transitions (see e.g., Kemp et al., 1998). Its core focus is on stimulating promising socio-technical niches, and in particular focuses on stimulating niche development through (1) the articulation of visions and expectations; (2) building strong multi-actor networks; and (3) stimulating multi-dimensional learning processes (see Geels and Schot, 2010; cf. Kemp et al., 1998). Amongst others, it focuses on both destabilizing regimes and creating space for niches, by guiding variation and selection (of niches), stimulating learning in multi-actor settings, creating shared visions, fostering (systemic) anticipation and adaptation, and emphasizing the role of the frontrunners as key change agents in transition processes (Rotmans and Loorbach, 2010). TM could then help to scale-up, broaden or deepen innovations and thus catalyze transitional dynamics (see Van Den Bosch, 2010).

Though both SNM and TM are prominent approaches in transition studies (see Köhler et al., 2019), in recent years the field has opened up (also in connection to other sustainable-transformation-oriented fields such as transformation studies, sustainability science and socio-ecological systems thinking) and more broader interpretations of experimental transition governance have emerged. In experiments novel and transformative (social, technical, or policy) innovations can be developed through iterative multi-actor processes in relatively protected yet real-world contexts. Experiments can be supported and nurtured, after which they can accelerate transitional dynamics through different scaling, or *amplification*, mechanisms to enhance their systemic impact and set in motion transitional dynamics (see an overview and synthesis by Lam et al., 2020a, drawing on Westley et al., 2014; Gunderson and Holling, 2002; Grin et al., 2010; Van Den Bosch and Rotmans, 2008; Gorissen et al., 2018).

After reviewing literature on a wide variety of different (interpretations of) transition-oriented experiments (also including grass-roots experiments, bounded socio-technical experiments and sustainability experiments), Sengers et al. (2019: 161) present a conceptualization of experiments as "*inclusive, practice-based and challenge-led initiative[s] designed to promote system innovation through social learning under conditions of uncertainty and ambiguity*." Throughout this thesis, I will draw on, and further operationalize, this broad definition of experimentation, based on Sengers et al. (2019) as well as the wider literature on transition experiments and sustainability initiatives (e.g. Rotmans and Loorbach, 2010; Kemp et al., 1998; Van Den Bosch et al., 2010; Luederitz et al., 2017; Bergek et al., 2008a; Lam et al., 2020a). This means I consider experimentation to evolve around elements of (1) mobilizing actors and resources; (2) developing visions and directionalities; (3) developing and scaling innovations; (4) learning and reflexivity; and (5) creating legitimacy[13]. These considerations on experimentation strongly echo work on transdisciplinary R&I for sustainable transformation, which, in addition to transition studies, forms the second main conceptual pillar of this thesis.

1.4 GOVERNING THROUGH TRANSDISCIPLINARY EXPERIMENTATION

Related to the experimental turn in governing complex societal transitions is the emergence of transformative research and innovation (R&I) approaches (Klein et al., 2001; Lang et al., 2012; Fazey et al., 2018a; Norström et al., 2020; Caniglia et al., 2021). At the core of these interpretations of R&I lies the notion that R&I should not only 'create' knowledge, but rather should bridge the gap between knowledge and action (Van Kerkhoff and Lebel, 2006; West et al., 2020) in the sense that R&I could contribute to tackling complex societal challenges through the co-creation of knowledge, innovations and policy (pathways) with researchers and societal stakeholders (such as policy makers, business and civil society; see work on the "Quadruple Helix", e.g., Leydesdorff, 2012). Underpinning the development and uptake of such approaches is the insight

13 I elaborate on this conceptualization in more detail, together with co-authors, in Chapter 10.

from Science and Technology Studies (STS) that the clear-cut and dialectical separation between facts and values; nature and society; and thus, science and politics was becoming untenable, especially in light of the highly complex (sustainability) problems our world is facing in the "risk society"[14] (e.g. Beck, 1992; Jasanoff, 2003; Collins and Evans, 2002; Latour, 1987; 2004; Loeber, 2003; Regeer, 2009). As such, opening up appraisal of a variety of voices, perspectives and values in the development of knowledge, (technological) innovations and (sustainability) policy is not just a *'nice to have'*, but an indispensable ingredient for better understanding and governing complex challenges (Hajer, 2003; Stirling, 2008; Cuppen, 2012; Pattberg and Widerberg, 2016).

Approaches that try to bridge this gap between knowledge and action, and seek to open up R&I processes (cf. Stirling, 2008) have emerged under a variety of labels in recent decades (see Regeer, 2009 for an overview). For instance, they have been dubbed "mode-2" approaches where knowledge production takes place 'in society' rather than purely in 'science' as is case for linear and traditional' R&I approaches ("mode-1") (Gibbons et al., 1994; Nowotny et al., 2001; Regeer, 2009). Funtowicz and Ravetz (1993) famously coined the need for "post-normal science" to emphasize how societal engagement in R&I could help contribute to knowledge production and innovations in contexts with high degrees of uncertainty around both facts and values. Others, such as Schot and Rip (1997), Grin et al. (1997) and Loeber (2003) have emphasized the potential of Constructive Technology Assessment (CTA) or Interactive Technology Assessment (ITA) for unraveling the interrelations between technology and society through shared design, deliberation and learning; also in policy analysis for highly complex societal challenges (Loeber, 2003). Scholars advocating Responsible Research and Innovation (RRI)[15] have argued that inclusion of societal stakeholders in R&I processes could benefit democratization, and enhance responsibility of and accountability for R&I processes and outcomes (Owen et al., 2012; Stilgoe et al., 2013; Von Schomberg, 2011).[16] Another approach that has emerged in the last two decades which aims to bridge the gap between knowledge and action is labeled *transdisciplinarity* (Klein et al., 2001; Lang et al., 2012; Brandt et al., 2013).

This thesis mostly draws upon the label *transdisciplinarity*, sometimes accompanied by the notion that transdisciplinary endeavors could (or should?) involve *transformative* ambitions (e.g., Fazey et al., 2018a). There are several arguments for deploying this

14 Although it is also likely that the bankruptcy of this separation simply became visible in light of these problems, but that in fact, we "have never been modern" (Latour, 1991).

15 Since its emergence in the early 2010's, RRI had been taken up quite rapidly in the EU policy discourse and for instance in R&I funding mechanisms such as Horizon 2020.

16 These of course are merely a snapshot, there are also fields working with Participatory Action Research (e.g., McIntyre, 2007), Deliberative Policy Analysis (Hajer, 2003), Interactive Learning in Action (e.g., Betten et al., 2013) or other types of interventionist research (e.g., Zuiderent-Jerak, 2015).

demarcation. First, transdisciplinarity focuses strongly on establishing and supporting multi-actor processes, including not only different scientific actors and for instance policy makers, but explicitly opening up the potentialities for engaging a wide variety of societal stakeholders in R&I. Second, though transdisciplinarity as an approach is still emerging and in need of more coherence in terms of methodologies and concepts used (see Hakkarainen et al., 2022; Brandt et al., 2013), the field is expanding rapidly and gaining traction in both academia and policy environments, pointing to the increasing relevance of its rationale[17]. Some other 'terminologies' (such post-normal science, RRI and CTA) seem to be losing prominence, leading scholars to express concern as *"RRI will feature less on the EC's political agenda"* (Shelley-Egan et al., 2020: 9). Third, in contrast to some other approaches (such as CTA) transdisciplinarity does not have a primary aim of considering social aspects of technology or the natural sciences. Rather, it has a more symmetrical consideration of natural and social sciences, or in fact, of social and technological innovations which is fitting in the context of sustainability transitions where the focus is shifting from technological, to social and policy innovations as key in bringing about transformative change (e.g., Avelino et al., 2019). Fourth, transdisciplinarity has a strong and explicit focus on contributing to tackling and solving complex societal challenges (Lang et al., 2012). It thereby moves beyond "user-engagement" in research processes for the mere purpose of knowledge (co-)production, rather it focuses on contributing to *systemic change* through co-creation of transformative innovations (see Hakkarainen et al., 2022 on the different uses of 'co-concepts' in transdisciplinarity), which is fitting in the context of the grand sustainability challenges in transition studies. Finally, and perhaps as a consequence of the fourth argument, transdisciplinarity as a methodological approach is coined as one of the important pillars of the field of transition studies in the field's most recent research agenda (Köhler et al., 2019; Fazey et al., 2018a). In fact, Köhler et al. (2019: 3) explicate this centrality by emphasizing the *"transdisciplinary nature of the research on sustainability transitions."* Precisely due to its focus on tackling complex societal challenges and its interventionist character, transdisciplinary R&I has been considered explicitly as a 'mode of governance' (Jahn et al., 2012; Maasen and Lieven, 2006).

There are several arguments in favor of deploying transdisciplinary approaches, that complement and integrate (inter)disciplinary R&I and societal perspectives. Schmidt et al. (2020, based on Fiorino, 1990) argue that literature generally distinguishes between four different arguments for stakeholder inclusion in transdisciplinary R&I:

17 Note that this is not the same as using it because it is a new "*buzzword*". Rather, in research on the societal impact of R&I, I would argue that in addition to analytical usefulness, the (societal) relevance of chosen concepts and approaches is an important element to consider.

1) **Substantive**. Scholars have argued that including societal stakeholders through transdisciplinary R&I efforts might lead to 'better' R&I processes and outcomes. For instance, including different views and perspectives could lead to the development of knowledge and innovations that better fit local needs and thus are able to provide better 'solutions' to specific (sustainability) challenges that particular stakeholders or contexts might face (see e.g., Nowotny et al., 2001; Lang et al., 2012; Fazey et al., 2018a).
2) **Democratic.** A democratic, or normative, argument refers to insights in STS that those who are affected by R&I outcomes (such as the implementation of specific innovations) should be involved in the processes that lead to those outcomes, as to participate in deciding the directionality of R&I processes. This is also referred to as *"nothing about us without us!"* (see e.g., Dryzek, 2002; Cash et al., 2003; Jasanoff, 2003; Owen et al., 2012).
3) **Legitimacy.** It is often argued that R&I is perceived as more legitimate when co-created and when different stakeholders' knowledge and perspectives are taken into account, and become visible in outcomes and implementation. Hence, transdisciplinary processes might enhance legitimacy to R&I interventions, also in the context of sustainable transformation (see e.g., Owen et al., 2012; Van Kerkhoff and Lebel, 2006; Fazey et al., 2018a).
4) **Learning.** A final argument that Schmidt et al. (2020) elaborate on is one on learning and reflection. Transdisciplinary processes have the potential to stimulate (social and individual) learning and reflection by bringing together different stakeholders (with their own knowledge, values and perspectives) if they manage to meaningfully facilitate engagement between those different stakeholders (see e.g., Cuppen, 2012; Reed et al., 2010; Ines and Booher, 2004; Mathur et al., 2008).

While transdisciplinarity is considered valuable for catalyzing sustainability transitions (Norström et al., 2020; Caniglia et al., 2021; Fazey et al., 2020; West et al., 2020), it is, of course, not the only important mode of R&I that needs to be considered in transitions. Importantly, Geels et al. (2016) point to the need for combining different analytical research traditions in efforts to support low-carbon transitions, including 'practice-based' approaches (such as transdisciplinarity), but also socio-technical system analyses and quantitative modeling. Embracing transdisciplinary R&I does not mean that we should abandon valuable other 'styles of knowing' (cf. Kwa, 2011), such as well-established R&I approaches and practices in both the social and natural sciences. Furthermore, supporting the uptake of transdisciplinary R&I and the normalization of knowledge co-creation (cf. Verwoerd, 2022) does not mean the abandonment of technical expertise. Rather, it means that transdisciplinary approaches that co-create knowledge and innovations also need to become *normal* (Verwoerd, 2022) and *mainstream* (Jahn et al., 2012), especially in light of their potential to catalyze urgently needed transformative change. Yet, this is not straightforward as there are many challenges involved in 'doing transdisciplinarity' within the context of incumbent R&I systems (see e.g., Brandt et al., 2013; Lang et al., 2012; Fazey et al., 2020). As such, it is prudent to better understand (1) how R&I efforts do or do not support transdisciplinary R&I efforts, and as a consequence (2) how incumbent R&I systems could be transformed in order to support the uptake of transformative and transdisciplinary R&I.

One particular type of setting in which transdisciplinary R&I processes are increasingly being conducted and shaped, are different types of so-called 'Laboratories' also labeled 'Labs' (see McCrory et al., 2020 for a review). These Labs are socio-physical or socio-virtual spaces in which a variety of societal stakeholders can co-create knowledge and innovations that address (local) sustainability challenges through *experimentation.* Many different types of transition-oriented Labs have emerged in recent years that have different focal points, regarding types of to-be-included stakeholders (for instance, citizens or policymakers), types of innovations (for instance, policy innovations or novel technologies), geographical contexts (for instance, urban or rural), topical focus (for instance, food or energy), conceptual rationale (for instance, transition-oriented or sustainability-oriented), or purpose (for instance, testing innovations or co-creating innovations). It is not surprising that a broad range of literature then describes i.a., Real-World Laboratories (Schäpke et al., 2018); Living Labs (e.g., Leminen et al., 2015; Hossain et al., 2019); Urban Transition Labs (e.g., Nevens et al., 2013); Social Labs (e.g., Timmermans et al., 2020); Urban Living Labs (e.g., Nesti, 2018); Food Labs (e.g., McLachlan et al., 2014) and Transformation Labs (e.g., Carli-Joseph et al., 2018, cf. Pereira et al., 2018a).

Though different labels are used, and different conceptualizations of different Labs (and experiments more broadly) are emerging (see e.g. Hossain et al., 2019; Sengers et al., 2019; McCrory et al., 2020; 2022 for overviews), in practice the different types of Labs share many similarities regarding their multi-stakeholder experimentation ambitions in the context of sustainable transformation, while at the same time there are many differences between different (types of) Lab. This makes for a rather complicated picture, and also makes it difficult to develop unified strategies or methodologies for evaluating Lab impact (Bronson et al., 2021). While studies on the impact of transdisciplinary experimentation are valuable and manifold (e.g. Lux et al., 2019; Schneider et al., 2019; Luederitz et al., 2017) there is still a need to both conceptually and empirically explore the different 'societal impacts' that Labs, and transdisciplinary experimentation more broadly, can bring along (Williams and Robinson, 2020). In addition, Sengers et al. (2019: 162) argue that a *"topic to be explored in more detail is the ways in which experiments become connected across different spatial scales"*. As such, there is a need to consider how we can move beyond single Labs or experiments as transformative interventions, by better understanding how multiple (coordinated) experiments can catalyze change across different scales. More precisely, there is ample room to better understand and specify (1) the impacts that transdisciplinary experimentation processes might or might not bring along; and (2) how transdisciplinary experimentation can be governed across scales in ways that contribute to its transformative potential.

1.5 WHAT ABOUT THE POLITICS OF TRANSFORMATIVE CHANGE?

Scholars of transitions have stressed that better grasping the politics of transitions is crucial for understanding how transitional dynamics might be hindered or accelerated (Grin, 2010; Meadowcroft, 2011). At the same time, scholars of transdisciplinarity have stressed the deeply political nature of knowledge co-creation processes aimed at sustainable transformation (Turnhout et al., 2020). These 'politics' come in many forms and shapes. I will briefly introduce both literatures (the politics of transitions and the politics of transdisciplinarity)[18] and then further explicate some key 'political' concepts that I invoke throughout the thesis.

Literature on the politics of transitions has stressed that the politics is *"an aspect, rather than a bother in, transitions"* (Grin, 2010: 234). Grin (ibid) draws on Laswell's well-known description of politics as the question of *"who gets what, when and how?"*. These notions are particularly important to consider in large-scale transition processes that are highly normative and contested in terms of their directionality, and involve the significant re-configuration of incumbent (governance and policy) structures. In response to early criticisms that transition frameworks did not incorporate enough 'politics' (e.g., Smith et al., 2005; Shove and Walker, 2007; cf. the response from Geels, 2011), scholars of politics and governance have conceptualized different types of power (relational, dispositional and structural, cf. Arts and Van Tatenhove, 2004) that play a role in the multi-level dynamics of transitions (Grin, 2010). Building on the notion of power as human agents' capacity to influence resource dynamics, Avelino and Rotmans (2009) developed a widely used framework to understand politics and transformative change. Other 'early work' on the politics of transitions has focused for instance on the role of ideas, institutions and interests in transition policy development (Kern, 2011), and the role of legitimacy and democracy in transition management (Hendriks, 2009; Hendriks and Grin, 2007; Meadowcroft, 2011).

18 With the entwinement of both fields also comes the entwinement of both fields' considerations of politics. Yet, a separate or layered introduction seems appropriate also considering that scholars often focus more on either one of the perspectives.

Currently, the 'politics of transitions' is a widely discussed topic and it is featured prominently as one the sub-themes of the transition studies research agenda (Köhler et al., 2019). In recent years, studies have shed light on i.a.[19]

- the role of the state in bringing about (un)just transitions (Johnston and Newell, 2018),
- the dynamics of conflicts and normative diversities in transition processes (e.g., Cuppen et al., 2019);
- the role of capitalist systems in transitions (Feola, 2020);
- the politics of deep incumbencies (Stirling, 2019);
- transformative agency of change agents in transitions (e.g., De Haan and Rotmans, 2018; Westley et al., 2013; Huttunen et al., 2021);
- agency and creativity in the politics of niche experiments (Hoffman and Loeber, 2016);
- the political nature of (regime) resistance to transitions (Geels, 2014);
- justice considerations of transition governance (e.g., Jenkins et al., 2016; McCauley and Heffron, 2018; Kaljonen et al., 2022);
- legitimacy of (democratic) transition governance (De Geus et al., 2022);
- policy mixes for accelerating transitions (Rogge and Reichardt, 2016); and,
- the political role of non-humans in transitional dynamics (Svenson and Nikoleris, 2018; Rosin et al., 2017; Contesse et al., 2021).

Yet, despite (or perhaps because of) these many valuable contributions, there is still a need to *"compare and integrate the diversity of studies on politics and power and to reflect what the findings so far imply for transition theory"* (Köhler et al., 2019: 8).

In similar fashion and related, scholars of transdisciplinary experimentation and co-creation processes have explored the political dimensions of transdisciplinary R&I aimed at sustainable transformation. A recent and comprehensive review by Turnhout et al. (2020) indicates that the deeply political nature of co-creation[20] is often de-emphasized, or even brushed away, in research and practice that labels itself participatory or transdisciplinary. This is problematic, as this might contribute to co-creation processes that *"can end up reproducing, rather than mitigating, existing unequal power relations and that […] often do not contribute to societal transformation"* (ibid: 18). *De-politicization*

19 To be fair, given the breadth and depth of the work on the politics of transitions, a systematic literature review would do the topic more justice than these examples!

20 Turnhout et al. (2020) use the term co-production, whereas I mainly use the term co-creation throughout this thesis. My etymological choice is grounded in the recent review of Hakkarainen et al. (2022) who explore different 'co-concepts' (co-creation, co-learning, co-management, co-production and co-design) in transdisciplinarity for transformation. They contend that co-creation is a relatively overarching co-concept as *"co-creation is positioned as a concept which encompasses the whole [transdisciplinary] process both temporally and conceptually"* (ibid: 318).

of co-creation is partly driven by the increasing focus on ‘effectiveness-orientation’ of stakeholder participation in transdisciplinary processes (in particular in response to funder demands for ‘concrete outputs’, as illustrated by Musch and Von Streit, 2020). At the same time, de-politicization is surprising as many of the rationales for ‘doing inclusion’ such as the democratization of R&I of stakeholders are deeply political (see Section 1.4), especially given the contested nature of sustainable transformation processes. In that light, the political nature of transdisciplinarity for transformation has been highlighted in recent years. Adopting a ‘political lens’ might help to understand, i.a.;

- the different types of conflict that emerge in transdisciplinary practice for instance regarding different values, interests, claims of legitimacy or knowledge (Siebenhüner, 2018), but also strategies for conflict resolution (Stepanova et al., 2019);
- how power dynamics shape project dynamics and (knowledge integration) outcomes (Bréthaut et al., 2019);
- how different manifestations of power (relational, dispositional and structural, cf. Arts and Van Tatenhove, 2004) emerge in transdisciplinary projects (Fritz and Binder, 2020);
- the challenges of engaging citizens and publics in participatory transition processes (Chilvers and Kearnes, 2020);
- the “tragedy of transdisciplinarity’, where *“collaboration is hampered by the multi-layered mismatching institutions and their complex structures, which individuals are entangled in”* (Schmidt and Pröpper, 2017: 376); and,
- how ‘doing participation wrong’ can lead to tokenism or even tyranny for those involved in participatory projects (Cooke and Kothari, 2001).

In the context of experimentation in Labs for sustainability transitions, scholars have pointed out that *“there is a politics to Labs”* (McCrory et al., 2020: 12). In their review on (transdisciplinary) experimentation, Sengers et al., (2019: 162) state that regarding future research endeavors, one

> *“promising avenue is concerned with and analysis of the different forms of micro-politics, power and agency in experimentation. We believe that there is scope to get under the skin of experimental projects in more detail and spell out the actual practices in experimentation.”*

In addition to the risk of the politics being brushed away, there is a second challenge for transdisciplinarity for transformation. Opening up appraisal (cf. Stirling, 2008) for different stakeholders and perspectives, and creating Habermasian safe spaces to foster reflection, deliberation and empowerment (cf. Habermas, 1981; Pereira et al., 2018b) does not automatically lead, and could even stand in contrast, to creating transformative change. Creating such change arguably requires transdisciplinary initiatives to both work with and against systemic power relations (e.g., Van Breda and Swilling, 2019). This also begs reflection and reconsideration of how such inclusive transdisciplinary experimentation can, or cannot, aim for catalyzing transformative change through their interventions. As I will further explicate in Chapter 2, connecting the micro-politics of transdisciplinary experimentation to systemic transitional dynamics thus forms a key endeavor in this thesis.

Before presenting research questions and the research design in Chapter 2, I will present a brief overview of the broad empirical context in which the considerations presented in this thesis took shape: sustainability transitions in food systems.

1.6 CONTEXT: TOWARD SUSTAINABLE FOOD SYSTEMS

Incumbent food systems face and reproduce many interlinked and persistent sustainability challenges. As such, there is a need to rapidly transform our world's food systems to stay within planetary boundaries (Rockström et al., 2020) and to deliver healthy and sustainable diets (Willett et al. 2019). It is estimated that food systems account for 21%–37% of greenhouse gas emissions (IPCC, 2019) and 70% of freshwater use (FAO, 2017). Excessive agricultural pesticide and herbicide use further contributes to soil degradation and biodiversity loss (Silva et al., 2019). As a consequence, over 16% of global pollinators are currently threatened with extinction (FAO, 2019). Furthermore, immense amounts of food are wasted each year (Barrera and Hertel, 2021), of which 14% already before even reaching the retail stage in the supply chain (FAO, 2019). In addition, food systems currently contribute to unhealthy diets, leading to the triple burden of malnutrition, with severe obesity and undernutrition (co-)existing in the communities across the world (Popkin et al., 2020). As a consequence, diet-related non-communicable diseases (NCDs), such as cardiovascular diseases, diabetes, and certain cancers, are on the rise globally and already lead to an estimated 40 million deaths per year (WHO, 2018).

Food systems are highly complex and diverse systems (e.g., Leeuwis et al., 2021; Ingram et al., 2011; Zhang et al., 2018) that include

> *"all elements and activities that relate to the production, processing, distribution, preparation and consumption of food, as well as its disposal. This includes the environment, people, processes, infrastructure, institutions and the effects of their activities on our society, economy, landscape and climate"* (EC FOOD 2030 Expert Group, 2018).

Complex systems approaches to food systems therefore aim to move beyond traditional divisions between production-oriented and consumption-oriented approaches by emphasizing the need to include all relevant processes (e.g., food production, distribution, consumption), actors (e.g., farmers, researchers, consumers), policy sectors (e.g., health, agriculture, environment), governance levels (e.g., local, national, global), and societal functionalities (e.g., healthy diets, access to food, employment, fostering commensality, and cultural identity) in research and policy efforts. Therefore, a complexity-lens also implies moving beyond linear models (such as value or supply chains) and circular food system models (such as food cycles) as they do not sufficiently grasp the complex non-linear dynamics and the interrelations between different components in food systems (Zhang et al., 2018; Ruben et al., 2019).

Realizing sustainability transitions in food systems is notoriously challenging, precisely due to their complex non-linear dynamics and their undesirable resilience (Oliver et al., 2018). Yet, in recent decades the field of transition studies has turned its gaze toward understanding and governing transitions in food systems (e.g., Leeuwis et al., 2021; Elzen et al., 2012; Spaargaren et al., 2013). Studies on food transitions have for instance shed light on diversity of food systems in transitions (e.g., Gaitán-Cremaschi et al., 2019); the role of consumer practices and retail in bringing about transformation (Spaargaren et al., 2013); the potential of alternative food production approaches such as agroecology (Anderson et al., 2019), the role of alternative food networks (e.g., Randelli and Rocchi, 2017), the role of politics and values in agri-food transitions (e.g., Rossi et al., 2019; Vivero-Pol, 2017).[21] While studies are manifold and valuable, Hebinck et al. (2021a) stress that (agri-)food transitions research is still scattered across disciplines and conceptual frameworks. Hence, there is a need to further integrate the different studies and approaches within the field. In their outlook for the field, Hebinck et al. (2021a) present four avenues for future agri-food transitions research, and call for more thoroughly exploring (1) considerations of justice, politics and inclusion; (2) cross-scale and translocal dynamics in agri-food systems; (3) multi-system interactions between agri-food systems and other societal systems; and (4) shifting a focus toward low and middle income countries. As I have illustrated throughout this introductory chapter, the first three of these avenues lie at the heart of the work presented in this thesis. Focusing on these avenues is important, as it might contribute to accelerating the urgently needed transitions toward sustainable, healthy and just food systems.

21 This is just a very small number of examples to highlight the diversity of the research conducted. More elaborate overviews are presented in Chapters 4 and 6.

1.7 A BRIEF RECAPITULATION

In this introductory chapter, I have tried to sketch the field in which this thesis positions itself. Or rather, the *fields* it engages with.

Re-iterating: the aim of this thesis is to contribute to a better understanding of the governance and politics of sustainability transitions, with a particular emphasis on transdisciplinary experimentation as a promising mode of governance. In the next chapter I will elaborate on the research design, by introducing the concrete research questions that I ask in this thesis; specifying my stances within the social sciences and its relation to transdisciplinarity; and by introducing the case study approach that was used for (parts of) this thesis.

2

Research design

In this chapter, I will elaborate on the research design that was (iteratively, reflexively and adaptively) 'implemented' in order to conduct the research presented in this thesis. I will first elaborate on the research questions and thesis outline. Then, before presenting in detail the case study approach and the case that formed the basis of the empirical work (the FIT4FOOD2030 project), I will highlight some key notions regarding the role of transdisciplinary research in this thesis; and how I consider the relationship between theories, empirical work and action. Without aiming to provide full philosophical scrutiny, I believe that clarifying these points of view might help readers understand the specific choices made in both the research design of the thesis, as well as in the individual chapters that are published in, or under review at, peer-reviewed journals.

2.1 RESEARCH QUESTIONS AND THESIS OUTLINE

The aim of this thesis is to contribute to a better understanding of the governance and politics of sustainability transitions, with a particular emphasis on transdisciplinary experimentation as a promising mode of governance. In addition, the work presented in this thesis has a distinct action-oriented focus, which may help to provide insights and recommendations for practice and governance, and may contribute to help accelerate transformative change through the act of intervention. In order to help address the aim of this thesis, the main research question addressed in this thesis is: *"How may we understand the governance and politics of transdisciplinary experimentation in sustainability transitions?"*

In this thesis I present three parts (Parts II, III and IV) that each answer this question from a different perspective, and in each part I ask several sub-questions.

Part II: Theoretical explorations

The second part presents theoretical explorations into the politics and governance of sustainability transitions. More specifically, it asks the question: *"How may we understand the politics of sustainability transition governance from a theoretical perspective?"*. This part elaborates on two different explorations that deal with rather different 'facets' of the politics of transition governance.

The first exploration (Chapter 3) investigates the role of agency, power and powering in the transitional dynamics of complex adaptive systems more generally. In particular, it seeks to bridge the gap between socio-material and complex adaptive systems approaches in conceptualizing the politics of transformation. Through this contribution we aim to provide a further clarification of the relational nature of power, and the role of non-humans in transitional dynamics of complex adaptive systems.

The second exploration (Chapter 4) zooms in on the empirical context of food systems[22], and asks the question how we can better understand the relationship between democracy and justice in the governance toward just transitions. It explores different dimensions of justice and their relation to efforts for democratization of transition governance. Through this contribution we aim to provide a further clarification of how democratization of transition governance might pave the way for enacting just transitions in food systems, and an elaboration on several key challenges democratization brings along for *institutionalizing* just transition governance efforts.

Part III: A tale of two systems

The third part considers the entanglement of two systems: food systems and R&I systems. Especially, it considers the role that transdisciplinary R&I efforts can play in catalyzing urgently needed food system transformations. Therefore, it asks the question: *"How may we govern transformative change through transdisciplinary R&I?".* The part presents two different chapters that each tell a different, yet complementary, part of this tale of two systems.

The first contribution (Chapter 5) explores the 'how and why' of transdisciplinary R&I for food system transformation. It seeks to argue why transdisciplinary approaches could be more effective in catalyzing transformation than traditional 'linear' R&I endeavors, especially given the increasing focus on the complexity of food system dynamics. It then argues that specific governance interventions are needed in R&I systems to pave the way for institutionalization of transdisciplinary and transformative R&I. This study resulted from collaboration within the *EU Think Tank* of the FIT4FOOD2030 project (see Section 2.4) and can also be seen as a perspective paper that aimed to set the scene for future research and inform policy makers regarding R&I funding and policies.

In the second contribution (Chapter 6) the tale of two systems is further conceptualized and operationalized. This chapter sets out to explore how we can understand the relation between R&I systems and food systems, and the implications that brings along for interventions in R&I systems. It first elaborates on the many challenges that are involved in 'doing' transdisciplinary and transformative R&I, and then stresses that

22 As elaborated on in the introduction, I use the term food systems throughout the thesis. In this particular chapter, in line with the journal article, we refer to *agri-food systems*. See also Chapter 11 on reflections for some other within-thesis differences in use of terminologies, that result from the fact that the thesis is based on a collection of journal articles, rather than a monograph.

these challenges are intertwined and systemic in nature and that there is a need for a coupled-systems perspectives and a double system transformation: of both R&I systems and food systems. As an empirical illustration (not as a case study) this study highlights the FIT4FOOD2030 project and presents it as a promising intervention at the boundaries of these two systems.

Part IV: Empirical elaborations

This part empirically explores the politics and governance of transdisciplinary experimentation. In particular, it focuses on the role of transdisciplinary experimentation as an instrument for transition governance. It asks the question *"How may we understand the politics, and facilitate the governance, of transdisciplinary experimentation in transition-oriented projects?"* This part zooms in on the FIT4FOOD2030 project that had transition-oriented ambitions and sought to engage a wide variety of societal stakeholders in transdisciplinary experimentation processes (see Section 2.3 for an elaboration on the case and the case study approach). This study was also transdisciplinary in nature, in the sense that as researchers working in the project, we were actively engaged in the dynamics of the project and its transdisciplinary activities. The studies presented here sought to unravel several distinct features of the project.

First, as an *intermezzo*[23], the FIT4FOOD2030 project is highlighted in Chapter 7 that elaborates on the different tools that the project used during its activities, and the role of the Food Systems Network that was set up as part of the project. It also provides some insights into the 'how and why' of the project in relation to transformation literature and positions the project in the EU policy landscape. It resulted from close collaboration with FIT4FOOD2030 partners.

Second, an in-depth analysis of the dynamics within FIT4FOOD2030 Labs is conducted (Chapter 8) in order to shed light on the politics of 'doing inclusion' in transdisciplinary experiments aimed at sustainable transformation. While one of the main elements of transdisciplinary efforts is the 'inclusion' of different stakeholders, values and perspectives in participatory R&I processes, 'doing inclusion' raises a number of political challenges. This chapter aims to contribute to re-politicizing inclusion in transdisciplinarity for transformation, by (1) empirically unraveling four key challenges that emerge in the political practice of 'doing inclusion', (2) illustrating how facilitators of inclusion processes perform balancing acts when confronted with these challenges, and (3) reflecting

23 This is an intermezzo because it is published as an 'emerging research' article, which means it is more a description of the project that sheds light on some of the project's key features, than an original research article.

on what the unfolding dynamics suggests about the politics of stakeholder inclusion for societal transformation.

Third, a case study into the FIT4FOOD2030 project is presented in order to better understand the practices of 'creating impact' in transdisciplinary experiments aimed at sustainable transformation (Chapter 9). While it is increasingly argued that transdisciplinary Labs can contribute to transformation, it is also suggested to further explore how the practice of 'doing Labs' relates to the wider impacts these Labs (aim to) create. Therefore, this sub-study aims to contribute to clarifying the practice of 'creating impact' in transformation-oriented Labs, by identifying the strategies that Labs pursue in their efforts to create impact, and by unraveling the (political) challenges this brings along.

Finally, another perspective on the FIT4FOOD2030 case is executed. In Chapter 10, insights on the geography and governance of transitions are synthesized with the case study in order to investigate how multi-sited transition programs[24] with multiple experiments (that is: programs that conduct these experiments at different locations (e.g., different countries in the EU) simultaneously) aim to catalyze translocal dynamics. While a focus on translocal dynamics between different transition experiments is increasingly suggested by transition literature, this study aims to contribute to better understanding how such translocal experimentation can actively be facilitated by transition governance, and what challenges that brings along in practice.

Part V: Reflections and reconsiderations

In the final part, I will present key findings, cross-cutting themes that also point to future research and a number of reflections (in Chapter 11), before explicating recommendations for R&I projects and policy (Chapter 12) I will conclude the thesis in Chapter 13, before opening the floor to the Postlude, which contains the usual show of summaries, references, appendices and some kind words of acknowledgement. Doing a PhD is a iterative process. That also means that I do not dare to suggest that there is an explicit causal sequentiality between the different chapters or parts presented in this thesis. Rather, the work in the different parts has inspired each other in more 'organic' ways. In general, I consider the ideas presented in the different parts to more organically float together in the ecology of thoughts that makes up this thesis. Their interconnections are explicitly considered in Part V.

24 In this chapter, we label FIT4FOOD2030 as a transition-oriented program, instead of a project. See Chapter 11 for reflections on that choice.

2.2 THEORIES, REALITY AND ACTION

The work presented in this thesis is qualitative social science research that looks into highly contested and deeply political topics regarding sustainable transformation. As I have indicated in the previous section and I will further explicate throughout this chapter, while part of these endeavors are theoretical explorations, it is also in part based on my active participation in those very processes I studied. Hence, there is an active transdisciplinary and action-oriented element to the presented research, and we can safely state that through my work I have crossed the traditional clear-cut distinction between knowledge and action into territories beyond the modernist constitution (cf. Latour, 2004; Van Kerkhoff and Lebel, 2006; Hajer, 2003). I touched upon this topic in Chapter 1, and even though detailed and in-depth philosophical considerations are outside the scope of this chapter (and in fact, the thesis), I do set out to clarify those positions I take that might help shed light on some of the choices regarding research design and methodologies that stem from these positions.

The second part of this thesis is an explicit theoretical exploration. The third part, to a lesser extent, as well. That means that in the work presented there (most explicitly in Chapters 3 and 4), my co-authors and I develop theories on the governance of sustainability transitions based on synthesizing insights from both empirical and conceptual literature, but without conducting explicit empirical analyses in those endeavors ourselves. This notion raises two questions. First, how do I understand the concept of *theory* within this thesis? Second, and perhaps as a consequence of the first, how does this notion of embarking on theoretical explorations to create 'knowledge' align with the high aspirations of generating '*knowledge through action*' as elaborated on in the introduction?

Central to answering the first question are two underlying assumptions I hold about the world around us: first, I acknowledge its fundamental ontological *complexity*[25] and its epistemological *plurality*. Second and perhaps as a consequence, I follow Meyfroidt et al. (2018) in arguing with Merton (1968) that "grand and universal (positivist) theories" in the social sciences, and particular in the realm of theorizing for sustainable transformation, might not be that useful as they fail to connect to empirical phenomena.

25 Complexity thinking has emerged in both the natural and social sciences in recent decades, and has a profound number of implications for how one considers the 'world out there', and for how one constructs theories about that world (see e.g., Holland, 1992; Mitchell, 2009). Yet, it is not necessarily one particular "unified theory". Though this is still somewhat a matter of debate in the field, theories of complexity can be considered a *class* of theories or perhaps a mode of thinking about theories (see e.g., Chu et al., 2003). I draw heavily on considerations regarding systemic complexity in this thesis, and will specify, where relevant, my stances on the notions I use in the particular chapters.

Therefore: it might be more prudent to develop *middle-range theories,* which can be conceptualized as *"contextual generalizations that describe chains of causal mechanisms explaining a well-bounded range of phenomena, as well as the conditions that trigger, enable, or prevent these causal chains"* (Meyfroidt et al., 2018: 53, drawing on Meyfroidt, 2016, cf. Merton, 1968). These (non-linear) *causal mechanisms* in turn can be understood in a variety of ways (see Hedström and Ylikoski, 2010), for instance as the generative mechanisms that produce the patterns we observe (cf. Harré and Secord, 1972), as a process that is capable of bringing about or preventing some change in the system (Bunge, 2004) or as entities (with their properties) and the activities that these entities engage in, either by themselves or in concert with other entities (Hedström, 2005). In other words, and slightly broadening up these notions: theories that present specific (either abstract or concrete) mechanisms might thus help understand (that is: describe and explain) the current, future or desired dynamics that are observed within complex systems, by linking empirical phenomena to more abstract generalizations.

This understanding of theories as contributing to explaining (mechanisms of) empirical system dynamics[26], I realize, draws on scholarship in the critical realist traditions of social science research (cf. Bogna et al., 2020; Hedström and Ylikoski, 2010). At the same time, the act of refuting the positivist tradition also implies acknowledging interpretivist (or even subjective) epistemologies (e.g., Gray, 2014; Madill et al., 2000), which means acknowledging that *"the way we perceive facts, particularly in the social realm, depends partly upon our beliefs and expectations"* (Bunge, 1993: 231). Here, there are also linkages to more constructivist approaches that emphasize the social construction of knowledge, in which subjective knowledge and meanings are socially and historically negotiated, meaning that *"they are not simply imprinted on individuals but are formed through interaction with others (hence social constructivism)"* (Creswell, 2007: 21). Whereas there are fundamental differences between these schools of thought[27], especially regarding ontologies, scholars also suggests that especially on the epistemological and methodological level there might be opportunities for reconciliation and pathways toward integrated approaches (Bogna et al., 2020). Elder-Vass (2012) argues that moderate social constructionism[28] that acknowledges the construction of knowledge and social reality can also be ontologically compatible with critical realism. Hence, interpretivist

26 Rather than for instance, linearly predicting future dynamics.

27 In his 1993 essay, Mario Bunge is very critical of what he calls the anti-realists (amongst which he considers Bruno Latour). He concludes his contribution as follows: *"If ever there were subjectivist animals, they either died very young from exposure to the world they denied, or they were appointed professors of philosophy"* (Bunge, 1993: 233). Though I shattered with laughter when I read this, I find Bunge too harsh in his criticism, as I see value in constructivist approaches, especially regarding their contributions to understanding how knowledge is generated and what that means for transformation.

28 Elder-Vass refers to constructionism, not constructivism.

considerations regarding epistemologies (whether grounded in critical realist or constructivist approaches) reinforce the subjective orientation of contextualized theories, as well as the empirical phenomena they relate to. In this thesis I draw upon work from both research traditions, where I lean toward critical realist considerations of ontology, and more toward subjective, interpretivist understandings of epistemologies. For the research design at hand, acknowledging the subjectivity of knowledge generation and theory development, is also to acknowledge that research itself can be considered a subjective act of intervention (cf. Zuiderent-Jerak, 2015; Fazey et al., 2018a). This allows for exploring how the act of doing research relates to theory development, and in which ways this act of doing research can take shape.

That brings us to the second question: what about the relationship between theory and action? In a recent contribution, Schlüter et al. (2022:1) point out that theorizing in sustainability science is an important endeavor, but also rather neglected by transdisciplinary scholarship as it is *"often considered secondary or even in competition with action"*. They suggest that in order to *"make theories useful for understanding complex sustainability problems and enabling transformative action, it is necessary to reflect on theorizing and the ways theories are being used"*. They also argue that in sustainability science, theories are hardly developed in the *ivory tower of academia*, but rather emerge from engagement in empirical contexts, and particularly in inter- and transdisciplinary processes. Yet, that does not mean that theoretical contributions to the field necessarily need those empirical engagements to be explicitly part of the structure and content of the contribution itself.[29] Rather, Schlüter et al. (2021) point to four different ways in which theories can be developed, whereby they distinguish between processes of *theorizing* from the outside or *theorizing* from the inside; and outcomes as *theories* for explanation or *theories* for action. In this light and importantly, theories do not only have the function to describe causal mechanisms, but can also for instance help in synthesizing (contextualized) knowledge; explaining transitions and their dynamics, or be action-oriented by for instance guiding transitions or informing interventions. This also echoes work from Fazey et al. (2018a) who stress that research on transformation can be conducted from 'outside' the societal systems of interest (*first order*, descriptive or explanatory), or from 'within' (*second order*, aiming to contribute to transformation processes through engagement). In similar fashion, Lang and Wiek (2022) indicate

29 Take for instance Chapter 3. When working on my MSc thesis on the politics of biomass co-firing practices in the Netherlands, Anne Loeber, John Grin and I realized that materialities played an important role in the politics of this contested practice, but we also realized that complexity theory did not fully engage with this insight yet, and did not sufficiently offer description of the dynamics that we witnessed. As such, we synthesized insights from literature and drafted a conceptual contribution. Because, however, the theoretical argumentation also 'stands alone' and we do not elaborate a case study, the empirical engagement is not explicitly discussed in the chapter.

that solution-oriented sustainability research can be conducted by *engaging* (that is: collaborating with societal actors in research practice) as well as through more *distant* modes of research. Therefore, I contend that theory development on the relation between *knowledge and action* can both result from the interaction between knowledge and action, as well as from more distanced research.

In the chapters presented in this thesis, we iterate between different modes of theorizing, or orders of transformation research, sometimes positioning ourselves more on the inside, and at other times, conducting research from a distance. This hopefully also helps to sketch a broader (and maybe even a richer) picture of the different types of perspectives on the politics and governance of sustainability transitions. The non-empirical chapters are to different degrees, or in different ways, *theoretical*. Some of them, such as Chapter 3, focus explicitly on developing understandings on causal mechanisms to help explain transitional dynamics. Chapter 4, which is also a theoretical contribution, is perhaps even more 'middle-range' as it aims to synthesize context-specific (that is: agri-food system oriented) knowledge that might help to guide transition governance processes. Another example: the work presented in Chapter 10 also aimed to develop theoretical insights (through action!) that seek not only to offer explanation of transition dynamics, but importantly, to inform interventions. As such, in this thesis I present a varied collection of (contextualized) generalization and theories that were gathered through a variety of modes of theorizing.

One of those modes was theorizing through an in-depth empirical case study. The empirical explorations are in turn based on transdisciplinary endeavors in co-creation processes with researchers and societal actors. In other words: the work described in this thesis heavily draws on transdisciplinary research approaches. At the same time, as elaborated on in the introduction, one of the core 'objects' of study in this thesis concerns transdisciplinary R&I approaches as modes of governing sustainable transformation (cf. Lang et al., 2012; Klein et al., 2001).[30] Therefore, transdisciplinarity has a dual functionality in this thesis: both as *object* and as *subject*. There is no clear-cut distinction between these functionalities, nor a coherent overlap, in the chapters described in the thesis. Some chapters are not considering transdisciplinarity as an explicit object, but focus, for instance, on describing political dynamics of sustainability transitions. Other chapters focus strongly on the role of transdisciplinarity in transformative change, but they are theoretical in nature and do not explicitly draw upon empirical transdisciplinary work (for instance, Chapter 5). Again other chapters heavily draw on transdisciplinary work,

30 Scholars have also labeled research that investigates transdisciplinary projects or programs "accompanying research" *(Begleitforschung)* (e.g., Defila and Di Giulio, 2018). This type of research can be transdisciplinary and engaging in nature, but that need not be the case.

and to varying degrees take transdisciplinarity as an explicit object of study. Hence, the notion of *transdisciplinarity as both object and subject* forms a red thread throughout the thesis.

In the introductory chapter, I have elaborated on the 'why' of transdisciplinarity (as *object*). In the next section (Section 2.3) I will elaborate on the 'how' of transdisciplinarity (as *subject*) in this thesis by introducing the case study approach.

2.3 CASE STUDY DESIGN

In multiple chapters, I draw upon a case study of the FIT4FOOD2030 project (2017-2020). Funded by the EC under the Horizon 2020 funding scheme, FIT4FOOD2030 consisted of 16 partner institutions across the EU (such as universities, funders, science communication), aimed to contribute to EU food system transformation, and to that end set up 25 multi-stakeholder Labs. I will first elaborate on the rationale for adopting a case study design, before presenting a narrative description of the project, its ambitions and practice.

2.3.1 Rationale and justification

Case studies are important methods for asking detailed 'how' and 'why' questions on ambiguous and complex phenomena, and can be seen as empirical inquiries that *"investigate a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident"* (Yin, 2009: 18). Gray (2014: 266-267) stresses that case studies are *"particularly useful when the researcher is trying to uncover a relationship between a phenomenon and the context in which it is occurring"*, and thus can try to *"attribute causal relationships'' instead* of merely describing situations. In these efforts case studies involve detailed, in-depth data collection involving multiple sources of information (Creswell, 2013). Importantly, however, case studies should not merely be conceived as a collection of qualitative methods. Rather, they can be seen as a research strategy that has the "*purpose of ''confronting'' theory with the empirical world"* (Piekkari et al., 2009: 569).

In his work on case study research, Flyvbjerg argues that *"one can often generalize on the basis of a single case, and the case study may be central to scientific development via generalization as supplement or alternative to other methods"* (Flyvbjerg, 2006: 228). At the same time, this is not to say that I only aim to develop formal generalizations, as I follow Flyvbjerg (2006: 228) in stressing that *"formal generalization is overvalued as a source of scientific development, whereas "the force of example" is underestimated."* In this sense, in-depth analysis of the within-case dynamics of FIT4FOOD2030 might not only yield insights into the 'why and how' of case dynamics by providing concrete and context-specific knowledge, but might also lead to more *contextualized* generalizations that provide insights into the types of dynamics that can be encountered in similar initiatives.

The case study approach adopted in the work presented here has a number of distinct characteristics: (1) it was an *embedded single case study* in terms of its design; (2) it was *paradigmatic* in terms of its relation to the wider field of study; (3) I embraced *interpretivist* considerations regarding my analysis of the case; (4) I adopted *abductive reasoning* while relating empirical data to theory development; and (5) my engagement with the case was of *transdisciplinary* nature.

By considering FIT4FOOD2030 as an embedded single case study, I mean that I explicitly consider the different 'sub-units' (for instance, the different Labs) as part of a wider context (the project as a whole) (cf. Scholz and Tietje, 2002; Gray, 2014). One argument in favor of this distinction is that this allows more explicitly to consider the within-project diversity and acknowledges the autonomy (and agency) of the different sub-units, while suggesting to investigate not only the dynamics within sub-units, but also the interactions between different sub-units in the context of the project. At the same time, it still allows for considering the wider system dynamics at play (the context in which the project found itself embedded). Another argument in favor of this distinction is that considering the project as a complex heterogeneous superposition of different sub-units, might also allow to uphold a complexity-perspective in case study research, whereby one can consider the interactions between different elements at play in cases as to gain more detailed insights into the processes and mechanisms that are manifest (cf. Anderson et al., 2005).

In this thesis, FIT4FOOD2030 represents a *paradigmatic case*[31]. These are *"cases that highlight more general characteristics of the societies in question"* (Flyvbjerg, 2006: 16) and can be used to *"develop a metaphor or establish a school for the domain that the case concerns"* (Flyvbjerg, 2011: 307). Regarding these considerations, this FIT4FOOD2030 represents a broader "set" (or: trend) within contemporary sustainability science and

31 Flyvbjerg (2001; 2011) identifies four 'archetypes' of cases that each have particular rationales for selecting them. In addition to the paradigmatic case, there are *extreme/deviant cases* (to obtain information on unusual cases, which can be especially problematic or especially good in a more closely defined sense); *maximum variation cases* (to obtain information about the significance of various circumstances for case process and outcome); and *critical cases* (to achieve information that permits logical deductions of the type "If this is (not) valid for this case, then it applies to all (no) cases.") (taken from Flyvbjerg, 2011: 307).

policy (as also described in Chapter 1) to govern sustainability challenges through transdisciplinary experimentation processes. It does so by involving a wide variety of societal stakeholders in the context of multiple 'Labs' that aim to co-create innovations targeted at instigating systemic transformation processes. I thus consider FIT4FOOD2030 to be paradigmatic, as better understanding its project-dynamics might also inform, as well as reflect patterns of dynamics in, the many other (often similar) projects that are initiated across the globe in efforts to contribute to sustainable transformation through transdisciplinarity.

The approach I took while conducting the case study drew upon interpretivist considerations. Much of the valuable work on case study methodologies has been conducted by scholars in the positivist tradition (most notably by Eisenhardt, e.g., 1989 and Yin, e.g., 2009). Boblin et al. (2013: 1269) describe that within this case study tradition, reality is mostly conceived of as objective and predictable, and the researcher mostly considered *"detached, neutral, and independent of what is being researched",* leading case study research to develop *"prepositions [that] are subjected to replicable empirical testing, providing the opportunity for confirmation and falsification."* I side with the critics of positivist traditions in case study research (such as Piekkari and Welsch, 2018; Dubois and Gadde, 2002; 2012) and argue that positivism undervalues the contextual, political and situated nature of social phenomena and the value-laden role of the act of doing research. On the other side, we find more constructivist considerations of case study research (such as the work of Stake, 1995), that understand *"subjective realities as an essential aspect of understanding"* and emphasize *"holistic treatment of phenomena, with elements [being] intricately linked"*, where the *"value- and bias-laden nature of the work is acknowledged and embraced"*, and *"discovery and interpretation occur concurrently"* (Boblin et al., 2013: 1269). These case studies tend to be less structured than those designed in positivist ways, hence there is a need to embrace flexibility, for instance in designing and implementing particular research methodologies (cf. Boblin et al., 2013). These considerations align with the turn toward embracing pluralist understandings of knowledge in the context of sustainable transformation (e.g., Caniglia et al., 2021) common in transdisciplinary approaches (Lang et al., 2012).

In the presented studies, co-authors and I draw upon abductive reasoning to bridge the gap between empirical data and theory development. Whereas styles of inductive reasoning (formulating theoretical notions based on empirical observations) and deductive reasoning (evaluating theoretical assumptions in empirical contexts), they are also criticized for either neglecting the importance of "*theoretical baggage*"[32] (induction), or for allowing insights to be overlooked if they fall beyond the adopted theoretical notions (deduction) (see e.g., Kennedy and Thornberg, 2018). Hence, Peirce (1903/1997) suggested another mode of reasoning: abduction. Through abductive reasoning, researchers embark on a *"creative process to examine how the data supports existing theories or hypotheses, as well as how data may call for modifications in existing understandings"* (Kennedy and Thornberg, 2018: 52, drawing on Thornberg, 2012). In other words: abductive reasoning aims to contribute to theory development by iterating between theoretical notions[33] and empirical data, which might help to highlight surprising findings and new explanations. Abductive reasoning aims to *"yield plausible explanations of puzzling phenomena"* (Shani et al., 2020: 64; cf. Peirce, 1903/1997). Dubois and Gadde (2002; 2012) have argued that abductive approaches in case study research can be seen as efforts to 'systematic combining': that is, the iterative matching, direction and redirection of insights on the case; the broader empirical world; the framework used and the wider theory. In his elaboration of different methodologies and styles of enquiry in the context of transdisciplinary research, Stirling (2015: 18) highlights the importance of abductive approaches as they might help to grapple with the complexity of the (transformative) systemic dynamics at hand, and states that chiefly abductive reasoning involves *"creative exploration of alternative possible hypotheses"*. In addition, he also points to specific methodologies that are well suited for qualitative abductive research. Shani et al. (2020) also indicate that abduction is an appropriate, yet undervalued, style of reasoning in transformative change research, with its high degree of complexity that also requires reflexively adapting research strategies *ex-durante* (cf. Lang and Wiek, 2022).

2.3.2 Case: FIT4FOOD2030

In 2015, the EC prepared the launch of the FOOD2030 R&I policy framework (EC, 2017, 2021). The purpose of this framework is to transform Europe's R&I systems so that they are better able to aid the future-proofing of European food systems, that is, to make them more sustainable, resilient, responsible, diverse, competitive and inclusive. In the vision of FOOD2030, R&I could contribute to food system transformation by focusing on four *FOOD2030 priorities*: (1) nutrition for sustainable and healthy diets; (2) climate smart

32 In providing methodological reflections on the rationales for interpretivist approaches in sustainability science and policy, Loeber (2003: 38) stresses the importance of *"the Popperian viewpoint that one cannot approach a research object without a theoretical lens that functions as a search light to guide the process of data collection"*.

33 These theoretical notions can be clearly defined concepts, or, as Blumer (1954) posited, *sensitizing concepts* that are not definitively demarcated but suggest general directions or guidance for interpreting empirical phenomena. They can be concepts such as "social structure" or "culture".

and environmentally sustainable food systems; (3) circularity and resource efficiency of food systems; and (4) innovation and empowerment of communities.

Current R&I systems, it was argued, were not up to that task. Though they had contributed to providing solutions to food systems' problems, they are also considered unable to effectively contribute to large-scale sustainable transformations. Incumbent EU R&I systems are not supportive enough of the systemic and transdisciplinary R&I efforts needed to foster transformation. There was too little involvement of societal stakeholders, citizens, and primary producers in food systems R&I, a lack of competences of researchers and policymakers to facilitate such involvement, modest and fragmented private R&I investments, and academic incentive structures that hinder transdisciplinary collaborations.

In order to support the EC in the implementation of the FOOD2030 framework, the FIT4FOOD2030 project (full name: 'Fostering Integration and Transformation for FOOD 2030') was funded under Horizon 2020. The project received €4.0 million in funding and ran from November 2017 until December 2020. It was a broad consortium, with 16 partner institutions across Europe that involved universities, research funders, technology and innovation platforms, industry networks, and science engagement organizations. The project had developed a *Theory of Change (ToC)*, which is an increasingly used method to envision the impacts it aimed to realize through its activities (cf. Deutsch et al., 2021; Schneider et al., 2019). The project's ToC is presented in Figure 2.1.

In light of this *ToC*, the main goal of the project was to set up a sustainable, multi-stakeholder FOOD 2030 Platform, mobilizing a wide variety of stakeholders from different sectors at the levels of cities, regions, countries, and Europe. The FOOD 2030 platform aims to contribute to

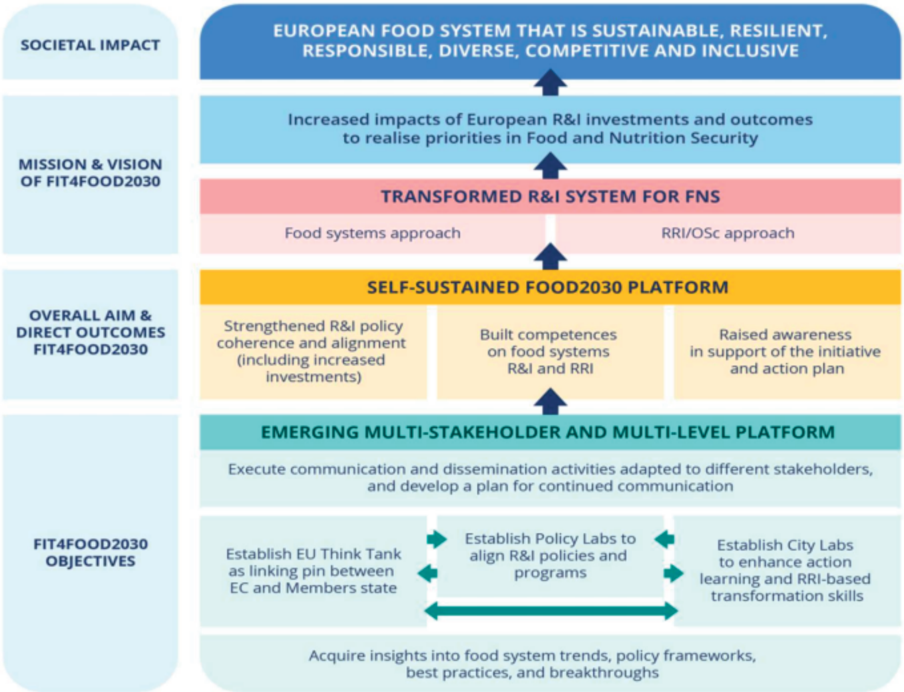


Figure 2.1 | The FIT4FOOD2030 Theory of Change.[34]

The project designed three structures to foster change at three different levels: (1) an 'EU Think Tank' that acted as a link between the EC and member states and associated countries, and to that end produced high-level policy briefs; (2) 14 *Policy Labs* that were hosted by national or regional ministries and that mobilized stakeholders in order to align R&I policies and investment schemes and integrate existing networks; and (3) seven *City Labs* and seven *Food Labs* on the local and regional levels that were hosted by universities, science museums or science centers and that developed and piloted hands-on (in)formal training for students and professionals by bringing a wide diversity of actors together. These Labs were recruited in two batches. At the start of the project, there were seven Policy Labs and seven City Labs. Midway the project, another four Policy Labs and seven Food Labs were recruited through an open call. An overview of the FOOD 2030 Platform is presented in Figure 2.2.

34 Note that the project ToC includes the notion of supporting the uptake of 'RRI'. In this thesis, for consistency reasons and other arguments as highlighted in the introduction, we speak of *transdisciplinarity*, with regard to the project's ambitions, the project practice, and with regard to my engagement with it. I have justified this throughout the introduction as well as this chapter.

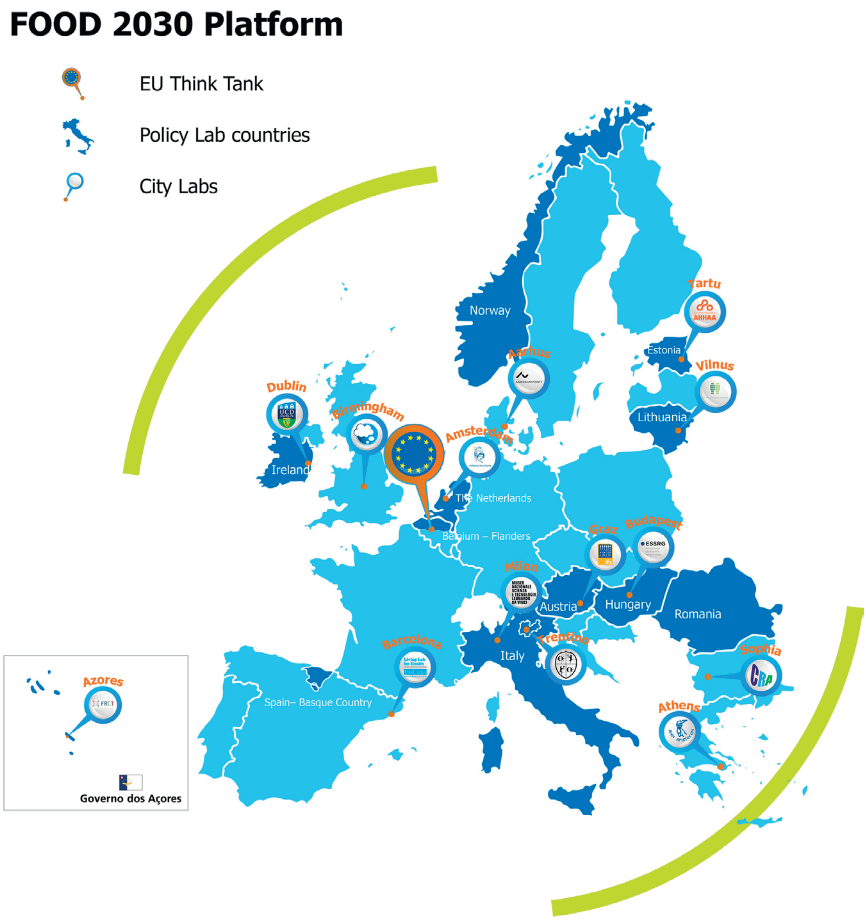


Figure 2.2 | An overview of the multilevel, multi-stakeholder FOOD 2030 Platform that the FIT4FOOD2030 project has established, indicating the 11 national Policy Labs, the 14 local City and Food Labs and the EU Think Tank.

These Labs built on the concept of Living Labs and Real-World Laboratories (Hossain et al., 2019; Schäpke et al., 2018) and each organized a series of workshops, in which they co-created policy innovations (in case of the Policy Labs) or educational modules (in case of the City Labs) together with their local stakeholders. To that end, they first developed visions for future food systems, built multi-stakeholder networks, worked on co-creating system understanding, developed (policy) pathways and innovations. Labs were managed by one or more 'Lab coordinators' who were employed at the Labs' host organizations. Labs received very modest project funding, but the Lab coordinators were trained and supported by the project team. The project developed a variety of tools and training materials to be used in the Labs, and set up a learning system for the Lab coordinators (see next section and Part IV).

In addition to the Labs, the project set up several other workpackages that aimed to provide input to the FOOD 2030 Platform. These include workpackages to identify current and future R&I trends in the food system; identify showcases of promising R&I innovations and interventions; and identify potential R&I 'breakthroughs' that could be supported to facilitate transitions to sustainable and healthy food systems.

A more elaborate description of the project and the work done in the Labs is presented in Chapter 7; and their dynamics are analyzed in-depth in Chapters 8, 9 and 10. Important to stress in this research design, is that I conceive this project and its directly involved actors (so both the Labs as subunits within the context of the project, as well as their interactions with the project partners and context) as the empirical object of the fourth part of this thesis. The Lab coordinators and project partners are thus the 'stakeholders' with whom I interacted and engaged with during my involvement in the project.

2.3.3 Engaging in FIT4FOOD2030

I was engaged in FIT4FOOD2030 during its existence. More precisely, I joined the project-team (that kicked-off in November 2017) at its coordinating institution in August 2018 and until the project completion (December 2020) I remained strongly involved in the project's overall management; the development, implementation and facilitation of training and learning sessions for Lab coordinators; several of its more content-oriented workpackages that sought to develop insights on showcases for food system transformation and potential R&I breakthroughs; the writing of project deliverables and reporting; the development of methodologies and theoretical advancements to aid learning and reflection in Labs and within the project consortium that had a variety of (academic and societal) backgrounds; and the organization of reflection sessions for the consortium partners. Along the way, I was involved in gathering and analyzing data for the purpose of 'research' (see the details on data in the next section). I think it is fair to say that the research conducted thus was transdisciplinary in nature. At the same time, reflecting upon the broader insights and frameworks for conducting transdisciplinary research (e.g., Klein et al., 2001; Lang et al., 2012; Lux et al., 2019), there were also aspects of my work that were less transdisciplinary. This is understandable, as there is a gap between transdisciplinary 'ideality' and 'reality' (see also Chapter 11, and Regeer et al., *forthcoming*). Whereas in 'ideality' there is ample room for engagement with *all* relevant stakeholders and careful design and knowledge integration through multiple project phases; the reality of short-term projects with strict project-proposal-based targets, where project partners with different perspectives on the project are based all across Europe; there is limited time and resources, and there is the need to deal with variety of project management issues, *etcetera*, which leads to a fuzzy reality. This I do not see as a fundamental problem, rather as something about which some reflection might help to understand specific choices regarding data gathering and analysis.

In particular, the design of the project shaped in large extent the research I conducted (see also Gjefsen et al., *forthcoming* on how the project-basedness of transdisciplinarity shapes project practice, cf. Fritz and Binder, 2020). In addition, FIT4FOOD2030 was not a research project, but a Coordination and Support Action (CSA). Though this provided many interesting opportunities for engaging with the project, it also led to challenges (for a junior researcher like myself) to align research activities with the architecture of project activities (see also Chapter 11 for reflections on this matter). Therefore, my engagement in the project was both very transdisciplinary in some ways, and perhaps less in other ways. Let me elaborate on both sides:

Why was it transdisciplinary? First, those stakeholders whose endeavors I investigated (such as the practices of the Lab coordinators) were actively part of the research process. Or more precisely: my research process was actively part of their work in the project. For instance, I engaged with the project during Lab training sessions, learning workshops or interviews, and the experiences and challenges that the Lab coordinators and project partners faced were a key point of attention, and led us (as project management, or facilitators) to adapt workshop planning and training sessions to fit to their needs. In turn, these workshops and the interactions that took place, formed the empirical data for my research. In addition, the interviews we conducted with Lab coordinators also needed to be useful to them. They were thus rather open in style and had, in addition to gathering their knowledge and experiences, the purpose of (1) feeding their insights back into project *redesign* where possible; and (2) serving as a reflection moment for the coordinators, so that the discussion might be useful for their own work in the Labs. Though these endeavors were always a balancing act between project ambitions and Lab needs, their knowledge and experience informed the project directions, and as a consequence, the research we conducted alongside the project. Second and related, the research had a clear action-orientation. Or, again to be more precise, it was the action-orientation in the project on which I based my engagement and (ex-post) research activities. For instance, I engaged in the development of tools and methodologies, the design, implementation and facilitation of workshops with Lab coordinators and project partners. These engagements (that fed in to the work presented here in the thesis) had the specific objective of being useful for action[35]. This was not only the case through facilitation and implementation of workshops, but also with regard to our role in monitoring and evaluating the work of the project and the Labs. That leads, third, to an emphasis on stimulating learning and reflection. I was partly engaged in this endeavor. Though bi-monthly learning sessions (using the format of the Dynamic Learning Agenda (DLA), see Regeer, 2009) for the Lab coordinators were organized by other project partners, I was involved in developing methodologies with these and other project partners, and I was involved in organizing and facilitating reflection workshops during the training sessions with Lab coordinators and project partners during project meetings. That relates, fourth, to our role as 'methodological team' at the project coordinating institution (of course in close collaboration with other project partners), we were also actively engaged in efforts to integrate knowledge between the different project partners during consortium workshops and meetings. This for instance involved workshops with the consortium partners to develop shared understanding and a common language for what it means to 'transform food systems through R&I'; or what the role of our project was in trying to catalyze some sort of 'transformative change'. In that light, our endeavors also had a clear aim of clarifying how integrated knowledge could contribute to tackling wicked societal problems through the project.

In these ways, the research activities were *transdisciplinary* as they focused on (1) involving the relevant stakeholders; (2) being action-oriented; (3) focusing on knowledge co-creation and integration; and (4) stimulating learning and reflection. Yet, a critical observer might also argue that there were less transdisciplinary elements.

First, some parts of the research that we designed 'along the way', as well as after the project was finalized, could also be seen more as accompanying research (cf. Defila and Di Giulio, 2018), where we conducted research *on* the project instead of as an explicit part of the project. In addition, the Lab coordinators were not involved in the formal analysis or article writing so their engagement was mainly positioned in the design and problem framing phases, as well as in the experimentation processes they set out to conduct, and which we in turn aimed to support in action. Another potential oddity about my work in this project has to do with whom I considered as 'stakeholders'. The stakeholders who were actively engaged in the activities through which we gathered

35 Whether we were always successful in that endeavor, of course depends on what one considers to be the important outcome of action. For us (the project management team in Amsterdam), a focus on emergent and iterative processes was very important yet rather intangible, while other project partners focused more on what they considered concrete and policy-relevant outputs. In particular, some partners felt that we (and other academic partners in the project) were not focusing enough on realizing those concrete outputs. To me, this also reflects the different perspectives on what constitutes 'impact' (see Chapter 9) and the diverging organizational logics at play in multi-stakeholder projects, see Chapter 11 for a reflection on this matter.

data, were the Lab coordinators and the project partners. This is a different group of people than the (thousands of) *stakeholders of the project,* who were engaged in the Lab activities! In other words: for the purpose of our research I myself did not engage with the stakeholders that the Lab coordinators engaged with. That does not necessarily diminish the transdisciplinary nature, as project partners and Lab coordinators had a variety of academic and professional backgrounds. It does however mean that I only engaged with the stakeholders '*on the ground of the system*' in a second-order way: through my engagement with the Lab coordinators. Even if I wanted to participate in the Lab activities (and though I did engage in several workshops of the Amsterdam City Lab and the Flemish Policy Lab) it would be difficult because the Lab workshops with local stakeholders were (rightfully) organized in local languages. Especially challenging in this regard was combining different roles in throughout my involvement in the project (see e.g., Wittmayer and Schäpke, 2014; Bulten et al., 2021; Schön, 1983): I was both a 'researcher' (with a PhD deadline!), as well as a project manager, facilitator, reflexive monitor, and in a way, a knowledge broker. Rather a daunting task for an early career researcher. Some reflections on that matter are presented in Chapter 11.

Of course, these *realistic* manifestations of transdisciplinarity also shaped the types of research questions that we were able to formulate, and influenced how we wrote the articles that are presented in this thesis. I do not believe these issues to be problematic, as they are carefully accounted for in each individual study. Yet, it points to the complexity of navigating different types of 'transdisciplinary settings', and illustrates how messy and non-ideal transdisciplinarity emerges in practice.

2.4 DATA GATHERING AND ANALYSIS

For the empirical contributions on FIT4FOOD2030, I used a number of qualitative methodologies for data gathering and analysis. I discuss these, as well as some issues regarding the validity of the approach. In each chapter in Part IV, the relevant data gathering and analysis methods are specified.

2.4.1 Interviews

I conducted semi-structured interviews with project partners and Lab coordinators of FIT4FOOD2030. These interviews were conducted online via ZOOM between July 2019 and February 2020. They were strategically planned around 2-2.5 years into the 3-year project, so that they still allowed for reflection and adaptation of project strategies in the final year of the project based on the outcomes of the interviews. In total, we conducted 29 interviews with 32 respondents. These included 16 interviews with 19

Lab coordinators (containing two duo-interviews) and 13 interviews with key project partners that were involved in management or coordination efforts, or training of Lab coordinators. The interviews with Lab coordinators were conducted and prepared by an interview-team that consisted of four researchers working on the monitoring and evaluation workpackage of the project. We co-designed an interview guide and conducted these interviews in teams of two researchers. With the Lab coordinators we mainly discussed four overarching topics: (1) the role and impacts of the Lab; (2) the inclusion of stakeholders; (3) the challenges encountered; and (4) the role and learning of the Lab coordinator. With project partners I mainly discussed the following three topics: (1) the role and functions of the project; (2) the role of the Labs; (3) the outcomes, impacts and challenges of the project; (4) their own roles and positionality within the project.

We conducted semi-structured interviews, which meant that overarching themes and questions were formulated beforehand, but depending on the answers and the direction of the interview, we had the freedom to be flexible and ask additional or different questions (cf. Gray, 2014). As this allows for context-specific answers and to capture the complexity of the empirical situation in which both the interviewer and the interviewee are operating, this is considered an appropriate methodology in transdisciplinary research (e.g., Stirling, 2015). Interviews lasted between (approximately) 45 and 90 minutes.

2.4.2 Surveys

Two surveys with questions for Lab coordinators were conducted as part of monitoring and evaluation efforts of the project. They were mainly designed by the project partners at the Oslo Metropolitan University. I was also involved in developing the second survey. They were sent out to the coordinators of the first 'batch' of Labs (the initial seven Policy Labs and seven City Labs) in the autumns of 2019 and 2020, with a 100% response rate. Questions enquired mostly into learning needs, their perceptions of (the usefulness of) the project's learning activities and training sessions; their experiences with stakeholder engagement; and the different roles of Labs and themselves as coordinators. They contained both open questions and closed questions on a 5-point Likert scale. Only the answers to the open questions were explicitly used in the research presented in this thesis. The surveys had the main goal of improving the project's learning and evaluation strategies, with research activities being a second purpose. In that regard, the outcomes of the first survey provided useful entry points for both designing, and tailoring, the interviews that were conducted afterwards and helped identify relevant (follow-up) questions. In these ways, we aimed to stimulate useful interaction between the different data collection methods.

2.4.3 Workshops and participant observation

In addition to these more 'formal' data collection methods that yielded transcripts, I was working on the project four days a week during two-and-a-half years. This meant I actively participated in hundreds of workshops, activities, meetings, ZOOM-calls or phone calls with project partners on all aspects of the project, its challenges, and future directions. This experience of *living the project* was perhaps the most insightful 'data' we collected[36].

Slightly more formal were my engagements in the other official meetings and workshops of the project. I participated in, observed, co-designed or co-facilitated:

- 3 FIT4FOOD2030 conferences (*participating, co-designing or co-facilitating*);
- 4 consortium-wide alignment and reflection workshops (*co-designing or co-facilitating*);
- 4 meetings of the EU Think Tank (*co-designing or observing*);
- 2 meetings of the project's Advisory Board (*co-designing or observing*);
- 4 workshops in Brussels/online with project partners (*participating, co-designing or co-facilitating*);
- 3 high-level EU conferences related to FOOD 2030 (two in Brussels, one in Vienna) (*participating*);
- 3 City Lab Amsterdam workshops (*participating or co-facilitating*);
- 1 workshop of the Policy Lab Flanders (*participating*);
- calls with the European Commission (*participating or observing*); as well as
- dozens of formal meetings of different management structures the project erected, with labels as the Taskforce for Impact; Executive Board; and the General Assembly (*co-designing, co-facilitating, participating or observing*).

More informal meetings included weekly workpackage meetings with the teams at our own institute (such as the methodology development team)[37]; weekly project management[38] meetings; and many calls and discussions with project partners[39]. These meetings were many in number but irregular in distribution. For example, their intensity would increase depending on the relevant deliverables or workshops that were coming up. In addition, we would have dinners after formal project meetings, and discuss informally through mails, phone or in person.

36 Collected is perhaps a troublesome term. Rather, my colleagues and I co-created the data as we co-created the social reality of the project.

37 This team included, in addition to myself, a senior researcher and two postdocs.

38 This team included, in addition to myself, a senior researcher, one postdoc, another PhD candidate, occasional student assistants, and anywhere between zero and two professional project managers.

39 I was, though to varying degrees and varying over time, involved in the activities and work of 8 (out of 9) different workpackages of the project, the only exception being the workpackage on communication and dissemination.

In addition, I was also involved actively in shaping and facilitating interactions between Lab coordinators in trainings in the form of *workshops*. I co-organized, co-designed, co-facilitated and made observations during:

- 5 two-day Policy Lab trainings[40];
- 3 impact sessions with the Policy Labs;
- 3 two-day City Lab trainings;
- 2 two-day Food Lab trainings.

The term 'workshop' is rather ambiguous and broad and the activities that were conducted during these workshops were diverse. Workshops could last between a couple of hours and 2 days, and could be attended by anywhere between a dozen (for instance, in a workshop for the *second batch* of Policy Lab coordinators, in addition to the 4-6 coordinators, perhaps 6 partners would attend as they would support during the day), and several dozens of participants (for instance, during consortium-broad workshops on alignment and reflection there could be up to 30-40 participants present). Workshops typically consisted of a plenary introduction with several 'talks' about the topic at hand, before participants would go out in break-out sessions to work on interactive exercises. Sometimes, there would be shared lunch or dinner in which participants could further discuss the topics. And at times even, after dinner there would be 'light sessions' including either a speaker or an informal session.

The interactive formats used were highly diverse and depended on the specific needs at the moment (often related to project phases). Many of these formats can be found on the FIT4FOOD2030 Knowledge Hub, and some of them are elaborated in Chapter 7. Examples include visioning exercises where one has to draw (or visualize with clay) a vision for the food system in 2030; pathway workshops where participants together construct policy pathways toward a specific policy goal; theater-based training exercises to reflect upon your own role in social groups as part of leadership training; but also exercises about co-creating educational modules; break-out discussions on how the project could improve its impact through increased interactions between workpackages; and learning history workshops that focus on learning as journey containing important moments such as eye-openers and challenges. An example of a program of one 'training session' of the Policy Labs is presented in Table 2.1. Workshops took place in-person (from November 2017-March 2020) and online (from March 2020-December 2020) due to the covid pandemic. Despite the difficulties this brought along, we aimed to stimulate inspiration, interaction and reflection by using creative online methodologies.

40 This means I also 'missed' some of the project's earlier workshops that were organized. My colleagues at the Vrije Universiteit did however co-organize these.

Table 2.1 | Overview of the first day of the training session for the second batch of Policy Lab coordinators, in Brussels, October 15-16, 2019. In parallel, there were training sessions for the first batch of Policy Lab coordinators, City Lab, and Food Lab coordinators.

Time	Description	Objective
9.00-10.00	**Welcome and catch up**	Introduction of this training session and catch up between the Policy Labs, discussing what they have done so far, next steps and potential barriers using a poster they prepared beforehand. Coordinators will also be asked about their needs and expectations from the training session.
10.00-12.00	**Breakthroughs, showcases and the role of experimentation**	The goal of this session is to familiarize coordinators with the concept of breakthroughs in relation to the visions of their Labs and to transforming the food system, relating the conducting of (policy) experiments to systemic transformation, and presenting inspirational cases for R&I policy experiments.
12.00-12.45	**R&I policy for future-proofing food systems and the role of funders**	One of the documents that has been developed within the FIT4FOOD2030 project, is a 'background paper' on R&I policy for future-proofing food systems. It is aimed at policy makers and will also be developed into a policy brief. The three key messages are on: 1) Inclusion of food system transformation topics on the R&I agenda; 2) Responsible research and innovation; 3) R&I funding institutions as 'innovation brokers' This session will focus mostly on the third point.
12.45-13.30	**Lunch**	
13.30-16.15	**Communication with and engagement of stakeholders**	The success of the Policy Lab depends in large part on involving the right people and gaining their support. This session will consist of theory on various communication models and practical tips and exercises, focussing amongst other things on understanding of the other's perspective and interests, checking assumptions and dealing with defensive reactions. Coordinators will learn about different ways of coaching and influencing and when to use which approach.
16.15-16.30	**Wrap up day 1**	Reflection of the first training day. What are the key items the coordinators take away from this day? What questions and needs do they still have for the next day in order to move forward with their Policy Lab?
16.30–17.00	**Buffer**	
17.00–18.30	**Network event**	In a World Café setting, coordinators will have the opportunity to discuss various FIT4FOOD2030 and Lab-related topics with Policy Lab coordinators from the first group, City Lab coordinators and consortium members.
18.30-	**Dinner**	

During all these events I was either actively engaged or observing the dynamics at play. Hence, this can be seen as a way of 'participant observation' in the sense that I paid attention to what was being said, by whom, why and in which context (setting and the relations between actors) (cf. Gray, 2014). While listening and interacting with our partners, I tried to be conscious of the different (organizational) contexts that these partners were embedded in as to come to better mutual understanding. Sometimes I (or others) made structured field notes during meetings. Mostly, I made less structured field notes. Sometimes, the situation was so hectic that I did not make any field notes at all. At all times though, these interactions and observations formed the basis by providing context to the project. That is not to say that the primary aim of all my interactions was to 'collect data'. Because it was not. Rather, the primary aim was to run the project. In addition though, I was conscious about the fact that my thoughts and observations would be helpful in the research that I was conducting alongside the project by providing insight and context. This helped me and my colleagues to formulate research questions, design project activities and to identify patterns in the formal data (e.g., the transcripts).

2.4.4 (Constructing) documents

As is the case for many projects, a sheer number of documents (written or otherwise) was developed as part of the project activities. These documents served different purposes and came in different forms and shapes. These included the project proposal and the *Grant Agreement* (with its *Description of Action*) that set out the planning and purpose of the project:

- 39 formal documents that were called *deliverables*[41] and were produced in efforts to codify the knowledge and insights of the project;
- 4 policy briefs of the EU Think Tank that addressed high-level policy makers;
- 1 co-publication with the EC on the outcomes and learnings of the project (EC, 2021) to share the findings of the project with a wide EU-audience;
- dozens of 'tools' (e.g., workshops, interactive exercises, educational modules, and even movie clips) that aimed to support those working on food systems transformation in creative ways (see Chapter 7);
- codified knowledge that helped to align internal project 'thinking', such as a conceptual note on the nature of R&I breakthroughs;
- internal project structuring such as minutes of meetings or reports of consortium workshops; and
- documents that served explicit external communication or advocacy purposes, such as position statements, two-pagers about the project, short videos, the website or particular bits of text that could be used by partners in their *own documents* to spread the *word of the project*.

I did not formally analyze the documents in detail. I did, however, contribute to writing, creating, negotiating or reviewing many of them. These documents for me represent the shared, negotiated and codified knowledge that the project partners produced together. The process of drafting these documents I remember as containing valuable interac-

41 This is an EU-project term for a particular (written) product. It mostly involved different types of reports.

tions and engagements that also showed which ideas were not yet commonly shared. These processes were sometimes very challenging due to different views partners held on either the content, process, or purpose of each document, yet in my experience they were almost exclusively constructive because project partners were committed to 'make it work'. In that light, I see both the documents themselves as well as the process of developing them as supporting data that helped me, both during the project and after, to grasp the common project discourses and ideas, in relation to the wider EU policy context in which the project found itself.

2.4.5 Transcription and coding

All interviews were recorded and transcribed verbatim. The workshops (especially those with Lab coordinators, that fed into the formal data collection for the research presented in the papers in this thesis) were selectively recorded and transcribed. In practice, this meant that the most 'interesting' parts of training sessions to transcribe and code were those toward the end of the project, as they included most reflections and insights on outcomes and impacts. The data was coded using Atlas.ti. A total number of 64 codes identifying 984 direct quotations was used to inform the abductive analyses presented in the different chapters of Part IV of this thesis. Taking all the data collection methodologies combined, a total of 49 different respondents were identified. In Chapter 9, they are explicitly referred to as R1-R49 in order to guarantee anonymity. In other chapters, they are not specified but we referred to their respective stakeholder categories, being: *Policy Lab coordinator*, *City Lab coordinator*, *Food Lab coordinator* or *project partner*.

2.4.6 Ethics

Informed consent to record interviews or workshop sessions, as well as to use the data for research purposes was given by all interviewees and participants of the workshops and training sessions (both in written forms at the start of their participation in the project, as well as during interviews). Anonymity was guaranteed. When using direct quotations, the participants are always presented anonymously throughout the work in this thesis. The (partners of the) FIT4FOOD2030 project adhered to the relevant data protection regulations (such as the GDPR) and through committing to the project proposal and implementation, relevant local and EU ethical regulations were upheld.

2.4.7 Validity

During our research endeavors my co-authors and I aimed to maximize the scientific validity of our work. This was done by pursuing various strategies:

First, in order to support *internal validity*, data triangulation, methodological triangulation and investigator triangulation were pursued (cf. Gray, 2014, drawing upon Denzin, 1989). We combined different data collection methodologies, such as interviews, workshops, observations, and surveys and by involving different relevant actors over a longer period of time. In efforts for these methods to reinforce each other, they were conducted so that in some cases their results could feed into each other. For instance, responses to the Lab coordinator survey would feed into interviews, and general insights from the interviews could in turn feed into the design of learning and reflection sessions. Furthermore, interview guides, surveys and training programs were co-designed and co-implemented in project teams consisting of project partners from different (scientific) backgrounds and employed at different institutions, as well partners from 'practice' in the case of the training programs for Labs. We worked on the scientific publications in teams, where we would discuss and reflect upon the approach, data, and their meaning in relation to theoretical concepts.

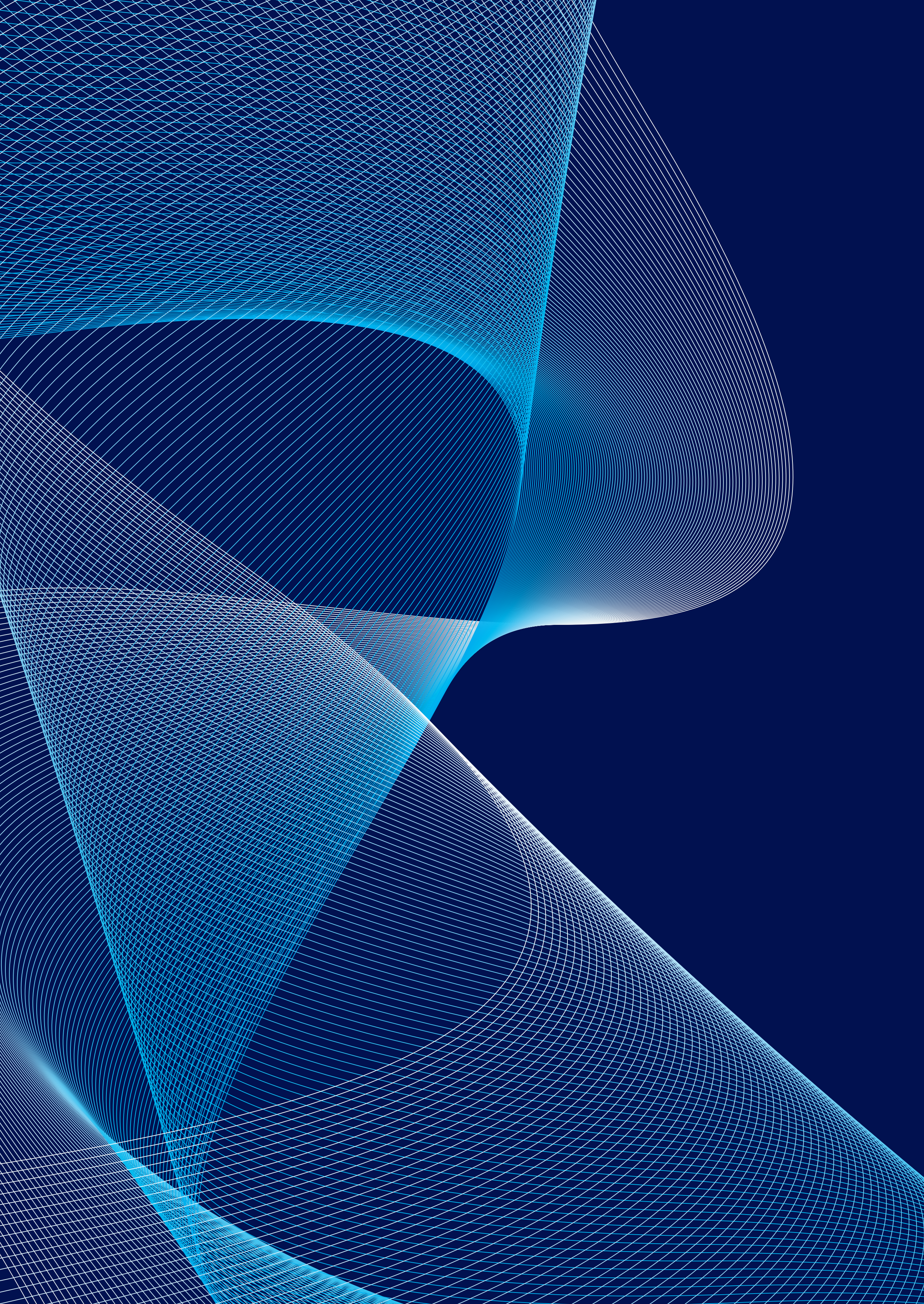
Second, as part of our semi-structured interview strategy, we paid careful attention to the validity of the interview methodology, by providing enough time for in-depth responses, prompting respondents to expand or elaborate on their answers, allowing them to formulate their own questions and space to engage with us in dialogue (cf. Gray, 2014).

Third, our interactive approach allowed us to discuss issues of interest multiple times with the project partners and Lab coordinators. This helped us to better understand the (time-dependent) dynamics and challenges they faced, and helped to actively contribute to finding solutions. This also relates to the concept of *contextual validity*, whereby we took into account the experiences and perspectives of the involved stakeholders (over an extensive period of time) in order to better grasp the contexts in which they found themselves.

Fourth, by taking an interactive approach we also aimed to contribute to *participatory validity*, which implies that our research activities were tailored to the involvement of the project partners and Lab coordinators (for instance: conducting surveys as part of monitoring and evaluation in preparation for the interviews as to find synergies for both our research and the Lab coordinators) and we aimed to mobilize a wider variety of different methodologies to actively engage the project partners and Lab coordinators in the workshops and other activities.

Fifth, as researchers we also tried to be reflective, transparent and open about our own positionality, the different roles we adopted and about the methodology we used. Through our engagement and reflection workshops, we also tried to stimulate this reflexivity with project partners and Lab coordinators. We hope that this contributed to an open atmosphere, building trust between different actors and thus to an environment in which open sharing of perspectives and experiences led to an enrichment of the discussions, which in the end, could enhance the validity of our work.

Finally, we paid close attention to the *external validity* of our work. In particular, by carefully choosing and grounding our case study design (to investigate in-depth three different aspects of the case, as presented in Chapters 8, 9 and 10) the approach of abduction was chosen so that our case could provide contextualized generalizations (see Section 2.3).



PART II

THEORETICAL EXPLORATIONS

“Nothing retains the form that seems its own, and Nature, the renewer of all things, continually changes every form into some other shape. Believe my word, in all this universe of vast extent, not one thing ever perished. All have changed appearance.”

on the lessons of Pythagoras
Book XV, Metamorphoses
Publius Ovidius Naso, 8 A.D.

“ ... and there began a sequence of causes, and concauses, and of causes contradicting one another, which proceeded on their own, creating relations that did not stem from any plan. Where is all my wisdom, then? I behaved stubbornly, pursuing a semblance of order, when I should have known well that there is no order in the universe.

But in imagining an erroneous order you still found something…

[...] The order that our mind imagines is like a net, or like a ladder, built to attain something. But afterward you must throw the ladder away, because you discover that, even if it was useful, it was meaningless.”

dialogue between William of Baskerville and Adso
The Name of the Rose
Umberto Eco, 1980

What is that thing called 'politics'? Its etymology rooted in Ancient Greece, *politika* refers to the 'affairs of the city'. But of course, there is no univocal answer. Being elaborated on by scholars for thousands of years (literally), scholars have argued that that politics deals with 'decision making', 'the state', 'power', 'agency', 'democracy', 'justice', 'distribution of wealth and resources', 'conflict', 'cooperation', *etcetera, etcetera, etcetera*.

Considering the politics of transitions, for me, is to ask ontological, epistemological and axiological questions. That is, it revolves around questions such as "who or what has which kind or politics?" (ontology); "how does politics (not) lead to change and how can we know?" (epistemology); "what is *good* politics?" (axiology). Though of course, these questions and their answers are likely to be strongly intertwined.

This part of the thesis is a rather theoretical one. It contains two chapters. The first (Chapter 3) deals mostly with ontological and epistemological questions concerning the politics of transitions in the context of complex adaptive systems. It aims to unravel who or what (that is: humans, non-humans and their networks) has politics in complexity. It explicates and relates the concepts agency, power and powering. It reflects on what the findings mean for the causal patterns and dynamics of transitions and, importantly, transition governance. Hence, Chapter 3 emphasizes the *causal orientation of politics.*

The second (Chapter 4) then shifts its focus to the epistemological and axiological considerations, as it deals mostly with the question of how more *democratic* forms of decision making relate to governing transitions toward *just* agri-food systems. It explores how transitions can be governed in just and hence, 'good' ways. It also points to several challenges that arise in the governance of transitions, when one considers both democratization and different dimensions of justice. Hence, Chapter 4 emphasizes the *normative orientation of politics.*

3

Politics of complexity: Conceptualizing agency, power and powering in the transitional dynamics of complex adaptive systems

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ABSTRACT

This chapter seeks to bridge the gap between socio-material and complex adaptive systems approaches in conceptualizing the politics of transformation. Our contribution in particular is a further clarification of the relational nature of power, and the role of non-humans in transitional dynamics of complex adaptive systems. We explore and operationalize the role of non-humans and relationality in (1) agency and (2) power, and the implications thereof for processes of (3) powering, through which power relations shape resource distributions and associated macro-scale dynamics. We consider agency as an embedded and temporal capacity for reorientation. This also entails attributing agency to entangled networks of humans and non-humans. Such a capacitive conception of agency follows from our understanding that agents and structures consist of comparable ontological building blocks, both being (networks of) components in complex adaptive systems. Power we understand as a productive and relational phenomenon that emerges from interactions between components and that structures their agency. We argue that such a 'force-field' understanding of power enables the observation of different types of power relations. Finally, we consider six different mechanisms through which power relations can result in a (re)distribution of resources and with that, contribute to self-reproducing or transformative systemic dynamics. With this conceptualization, we hope to advance the debate on the different facets of the politics of transformation, and to help further urgently needed transitions toward a more sustainable future.

3.1 INTRODUCTION

Large-scale societal sustainability transformations in fields like energy, water, food, healthcare and mobility are needed to meet some of the most pressing global challenges. Useful to that end are scholars' efforts at conceptualizing and understanding such transitions as non-linear processes of structural change (Geels and Schot, 2007; Rotmans and Loorbach, 2010). In an overview, Köhler et al. (2019: 19, drawing on Grin et al., 2010) indicate that the field of transition studies focuses on *"problems of path-dependence and lock-in, and development patterns of self-organization, emergence and co-evolution."* To understand the stability of locked-in constellations, and to conceptualize the power at play in sustaining and changing these are among the major themes in the field's current debates (Avelino and Rotmans, 2009; Avelino et al., 2016; De Haan and Rotmans, 2018; Geels, 2014; Grin, 2006; 2010; Hoffman and Loeber, 2016; Köhler et al., 2019; Markard et al., 2012; Smith et al., 2005). Yet, despite the many valuable conceptualizations of politics, power and agency in transitions, there is still a need to *"compare and integrate the diversity of studies on politics and power and to reflect what the findings so far imply for transition theory"* (Köhler et al., 2019: 8).

Interestingly, two main branches in the field conceptualize and relate agency and power quite differently.[42] A first is the socio-technical approach, which emerged from Science and Technology Studies (STS) and gave rise to the widely used multi-level perspective (MLP, see e.g. Geels, 2002; Geels and Schot, 2007; 2010).[43] Authors adopting this approach increasingly emphasize the power-laden role of materiality in system dynamics. Svensson and Nikoleris (2018) for example problematize the relation between (human) agency and (material) structure, arguing that undervaluing the causal influence of the material is problematic, since it can *"make it difficult to understand why some systems undergo change slower than others"* (ibid: 472). This view builds on classical STS insights regarding material forms of power, pointing out the power-laden role of (non-human) actants. More generally, it has been noted that understanding the 'political' as exclu-

42 There are more branches and distinctions to make within the field that studies transformations or transitions in societal systems. See Hölscher et al. (2018) for an overview of the etymological discussion on 'transformation' versus 'transition' and Markard et al. (2012); Grin (2016); Köhler et al. (2019) for overviews of the field. Other branches include for instance social practice approaches (SPA) (e.g. Shove and Walker, 2010; Hoffman and Loeber, 2016; Cherunya et al., 2020) and technological innovation systems (TIS) approaches (e.g. Bergek et al., 2008a).

43 The multi-level perspective (MLP) developed in transition studies (Geels, 2002; 2011; Geels and Schot, 2007; Grin et al., 2010) distinguishes three analytical levels: niches (micro-level, where novelties and innovations are localized), regimes (a meso-level that comprises 'incumbent actors', structures, technologies as well as associated self-reinforcing rules and practices) and the landscape (macro-scale social and physical developments external to the studied system) in which regimes and niches are embedded. These levels span structuration space rather than spatial, geographical or governmental levels and thus represent degrees in stability (Geels and Schot, 2007, 2010; Geels, 2011).

sively human/social is problematic and that developing an analytic language about the social and material worlds “as inseparable, [and] as constitutively entangled” is a key theoretical challenge (Orlikowski and Scott, 2008: 463). Another prominent understanding in scholarship on socio-material transformations refers to conceptualizing power as embedded in (social) relationships, in contrast to power being the property – or a capacity – of an agent (see e.g. Cooper, 1994; Foucault, 1978; and more recently Ahlborg and Nightingale, 2018).

In contrast, a second main branch within transition studies is the complexity-paradigm, which emerged from integrated assessment and Complex Adaptive Systems (CAS) science. Authors working in this field often sideline the role of materiality and non-humans in current conceptualizations of agency and power. Typically, studies focus on embedding human agency in structural contexts and on the power-laden role of specific categories of transformative actors, as e.g. “leaders of change” (Olsson et al., 2004), “front-runners” (Rotmans and Loorbach, 2009), or “topplers” (De Haan and Rotmans, 2018). Such an anthropocentric focus is surprising as the complexity approach to understanding transitions attributes a crucial role to non-humans in (modeling) systemic dynamics (see e.g. Sendzimir et al., 2010; Van der Brugge, 2009) in a way that is similar – or: ‘symmetrical’ – to human actors. A prominent example of the turn toward an anthropocentric focus in complexity-thinking is De Haan and Rotmans’ recently developed framework that depicts transformative complex system dynamics as *“the consequence of deliberate, or even strategic actions of specific types of value-driven actors”* (2018: 276). In an effort to explicitly counterbalance the emphasis that is put on structures in the MLP framework, they focus on ‘intentional human actors’ and their aggregates, such as *“alliances, the collectives and organizations of actors”* (De Haan and Rotmans, 2018: 279). While De Haan and Rotmans’ wish to avoid an overly functionalist take is understandable, their adoption of an asymmetrical and anthropocentric perspective in analyzing transformative dynamics in CAS in our view is throwing out the baby with the bathwater. We posit that in order to understand the dynamics and inertia in CAS, the ontological symmetry between humans and non-humans needs to be acknowledged. That requires an understanding of agency that does justice to the role of both humans and non-humans in power relations. Only in that way we can coherently grasp the causal influence of non-humans in transitional dynamics, that exert influence regardless of the (will) power of human actors in the system. In this chapter, we seek to reconceptualize the relation between agency, power and transformation in CAS, inspired by the socio-technical approach to transition studies and its revaluation of materiality’s causal influence in system dynamics (such as in Ahlborg, 2017; Chilvers and Longhurst, 2016; Geels, 2014; Svensson and Nikoleris, 2018).

A second point of departure in this chapter concerns the role of power in both micro-politics as well as macro-scale systemic dynamics in a CAS context, as proposed by Room (2015). Room seeks to reconcile Parson's conception of power as the generalized capacity of a system to 'get things done' with Weber's and Wright Mills' understanding of power as the capacity of an individual or group to secure their purposes, even against the resistance of others. Room's synthesis concerns a focus on the 'generative mechanisms' (Elder-Vass, 2010; Harré, 1972) which *"produce the patterns we observe"* and involve *"the potentialities or powers that are unlocked or closed down by contextual conditions"* (Room, 2015: 24). Interesting about Room's attempt is that he includes material system components in his understanding of the causal power of structures (drawing on Elder-Vass, 2010) which he combines with an interest in relating 'macro-behavior' with 'micro-motives' (drawing on Schelling, 1978) to explain 'transformative synergies' in complex systems. While Room makes an interesting start in his synthesis, along the way, through his focus on institutional structures, he seemingly loses Elder-Vass' attention for materiality.

By bridging the gap between socio-material and CAS approaches in conceptualizing agency and power, we seek to contribute in particular to a further clarification of the relational nature of power, and the role of non-humans in the transitional dynamics of CAS. We do so by exploring and operationalizing the role of non-humans and relationality in (1) agency and (2) power, and its implications for processes of (3) powering, through which power relations shape resource distributions and associated macro-scale transformative dynamics. Below, we will first discuss the nature of CAS and their (transitional) dynamics. We then reflect on academic debates on the symmetrical and relational nature of agency (Section 3.3) and power (Section 3.4), which helps us operationalize structure, agency and power specifically for CAS. Subsequently, building on the work of Avelino and Rotmans (2009) and Giddens (1984), in Section 3.5 we relate our operationalization to the effects that power relations produce in resource distributions and associated transformative systemic dynamics, and explore the implications for powering.

3.2 TRANSITIONS IN COMPLEX ADAPTIVE SYSTEMS

In recent decades, Complex Adaptive Systems (CAS) theory (Byrne, 1998; Holland, 1992; Holling, 2001; Mitchell, 2009) is used to study systems in both the physical and social sciences. Scholars of complexity indicate that there is yet no unified Theory of Complexity[44] (see e.g. Chu et al., 2003; Cilliers, 2001; Ladyman et al., 2013). There is, however, a general understanding in the field that CAS share certain deep commonalities (Holland, 1992) that can be considered the generators of complexity (Chu et al., 2003). In order to substantiate our operationalization of agency, power and powering in complexity, we briefly reflect on such commonalities of CAS, regarding their structure and dynamics, and implications for (sustainability) transitions.

3.2.1 Systems and boundaries

Defining a system is drawing a line between what is ‘in’ and what is ‘out’. It presumes that there is something (the system) with a particular functioning, or coherent behavior, that separates it from its environment and *“constitutes which is bounded”* (Cilliers, 2001: 141). For CAS, defining such boundaries is not straightforward (Cilliers, 2001) as they are radically open systems (Chu et al., 2003; Holland, 1992). The dynamic behavior of CAS reflects interactions within a system and interactions between a system and its environment.

If one manages to determine the bounds of a particular system, still the question remains: what does it consist of? The first answer is: subsystems. This rather unsatisfying answer is important in the context of transition studies (See Section 3.2.3), as it points to the contextualized nature of CAS. Multiple systems and their components can overlap, interact and are often embedded in each other (Chu et al., 2003). For instance, following John Holland’s (1992) example, an immune system can be considered a CAS which is embedded in another system (a human body), which itself is embedded in larger (and overlapping) socio-ecological systems. A second answer, scholars generally agree, it that complex adaptive (sub)systems exist of heterogeneous components and their non-linear interactions (Chu et al., 2003; Holling, 2001; Rotmans and Loorbach, 2009). Such components might be technological, ecological or social in nature, that is, they might be humans, animals, technological artefacts, laws, infrastructures, and so on. The macroscopic structural and dynamic properties of CAS are the result of micro-scale interactions. Therefore, let us zoom in on those interactions and the peculiar dynamical properties arising from them.

44 Whether there will ever be a unified Theory of Complexity is also a matter of debate, challenging assumptions on what one expects from a ‘theory’ or a ‘model’. See Cilliers (2001); Chu et al. (2003) for reflections on the scholarly pursuit of developing such unified theories. It also relates to the difference between descriptive and ontological complexity, where *“the first has to do with the complexity of our descriptions, the second with the “actual” complexity of things in the world”* (Cilliers, 2001: 139).

3.2.2 Dynamical properties of complex adaptive systems

There are three important, mutually related dynamical properties of CAS: emergence, self-organization and adaptation. A fundamental prerequisite for understanding their properties is that CAS are inherently dynamical, and that these dynamics are essentially non-linear (Holland, 1992; Holling, 2001; Ladyman et al., 2013). This means that linear superposition principles do not apply, and small changes in one interaction (or perturbations external to the system) do not linearly translate into similarly small changes in systemic behavior (Byrne, 1998). Due to non-linear interactions, systemic feedback-loops can emerge in the system, allowing small changes to either accelerate systemic change (positive feedback-loop) or dampen systemic change (negative feedback-loop). As a consequence, collective, macroscopic, or (sub)systemic properties may emerge that are not merely linear superpositions of the properties of the individual components. More precisely, according to Emmeche et al. (1997: 83) the concept of emergence refers to *"properties at a certain level of organization which cannot be predicted from the properties found at lower levels."* Cairney (2012: 1) contends that complexity theory *"suggests that we shift our analysis from individual parts of a system to the system as a whole".* However, not considering the micro-scales that constitute macro-scale phenomena does not advance our understanding of underlying mechanisms either. We need to consider *"the properties of wholes compared to those of their parts"* (De Haan, 2006: 295). Emergence is, in other words, also related to novelty and to new properties that emerge at a particular systemic level, arising from interactions[45] at underlying levels (see Bunge, 2003; Emmeche et al., 1997).

The notions of non-linearity and emergence do not necessarily imply that CAS are chaotic (Cilliers, 2001; Folke, 2006). Structured hierarchies (Cilliers, 2001; Holling, 2001; Simon, 1977), patterns (De Haan, 2010) or spontaneous order (Ladyman et al., 2013) emerge through processes *"by which systems acquire and maintain a certain emergent property: organization"* (De Haan, 2010: 33). Systems exhibit a degree of resilience as local interactions may adapt to their environment through such self-organization, making the system compatible with, or resistant to, perturbations, and allowing it to retain its functional or structural configuration (Folke, 2006; Foxon et al., 2009; Walker et al., 2004). Hence disturbances, instabilities, incumbent properties and (cross-scale) non-linear interactions drive both slow, fast and transformative (sub)systemic dynamics.[46] Importantly, systems tend to co-evolve toward equilibrium states – attractors – in which certain configurations display a large degree of resilience (Oliver et al., 2018; Walker et al., 2004) or incumbency (see e.g. Stirling, 2019). They then tend to remain locked in

45 Interactions also occur across systemic boundaries and across geographical, temporal and structural scales.

46 Holling and Gunderson (2002) for instance famously proposed 'Panarchy': a heuristic framework for understanding dynamics and stasis through phases in adaptive cycles of socio-ecological systems.

those states (see e.g. Grin et al., 2010; Rotmans and Loorbach, 2009), even if those states are considered undesirable or unsustainable. Therefore, within transition studies, a particular goal is to understand and redirect systemic dynamics toward desirable attractors (or to create such novel attractors), representing desirable and sustainable system states (Rotmans and Loorbach, 2009).

3.2.3 Transitions toward sustainability

Transitions in complex socio-ecological and socio-technical systems[47] entail *"profound change in various or all aspects of a system's functioning"* (De Haan, 2010: 59) and long-term processes of change that lead to "*far-reaching changes in the system along different dimensions: technological, material, organizational, institutional, political, economic, and socio-cultural"* (Markard et al., 2012: 956). Transitions are multi-actor, multi-level processes that require co-evolutionary reconfigurations of structures, cultures and practices in societal (sub)systems (Rotmans and Loorbach, 2009), across geographical, temporal, sectoral and spatial scales (Coenen et al., 2012, Foxon et al., 2009). The notion of societal subsystems is important in the context of transition studies (see Section 3.2.1), as transitions involve interactions (competition through variation and selection, or collaboration) between subsystems (or 'constellations', De Haan, 2010) that each have their own functioning within the system. These can be small and/or novel configurations ('innovations' or 'niches') or incumbent, dominant and highly structured configurations ('regimes'), each involving their own networks of structures, practices, cultures and actors (Grin et al., 2010; Rotmans and Loorbach, 2009). Their configuration exists through an interplay between ecological, technological and social components (Folke, 2006; Geels and Schot, 2007). For instance, an energy system may comprise constellations around coal, bioenergy, solar energy, wind energy, and so on, each with their own functioning and dynamics in the energy system. Analytically distinguishing between the 'landscape' as a system's context and the system itself may further help to explicate the 'how' and 'why' of societal transitions (cp. Geels, 2002; Jørgensen, 2012).[48]

Transitions from one relative state of equilibrium to another involve a multitude of interactions in and between constellations. These non-linear, highly uncertain, and

47 Alternatively: socio-technical-ecological systems (Ahlborg et al., 2019), incorporating technology into socio-ecological systems thinking.

48 Though CAS have a rather flat ontology in terms of their 'building blocks', emergence and self-organization allow for hierarchies to be (re)produced. This seems in contrast with social practice approaches and Actor Network Theory (ANT) that often reject ontological hierarchies (e.g. Law, 1992; Shove and Walker, 2010; Jørgensen, 2012). However, there might be room for reconciliation as complexity scholars move away from rigid levels of structuration (e.g. De Haan, 2010) and scholars of practice (e.g. Schatzki, 2011) indicate that macro-scale phenomena (e.g. regimes) have distinctly different characteristics than micro-scale phenomena (e.g. niches), even though ontologically they might exist of the same substance..

path-dependent processes have been conceptualized with typologies like ‘transition pathways’ (Geels and Schot, 2007), ‘transition patterns’ (De Haan and Rotmans, 2011) or ‘sustainability pathways’ (Leach et al., 2010a,b). Governance approaches aim at fostering pathways (or patterns) that destabilize regimes and create opportunities for niches (Transition Management, see Loorbach, 2007; Strategic Niche Management, (see Kemp et al., 1998), or enhance the resilience and adaptive capacity of sustainable system states (Adaptive Management, see Folke et al., 2002, Haasnoot et al., 2013). In order to understand and help influence (transitional) dynamics in CAS, scholars have obviously turned to studying the role of politics.

3.3 AGENCY IN COMPLEXITY

Transition scholars have time and again problematized and conceptualized the role of politics in transitions, producing a wide variety of definitions of power and agency, as well as of frameworks for analyzing their manifestations (among them Avelino and Rotmans, 2009; Grin, 2010; Smith et al., 2005; Späth and Rohracher, 2010; Geels, 2014; Geels, 2020; Hoffman and Loeber, 2016; Kern, 2011; Meadowcroft, 2011; Stirling, 2019). Yet, there still are blank spots in observing how agency and power relate to one another and play out in transitional dynamics (see also Avelino et al., 2016; Köhler et al., 2019). In order to substantiate our operationalization of power (Section 3.4) and powering in transitional dynamics (Section 3.5), we first elaborate our take on how the concepts of agency and structure can be understood in CAS.

A useful starting point is Anthony Giddens’ (1984) theorem of the duality of structure: *“[T]he structural properties of a system are both the medium and the outcome of the practices they recursively organize”* (ibid: 25). According to Giddens, agency refers *“not to the intentions people have in doing things but to their capability of doing those things in the first place”* (ibid: 9). Decoupled from intentionality, for Giddens agency is the human capacity *“to act otherwise”* (ibid: 14). Agency is therefore inherently related to the role of power in the reproduction of structures which, importantly, can both be constraining and enabling. Giddens’ work is both applauded and criticized, sparking debate on two issues: what exactly is it that agency does, and how does that relate to the possibility of non-humans to ‘have agency’?

3.3.1 What does agency do?

The first debate involves the nature of agency: what does it mean to have agency and how does it work? Like Giddens, many conceive agency as a capacity to act or to signify (e.g. Latour, 2018: 69–70). More ‘realistic’ scholars, like Margaret Archer (2000), see agency in the reflexive deliberation and normative orientation of human actors that lie at the heart of their actions. Such intentionalism is echoed in recent work on transitions by De Haan and Rotmans (2018: 278) who contend that *"beliefs and desires are the basis for an agent's intentional actions – the actions that manifest its agency".* It contrasts with Giddens' decoupling of intention from agency and with Bourdieu's[49] understanding of structure influencing agency through the habitus in which the actor is situated. For Bourdieu, action can be *"coherent without springing from an intention of coherence and a deliberate decision; adjusted to the future without being the product of a project or a plan"* (1990: 51). Emirbayer and Mische (1998) provide a subtle solution for this apparent deadlock between agency either being deliberate and reflexive, or socially constructed. Agency, in their view, consists of different temporal and entangled dimensions that together co-constitute the capacity for action: human agency is *"a temporally embedded process of social engagement, informed by the past (in its habitual aspect), but also oriented toward the future (as a capacity to imagine alternative possibilities) and toward the present (as a capacity to contextualize past habits and future projects within the contingencies of the moment)"* (Emirbayer and Mische, 1998: 963). This three-fold nature of agency stresses both the importance of habitual construction of agency (first temporal dimension) as well as the importance of (a degree of) reflexivity and future action (second and third temporal dimensions). Such an understanding also gives body to conceptualizing agency as a *capacity for reorientation* (related to Giddens' capacity to act otherwise, and, in the words of Stirling (2019: 3) to *"orient […] among many prehensible pathways for change"*). Furthermore, considering agency as situated implies that agency is not necessarily the attribute of an actor as such, but rather the product of interactions between an actor and his/her environment. As Fuchs (2001: 39) argues, agency can then be seen as a dependent variable, *"more likely in some situations, on some occasions, and in some networks than others."*

3.3.2 The role of non-humans

These considerations provide an interesting entrance to the second debate, on non-human agency. Critiquing the disentanglement of the 'social' and 'natural' worlds[50], STS scholars have sought to explore the role of non-humans in the dynamics of socio-ecological and socio-material systems, leading to a wide variety of interpretations relating non-humans to agency. On the 'symmetrical' front, Jane Bennett (2010), for instance,

49 According to Elder-Vass (2007) there are many differences between the works Archer and Bourdieu, yet their work can be reconcilable at the ontological level.

50 See for early work on Actor Network Theory (ANT) for instance Latour (1987), Law (1992), Callon and Latour (1992); Mol (1999); for geographies and spaces of socio-natural co-evolvement see Coenen et al. (2012); Castán Broto (2016); and for postcolonial anthropological inquiries into the entanglement of social and natural worlds for instance Viveiros de Castro (1998); De la Cadena (2010).

proposes the concept of vital materialism, arguing that non-humans have a kind of agency – or vitality – as *a "capacity of things – edibles, commodities, storms, metals – not only to impede or block the will and designs of humans but also to act as quasi-agents or forces with trajectories, propensities, or tendencies of their own"* (2010: viii). This 'thing-power' she more broadly positions as being distributed in assemblages containing humans and non-humans. Bruno Latour too grants agency to non-humans (see e.g. Latour, 2018). Yet, he maintains that *"[b]eing a subject does not mean acting in an autonomous fashion in relation to an objective context; rather, it means sharing agency with other subjects that have also lost their autonomy"* (Latour, 2018: 62). As such, nuanced interpretations of symmetry between non-human and human agency stress that non-human agency is different *"if only because they are never by themselves"* (Sayes, 2014: 144).

The symmetrical stance – even in its nuanced form – is criticized for diluting the concept of agency so that it is applicable to a wide variety of 'things', leading to a devaluation of the analytic purpose of the concept. As a consequence, through that dilution, it is critiqued for allowing confusion between (or rather, failing to explicate the difference between) power, action and agency. Such a confusion complicates studying power dynamics, as a consequence of the ontological flatness it brings along (see e.g. Cudworth and Hobden, 2015; Lemke, 2018). Other scholars stress that agency is an essentially human attribute (Archer, 2013) even though materiality and non-humans produce effects and have consequences (Hornborg, 2017), political strength (Akrich, 1992) or political dimensions (Winner, 1980).[51] This is different from yet another debate on whether the prerequisite for agency should be 'human' or 'living' (like animals) or should also pertain to machines. For instance, Donna Haraway in the *Cyborg Manifesto* influentially posited that distinctions between these 'categories' should be eradicated (Haraway, 1991).

In this chapter, we will not seek to resolve these debates, yet we aim to provide a conceptualization of power and agency in CAS that is at least coherent, while doing justice to these broader debates. In order to understand who or what can have agency, let us return to what we consider agency to do. We consider a multi-dimensional temporal conception of agency that is embedded in complex networks. We take agency to be a capacity for reorientation. Such capacity can be attributed to one component or a network of components in a system, and thus also serves as a collective capacity (see also Sewell, 1992). We therefore contend that a degree of agency can be attributed to non-humans, depending on how the non-human component expresses one or more of the temporal dimensions of its capacity for reorientation. This way, (non-human) living

51 Others object that symmetrists favor methodological consistency at the expense of ethical or moral consistency (Shapiro, 1997).

components and their collective networks (animals, ecosystems, companies, governments) and particular machines with a capacity for reorientation may have a degree of agency. For artefacts such as rocks, tables, windows and so on, this is more complicated. Such artefacts yet do play a role in the socio-material dynamics of particular networks. As it is difficult to disentangle non-linear dynamics in CAS, it might make more sense to consider the collective agency of such a network. In line with the so-called 'third stream' in research on science and technology dynamics that Orlikowski and Scott (2008) identified, we understand such collectivity in ontological terms, perceiving human components and non-human components to exist through *"their temporally emergent constitutive entanglement"* (cp. Pickering, 1995). With this conceptualization, a coal energy company for example could be said to have agency. This agency then refers to the collective capacity for reorientation of the non-humans and humans in the network combined, even though the non-humans (coal plants, transportation infrastructure, coal etc.) do not have agency by themselves and only take part in the collective agency of the network.[52]

3.3.3 Structure(s) and agency

Before discussing consequences of this take on agency for power in CAS, let us briefly return to the concept of structure. It is widely argued that agency cannot be considered without structure, and vice versa (Giddens, 1984; Sewell, 1992). As Jessop (1996) indicates, their relation has been (erroneously) described in scientific work as either dichotomous, as a duality or as dualistic. Following Giddens' (1984) structuration theory in developing an understanding of the relation between structure, agency and power specifically for CAS, we rephrase his more general definition. We understand structures as those (networks of) components that engage with agents through structuration, thus forming the conditions for agency – i.e. as constituting components' capacity for reorientation (cp. Stirling, 2019; Sztompka, 2014). These structures may be rules, habits, routines, cultures but also materiality, ecology, technology etc. (see also Bourdieu, 1977; 1996; Giddens, 1984).[53]

Does our take then present structures as an odd collection of non-agents, while obviously the properties of something like socio-cultural norms differ from those of a technological artefact such as a traffic light? Are not the ways in which they structure agency different? Our answer is both yes and no. No, in the sense that from a CAS perspective the collective behavior of components (such as the manifestation of social norms or

52 We might consider granting non-humans in such collectivity a 'projection' of shared collective agency.

53 We acknowledge that such a definition is still rather shallow on the role of resources, which Giddens understood to be the other part of the duality of structure, but we will return to this in Section 3.5 when we discuss the effects of power relations for systemic dynamics.

discourses) can be understood as an emergent phenomenon that exists by the virtue of a non-linear superposition of pluralities of components. Therefore, at the core such structures are not made up of different 'ontological building blocks' from, for example, ecological components or technological artefacts. Different structures are merely manifested across different scales. This helps in our view to further explicate that structures *are "irredeemably concrete, temporalized and spatialized and have no meaning outside the context of specific agents"* (Jessop, 1996: 126). Simultaneously, yes, there is obviously a qualitative difference in the mechanisms through which such collectivities structure agency (and in turn, how agency affects such collectivities) compared to agent-agent interactions or single agent-structure interactions. Acknowledging these differences is important for understanding how such interactions do or do not generate transitional macro-scale dynamics. But first, we turn our gaze to the concept of power.

3.4 POWER IN COMPLEXITY

While some (anthropocentric) scholars seemingly equate the concepts of power and agency in CAS, or not explicitly discuss their relation (see e.g. Cudworth and Hobden, 2013; De Haan and Rotmans, 2018; Westley et al., 2013), we contend that there is an important ontological difference between them. While understanding agency as a capacity of components, we conceive power as an emergent and productive phenomenon that is embedded in relationships. Stirling (2019) provides a useful starting point in disentangling and relating these concepts by conceptualizing power as *"asymmetrically structuring agency"*. Yet, he does not explicitly point out how such an understanding can be operationalized in CAS, nor where (by or through whom or what) it is located.[54] In order to contribute to such an operationalization, we turn to the aforementioned debates on power in transitions: on its relational nature and on the role of non-humans.

3.4.1 Debating power: Relationality and non-humans

Let us first briefly explore the context of these debates on power in transitions, by looking at the longstanding tradition of scholarship on power. Answers to the question what power entails are manifold (Lukes, 2005: 30) as the concept is essentially contestable. Arts and Van Tatenhove (2004) argue that literature generally distinguishes three different manifestations of power: (1) dispositional power (2) relational power and (3) structural power. Dispositional power refers to the power resources of actors (such

54 That is understandable as his goal seems to be to provide general description that offers an 'umbrella understanding' of manifestations of power, and he argues that the *"necessity in any given situation always to be more precise about the particular aspects and dimensions of power that come to the fore, is not necessarily impeded by a general heuristic framework like this"* (Stirling, 2019: 4)

as knowledge, money, charisma, expertise) as well as to actors' positions in social arrangements that shape their capacity to act (Arts and Van Tatenhove, 2004; Clegg, 1989). The second manifestation - relational power - refers to the capacity to influence other actors as well as the capacity to shape structures[55], and thus to achieve outcomes (Dahl, 1957). It may also be understood as the famous 'second face' of power: the capacity to influence the decision space of others in non-decision making (Bachrach and Baratz, 1962). Goehler (2000) further divides relational power into intransitive power (where power is exerted to achieve outcomes as a joint effort by multiple actors to benefit the community) in contrast to transitive power (where there is a zero-sum game and where power is deployed by actors at the cost of others). Drawing on Giddens and Bourdieu, Arts and Van Tatenhove (2004: 351) define their third manifestation of power, structural power, as *"orders of signification, legitimization, and domination, which are materialized in discourses as well as in political, legal and economic institutions of societies".* Lukes' notorious third dimension of power suggests that structural power is the power to influence the psychology (and thus the interests) of others through structures (Lukes, 2005), echoing Foucauldian ideas on power through domination and discourse (Foucault, 1978).

There are of course many different ways to categorize debates on forms of power. What Haugaard (2002) calls 'consensual' dimensions of power concern 'power-with', where power can build bridges and dialogue between different interests (Kanter, 1979; VeneKlasen et al., 2002). This contrasts with so-called 'power-over' conceptualizations that are concerned with conflict and domination (see e.g. Berger, 2005; Dahl, 1957). 'Power from-within' then focuses on a sense of capacity and self-worth and is related to empowerment (VeneKlasen et al., 2002). Avelino and Rotmans (2011) however argue that in spite of such nuances, most scholarship conceives manifestations of power either as 'power-to' (as a capacity) or 'power-over' (as a relationship).

This last point highlights the debate on the relationality of power. There is an uncomfortable dilemma (cf. Ahlborg and Nightingale, 2018): the same concept (power) cannot logically be both an attribute of entities (capacity) as well as a product of the relationships between those entities, in which it is embedded. We follow Ahlborg and Nightingale (2018) and with them, the likes of Cooper (1994), Allen (2008) and Foucault (1978) in siding with the (increasingly adopted) relational turn in the study of power. We understand power to be relational and *"incorporated in numerous practices"* (Barrett, 1991: 135), embedded in (social) relations or, in complexity jargon, in the interactions between components. In this tradition, power is seen as productive, meaning that it

55 Note that this conceptualization of 'relational power' still conceives power as a capacity!

"shapes, creates and transforms social relationships, practices and institutional arrangements" (Cooper, 1994: 437). This productive view is echoed in recent work in transition studies, which views power not just as dominating or constraining, but also as a force enabling, or contributing to, processes of transformation (see e.g. Avelino and Rotmans, 2011; Ahlborg, 2017; Castán Broto, 2016; Geels, 2014; Hoffman and Loeber, 2016). We contend that such a relational understanding helps to distinguish power from agency and to clarify how structure, agency and power can be considered to co-constitute systemic dynamics in complexity.

The second debate concerns the role of non-humans in power dynamics. As we attribute agency to heterogeneous networks depending on how these networks act, it makes sense to acknowledge the role of non-humans in power relations. Even those who reject attributing agency to non-humans, consider *"non-human objects [to] have causal powers that make a vital contribution to the causation of social events"* (Elder-Vass, 2008: 471) or to have *"impact on their surroundings (that is, have consequences for them)"* (Hornborg, 2017: 98). It is in that sense that we consider non-humans (either by themselves or acting in heterogeneous networks) to appear in power relations where they structure the agency of other components, and exert causal influence on systemic dynamics. Considering such heterogeneous networks is important as multiplicities of interactions can lead to *"broader and more elusive mechanisms and processes whereby power relations are (re)produced, beyond the exercise of power by individuals"* (Ahlborg and Nightingale, 2018: 385).

3.4.2 Relating power to agency in complexity

We consider power to be embedded in the relations between components and to structure their agency. Power, in other words, emerges from interactions. The constitutive or structural dimensions of power (Ahlborg, 2017; Allen, 2016; Foucault, 1978; 1980; Grin, 2010; Hoffman, 2013; Meadowcroft, 2011) point to the fact that power has an intensity as well as a directionality (Stirling, 2019). The capacitive concept of agency then refers to the potential of components to reorient dynamics as the product of internal properties of the components and their interactions. The difference between components as structures and components as agents lies in the simple fact that, even though they are both components able to engage in (power-laden) interactions, in contrast to agents, structures lack the ability to engage in processes of reorientation. This is in line with our take that agents and structures, ontologically considered, are not dialectically opposed discrete categories. Rather, agency is a situated and continuous property that can be attributed to some components but not to others.

An understanding of power that considers interactions of entire networks of components (and their emergent properties) with (the agency of) other components, is similar to the concept '(force) field' in practice approaches (see Ahlborg and Nightingale, 2018; Bourdieu, 1996; Bourdieu and Wacquant, 1992; Hoffman, 2013; Nuijten, 2005). The different faces, manifestations or dimensions of power in this view are different types of 'forces' acting upon the (collective) agency of components. Structural or constitutive forms of power entail the emergent behavior of a collectivity of components acting upon an agent as a force-field. Other forms of power can be considered force-like too. For instance, power relations can reconfigure the agency of human actors (e.g. influencing their decision space), or they can act upon structures and as such, indirectly act upon the interactions of those structures with other agents.[56]

In Figure 3.1, we visualize this conception of structure, agency and power in CAS and in several simpler subsystems. It shows how power relations emerge between human actors (Fig. 3.1a); how non-human components act as conditions for agency, thus co-constituting agency of components through structure-agency interactions (Fig. 3.1b); how collective embedded agency arises (for example in organizations, governments or ecosystems) as a consequence of the power relations between non-humans and humans, as well as how such collective emergent behavior of networks can be considered to result in an agentic component (Fig. 3.1c); and finally, how power relations of several constellations (each consisting of agentic components, human agents and non-agentic components) can be considered to constitute a CAS. In such a system the political dynamics is governed through multiplicities of non-linear interactions, embedded and situated agencies, historically dependent power relations, structuration of agency, and constellational self-organization (Fig. 3.1d).

56 This builds on the notion that forces can both exist in the interactions between two or several components (agent-agent, agent-agent-agent or agent-component) as well as between multiplicities of components through force-fields (agent-network).

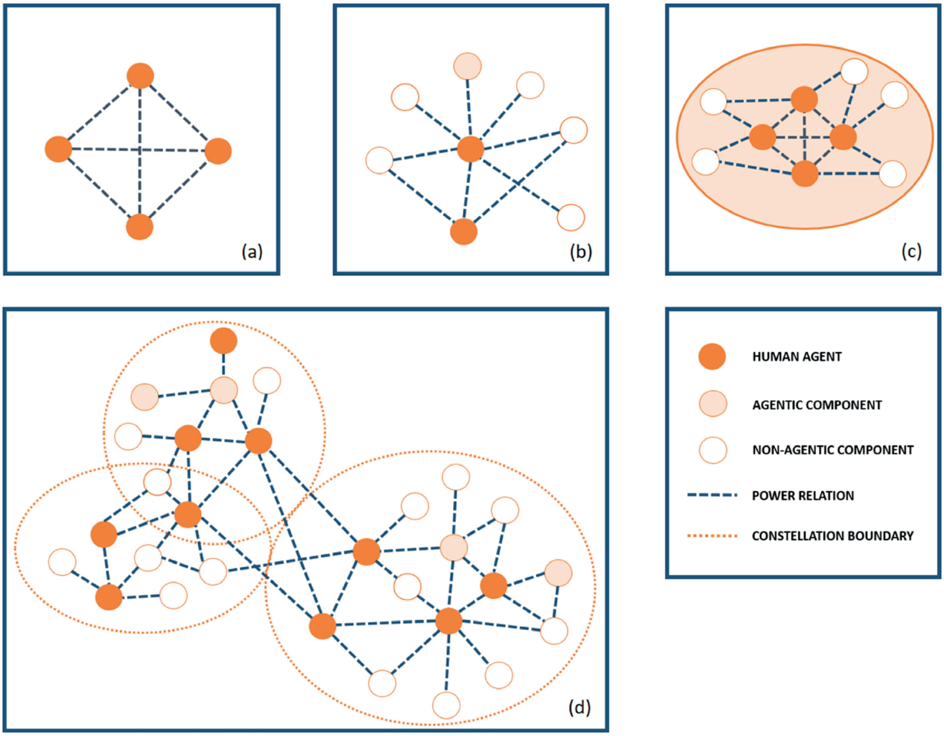

Figure 3.1 | Schematic visualization of structure, agency and power in complexity. Specified for several (sub)systems: (a) power relations between human actors; (b) structure-agency interactions; (c) collective embedded agency in agentic components such as organizations and finally (d) power relations in several constellations (each consisting of agentic components, human agents and non-agentic components) that can be considered to constitute a complex adaptive system.

Such a relational perspective, differentiating between agency and power while allowing for a degree of symmetry between humans and non-humans, might allow us to see all the known 'colors' of power but also to see new colors, namely of power dynamics that could not properly be understood before. Our operationalization captures the capacity of human (and some non-human) agents to act, the power-laden role of materiality as well as the structural dimensions of power that can shape agency. We believe that this operationalization of power, structure and agency in CAS can be useful for exploring empirical cases as it allows for the explication of the role of non-humans in systemic dynamics. However, what it does not yet do, is help explore via which mechanisms agency and power (micro-politics) might lead to macro-scale systemic dynamics. For such an understanding, we turn to processes of powering through which power relations lead to dynamics of resources, that in turn might drive or hinder systemic transformation.

3.5 POWERING: OPERATIONALIZING THE EFFECTS OF POWER ON RESOURCE DYNAMICS

As we have argued, scholars of socio-materiality are increasingly concerned with the situatedness of power: what kind of components are involved, and through which mechanisms do their interactions lead to macro-scale societal transformations? Identifying these mechanisms has been central in the work of anthropocentric scholars of power in CAS too. Seeking to link a temporal, embedded and capacitive understanding of agency and a symmetrical, relational understanding of power to transitional dynamics, we turn our gaze to the role of resource dynamics and processes of powering. A point of departure shared by many social scientists is that the politics of system dynamics is related to (dynamics of) resources (money, people, information, natural resources, artefacts, et cetera) for agents to draw upon in social action (Dahl, 1957, Giddens, 1984, Korpi, 1985, Parsons, 1967). Complex system transformation (and systemic resilience) is often associated with the control and distribution of resources by agents or entire constellations (Van Raak and De Haan, 2017), and the resulting reproduction of unsustainable configurations (Loorbach, 2007; Rotmans et al., 2001), as well as persistent practices of social injustice (De La Cadena, 2010; Geyer and Rihani, 2010; Room, 2011). As Room (2015: 26) stipulates in his efforts to link 'micro-motivations' to 'macro-behavior', for understanding these dynamics one cannot ignore the *"efforts of different groups to occupy and control particular resources and opportunities, and the dynamics of cumulative disadvantage that then develop"* throughout a system's evolution. Therefore, linking micro-politics to macro-scale dynamics logically involves a focus on the effects of agency and power relations on the dynamics of resources.

Avelino and Rotmans (2009; 2011) effectively connect these notions, conceiving power as a capacity of human agents to mobilize resources, which can lead to transformative dynamics. However, in their aim to *"insist on power as a capacity of actors"* (Avelino and Rotmans, 2011: 801), they tend to undervalue the role of non-humans and the relational nature of power. Therefore, we propose to understand their characterizations of power as power relations that drive resource dynamics through processes of powering. These processes might be instigated deliberately or non-deliberately by human agents, but can, crucially, also result from power relations in which structures act upon agentic components. Such processes of powering can be embedded in socio-material or socio-ecological configurations (see e.g. Burns and Hall, 2012; Svensson and Nikoleris, 2018). Instead of focusing on 'who has the capacity to, or the intention to', we frame these political processes to be about what causes what, understanding powering processes as causal mechanisms (Burns and Hall, 2012). If powering is enabling agents or constellations to mobilize resources (cp. Avelino and Rotmans, 2009), it may become manifest either in the construction of new resources (innovative power) or in the deconstruction of existing ones (destructive power). An example of innovative powering could be that a sustainable start-up company, in competition with others, deploys strategic agency to contract novel innovators, which in turn would enhance its capacity to further scale-up (cp. Hoffman and Loeber, 2016). On another level, Avelino and Rotmans relate power to the distribution of resources, and think of powering as agents or constellations constituting and reproducing distributions of resources, maintaining the status quo systemic equilibrium (constitutive power), or transforming the distribution of resources by deconstructing incumbent configurations and facilitating transitional change (transformative power). This of course reflects Giddens' insight that agents may both reproduce and transform structure (Grin, 2010: 224; 233–236). Importantly, constitutive powering processes lie at the very heart of systemic incumbency and contribute to systemic resistance to change. Conversely, in our view, this emphasizes again the need to understand how non-human components engage in the power relations underlying such constitutive powering processes. On the other side, transformative powering entails processes aimed at breaking down existing (self-reproducing) dynamics through the redistribution of resources. This is interesting because it emphasizes the role of regimes in fostering transitional dynamics (see also Grin, 2020; Hoffman and Loeber, 2016). It also relates to what Avelino (2017) in later work observes when attributing power to landscape trends, in the form of 'macro-scale reinforcive power' (structural power exercised by actors – cp. Grin, 2010) and 'macro-scale transformative power'.

We suggest that such processes of powering by themselves do not always lead to the creation or destruction of resources, nor do they inevitably effectively constitute or transform current resource distributions. Instead, they can also shape the distribution of pathways through which actors and constellations draw upon resources. These pathways are related to the aforementioned force-field interpretation of power, resulting from emergent collective behavior of larger networks of components. Such pathways describe dynamics that transition scholars attribute to the systemic 'landscape' or 'environment'. For instance, structural powering might entail the effect that an increased CO2-concentration in the atmosphere (and associated consequences for ecologies and public opinion on climate change) leads to a decreasing number of pathways for coal-based constellations to influence resource-dynamics. One can imagine that for a windmill production facility the same trend has the opposite effect. In this case, thus, this structural powering works path-enabling.

In sum, building on the work of Avelino and Rotmans (2009) as well as on a Giddensian interpretation of structural manifestations of power, we consider three mechanisms by which power relations influence system dynamics, namely via powering processes of (1) resource mobilization, (2) resource distribution, and (3) distribution pathways. Those mechanisms are related in the sense that they are, potentially, each other's derivative. Furthermore, in empirical reality they are likely to co-exist, interact, hinder or reinforce one another. Obviously, the nature of these powering processes heavily depends on the 'starting point' of resource distributions. If in a particular situation agents or constellations have many resources at their disposal, contributing to their strong capacity for reorientation (agency), the resulting powering processes are different than if agents lack resources, and their capacity for reorientation is constrained by incumbent power relations. This history-dependent role of resources is important, as resource dynamics are both the medium (ex-ante) and outcome (ex-post) of the powering processes. Such a view mirrors a Giddensian interpretation of the role of resources in social dynamics.

The implications of such a perspective on power are spelled out in Table 3.1, presenting 'three orders of powering' in a way that connects the work of Giddens (1984) to that of Avelino and Rotmans (2009). In this framework, the manifestations as identified by Avelino and Rotmans (2009) are interpreted not in their sense of power as a human capacity to act, but as processes of powering embodying the effect of power relations in heterogeneous networks. This is complimented by an order of powering on 'distribution pathways' based on a Giddensian interpretation of structural power.

Table 3.1 | Overview of (empirically observable) effects of power, categorized in three orders of powering, and regarding their relation to resources. Based on the work of Avelino and Rotmans (2009) and Giddens (1984).

	Order of powering		
	Mobilization	Distribution	Distribution pathways
Relation to resources			
Constructive	Innovative	Constitutive	Enabling
Desconstructive	Destructive	Transformative	Constraining

3.6 IMPLICATIONS AND CONCLUDING REMARKS

The aim of this chapter was to embed socio-material insights into the nature of societal dynamics in frameworks for analyzing transitions in CAS. To that end, we have constructed an operationalization of agency, power and powering as different facets of the 'politics of complexity'. We drew on various strands of work on the politics of societal transformation, seeking to contribute to an understanding of how to coherently connect agency, power and powering in the analysis of transitional dynamics. Our operationalization does so, we claim, in three ways.

First, we believe that our operationalization leaves open the possibility of established transition study frameworks such as the MLP as well as practice approaches to co-exist with CAS frameworks. By this, we do not mean that all theories can be reduced to a 'Grand Theory of Complexity', but we do see many opportunities for synergies between schools of thought. For example, within the MLP, scholars could consider how powering processes stabilize the dynamics of deeply connected (or institutionalized) networks of components (regimes). They could also study the emergence and dynamics of novel networks (niches), for instance by understanding how novel technologies or social innovations restructure power relations in existing networks. This relates to the literature on social practice approaches to conceptualizing transformative change (Genus and Coles, 2008; Hoffman and Loeber, 2016; Loeber, 2020; Schatzki, 2011; Shove and Walker, 2010). If one investigates how micro-scale dynamics are embedded in, as well as result from power relations between human components and their surrounding networks, in fact one is, arguably, studying practices. This implies that our operationalization allows for considering both hierarchies and structuration as well as human agency and micro-scale practices, depending on the perspective given primacy in the empirical analysis at stake.[57]

Second, we believe that our rather formal operationalization of the politics of complexity might contribute to modeling systemic dynamics. After all, structures and agents are both conceptualized as (networks of) components, meaning that their ontological building blocks are similar, while their properties vary greatly depending on their internal arrangement as well as their situated context. This enables us to differentiate between the concept of structures as the 'emergent properties of collectives of (human) components' and structures such as material artefacts. Both are 'structures', but the way they interact with agentic components can be different. Those interactions we also perceive as a matter of collectivity and therefore as emergent collective properties, instead of merely considering the social, ecological or material nature of the components involved. Conceptualizing power as a force that structures agency and that emerges from the interactions of components further formalizes these relations. This is important as there is an urgent need to combine qualitative and quantitative research approaches in the field of transition studies, so as to better understand and influence sustainable transformation (Köhler et al., 2019; Turnheim et al., 2015).

Third, the operationalization presented here directs the gaze to resource dynamics, which are better observable in empirical work than more abstract conceptualizations

57 Recent work by Geels (2020) also aims to bridge the gap between micro-scale and macro-scale dynamics, by connecting a multi-dimensional perspective of (human) agency to the MLP. It does not however explicitly couple agency to power.

of power and agency. This observability is an important practical reason to focus on resources in the final part of our operationalization. We consider our operationalization an explicit invitation to scholars to engage in empirical work to test our claims.

The work presented here also holds implications for future (research) policy. Not only are policy-making systems themselves complex, they also deal with problems that are increasingly acknowledged to be fundamentally complex 'beyond wickedness', in terms of radical uncertainty (Stirling, 2010) and system stability (Arkesteijn et al., 2015, cp. Rittel and Webber, 1973). The complexity paradigm that emphasizes how societal systems involve non-linear self-organizing dynamics of heterogeneous networks has therefore recently gained ample attention in the field of policy studies (Cairney, 2012; Geyer and Cairney, 2015). We see at least three policy implications of a material-relational understanding of politics in complexity. First, the transformative capacity of organizations, countries, or constellations does not only depend on the agency of human actors, but rather on the collective agency of the networks in which material and ecological factors can seriously affect the capacity for reorientation. This has implications for facilitating processes of powering that favor transitional dynamics. Importantly, human actors aiming at societal transformation can creatively draw upon the potential capacity for reorientation among the networks' ecological and material dimensions. As such, they could (non-linearly) enlarge the potential for systemic transformation. This is also relevant for efforts to facilitate nature-based solutions and local transformations drawing on the transformative potential of local spaces and ecologies (see Eggermont et al., 2015; Nesshöver et al., 2017). Second, efforts toward learning and reflexivity should be targeted not only to human agents, but to constellations as a whole (cp. Loeber and Laws, 2016). To be sure, learning is a key element of transition experiments (Grin, 2010; Huitzing et al., 2020; Loorbach, 2007; Voß and Bornemann, 2011) that however often fail to address the need of building transformative capacity in entire systemic constellations. This is needed to enhance the resilience of power relations that 'hold together' sustainable constellations, by deepening their institutionalization (thus solidifying those power fields) and enhancing their collective agency, while at the same time disrupting constitutive powering processes that reproduce unsustainable resource distributions. In this way, our work could also inform transdisciplinary processes of experimentation for sustainable transformation, helping to outline more precisely how, as researchers, we are part of the systems we aim to understand and transform (see e.g. Den Boer et al., 2021a; Fazey et al., 2018). This points, thirdly, to the possibility to clarify how agency of researchers and their power relations are being shaped by structural and material dimensions of incumbent research and innovation systems (see e.g. Fazey et al., 2018a; Kok et al., 2019). The need to explore these inter-systemic connections is also echoed in recent calls to study underlying mechanisms constituting multi-systemic incumbency in work on Deep Transitions (Schot and Kanger, 2018). Recently, attention is given to how such experimentation can be facilitated through policy mixes and transformative research and innovation policies (Rogge et al., 2017; Schot and Steinmueller, 2018).

To be sure, our contribution leaves many questions unanswered, not only on the level of ontological and epistemological stances in the social sciences but also in terms of how our operationalization can inform empirical research. Our hope is that others will consider this chapter as an explicit invitation to empirically study and theoretically reflect upon the conceptualizations that we offer. In that way, we can further advance our understanding of the politics of complexity and the complexity of politics.

CHAPTER ACKNOWLEDGEMENTS

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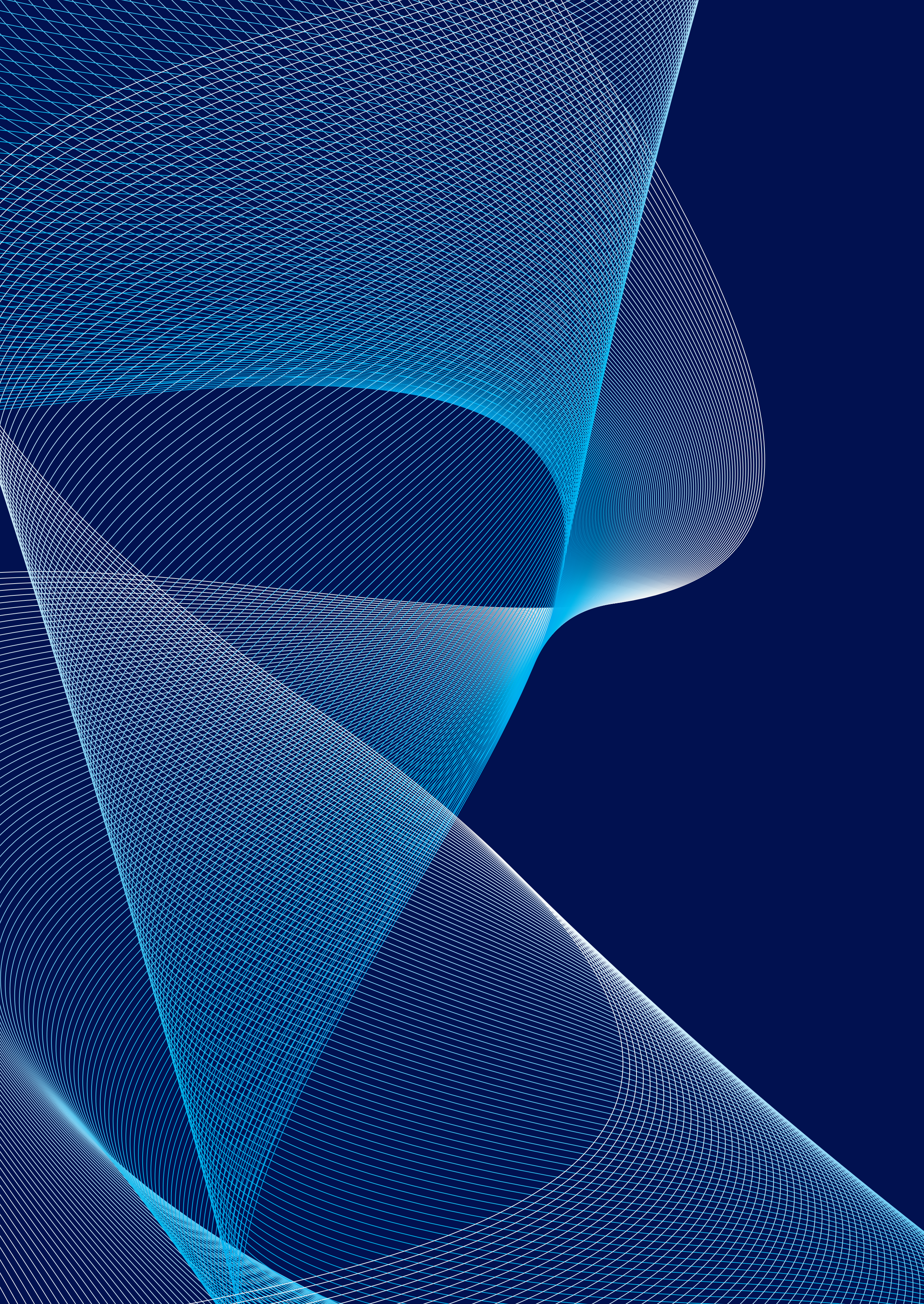

4

Deepening democracy for the governance toward just transition in agri-food systems

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ABSTRACT

In this chapter, we explore the relation between democracy and justice in governing agri-food transitions. We argue that a deeper understanding of democracy is needed to foster just transitions. First, we present a multi-dimensional understanding of justice in transitions and relate it to scholarship on democratizing transitions. Then, we argue that three paradigm shifts are required to overcome current unsustainable dynamics: (1) from expert toward pluralist understandings of knowledge; (2) from economic materialism toward post-growth strategies; and (3) from anthropocentrism toward reconnecting human-nature relationships. We explicate what these paradigm shifts entail for democratizing transitions from distributive, procedural, recognition and restorative justice perspectives. Finally, we highlight six challenges to institutionalizing deep democratic governance. These entail balancing tensions between: multiple justice dimensions, democracy and urgency, top-down and bottom-up directionalities, local and global scales, realism and idealism, and roles of incumbent scientific systems. This requires thoroughly rethinking transition studies' normative and democratic ambitions.

4.1 INTRODUCTION

In order to stay within planetary boundaries and combat the world's most pressing challenges such as climate change, biodiversity loss, malnutrition and social inequalities, there is an urgent need to foster transitions toward healthy and sustainable agri-food systems (Rockström et al., 2020; Willett et al., 2019). The field of transition studies offers tools and guidance for both understanding and governing long-term processes of structural systemic change[58] (see Grin et al., 2010; Köhler et al., 2019; Markard et al., 2012 for overviews of the field). Transition scholars use a wide variety of analytical frameworks and perspectives in analyzing the stasis and (transformative) dynamics in agri-food systems (El Bilali, 2020; Melchior and Newig, 2021). In that way, transition scholarship provides insights into multi-level dynamics that can result in diverse transition pathways, i.e. the scale-dynamics of novel agri-food grassroots innovations such as agri-food networks (Darrot et al., 2015), the role of consumer and producer practices in pathways of agroecology and diversified food traditions (Ely et al., 2016; Spaargaren et al., 2013), and the role of agency and values in food transitions (Rosin et al., 2017; Vivero-Pol, 2017). Yet, governing highly complex systems like agri-food systems is challenging as complex systems exhibit non-linear, co-evolutionary and multi-level dynamics (Rotmans and Loorbach, 2009; Zhang et al., 2018) that lead to locked-in system states (Geels and Schot, 2007) and undesirable resilience (Oliver et al., 2018). This requires adaptive, reflexive and pluriform governance efforts that confront fundamental inequalities and redirect vested power relations that stabilize status-quo configurations (Kok et al., 2021a; Rossi et al., 2019; Sievers-Glotzbach and Tschersich, 2019; cf. Grin et al., 2010).

In that light, transition scholarship points to the need to explore justice dimensions of large-scale transformation processes (e.g., Köhler et al., 2019; McCauley and Heffron, 2018; Williams and Doyon, 2019). While justice is a contested concept, scholars argue there are many different dimensions of social justice such as (1) distributive justice; (2) procedural justice; (3) recognition justice; and (4) restorative justice (see i.e. Fraser, 1998, 2010; Jenkins et al., 2016; Kaljonen et al., 2021; Kortetmäki, 2016; McCauley and Heffron, 2018). The concept of just transitions is rapidly getting traction in the field, but it *"has been tackled more explicitly in the energy transitions stream of literature"* (Köhler et al., 2019: 16, cf. Jenkins et al., 2016; McCauley and Heffron, 2018). At the same time, the broader scholarship on environmental sustainability of agri-food systems has provided ample insights on topics such as food justice, environmental justice, ecological justice,

58 Transition studies offers plenty of insights into the multi-level co-evolutionary dynamics of socio-technical systems through frameworks such as the Multi-Level Perspective (see Geels, 2002; Geels and Schot, 2007), the Technological Innovation Systems approach (see Bergek et al., 2008a) and social practice approaches (see Shove and Walker, 2007).

food sovereignty, and food democracy (Smaal et al., 2021; Whitfield et al., 2021; Pickering et al., 2020; Celermajer et al., 2021; Moragues-Faus, 2017; Loo, 2014; Allen, 2010). It is argued that synergies between these developments could be further explored and that the role of justice in agri-food transitions deserves explicit attention (Hebinck et al., 2021a; Tribaldos and Kortetmäki, 2021; 2022; Kaljonen et al., 2021).

A second and related point of departure in this chapter concerns the need to strengthen the role of democracy in, and efforts of democratizing governance of, sustainability transitions. Calls for democratizing transition governance have emerged in last decades (e.g., Chilvers and Longhurst, 2016; Hendriks, 2009), which does not only involve democratization of the state as an institution (cf. Pickering et al., 2022), but also entails enacting transitions through multi-actor co-production in research and innovation (e.g., Norström et al., 2020; Fazey et al., 2018a; Lang et al., 2012; Stirling, 2008) or efforts of deliberative policy making (e.g., Hendriks and Grin, 2007; Hajer, 2003). In light of the comprehensive nature of changes required for just agri-food transitions and widespread political apathy, rethinking democracy is essential in order to meaningfully engage various groups in these processes of transition. As Pickering et al. (2022: 10) stress in a review on the relation between democracy and sustainable transformation, democratization is important as *"deepening the quality of democracy across all scales of governance is likely to foster sustainability transformations"*, especially as this might *"help to counterbalance the powerful forces that pose roadblocks to sustainability, including neoliberal and extractive states and unregulated markets".* Democracy as a concept is strongly entangled with conceptualizations of justice, but mostly framed within a 'procedural' dimension of justice that is different from, and can be in contrast to other (outcome-oriented) forms of social justice (e.g. distributive, recognition or restorative justice dimensions). As we will argue in this chapter, more deeply exploring the highly political nature of 'democratizing' transformative processes (see e.g., Turnhout et al., 2020; Chilvers and Kearnes, 2020; Kok et al., 2021b) can provide a rich and dynamic picture of the interdependencies between multiple dimensions of justice, which in turn could provide guidance on how governance efforts could further contribute to just transitions.

In this chapter, we therefore set out to more deeply explore the relation between democracy and justice in the governance of transitions in agri-food systems and argue that a deeper understanding of democracy might help to foster just transitions. As an analytical focal point for advancing our argument we build on transformation studies in recognizing that fundamental transformations toward sustainability require addressing deep leverage points; points of intervention where (small) alterations can initiate comprehensive change processes throughout the system (Abson et al., 2017; Meadows, 1999). Hence, building on Sievers-Glotzbach and Tschersich (2019), we argue that three paradigm shifts in governance efforts are required to overcome current unsustainable dynamics: (1) from expert toward pluralist understandings of knowledge; (2) from economic materialism toward post-growth strategies; and (3) from anthropocentrism toward reconnecting human-nature relationships. Confronting these paradigms entails a thorough rethinking of transition studies' normative and democratic ambitions. Throughout our analysis we will therefore explicitly link and reflect upon the relation between democratization and justice from the perspective of these paradigm shifts. In this way, we aim for mutual enrichment of the debates around justice and democracy and derive concrete implications for transition governance efforts.

This chapter is structured as follows: In Section 4.2, building on the wider literature on justice in transitions (e.g., Fraser, 2007; Jenkins et al., 2016; McCauley and Heffron, 2018), we elaborate on the multi-dimensional concept of justice in sustainability transitions by highlighting four dimensions of justice (procedural, distributive, recognition, restorative). In Section 4.3, we build on insights from political science and Science and Technology Studies (STS) to deepen our understanding of democracy and efforts to democratize transition governance. In Section 4.4, we bring together these insights and relate a deepened understanding of democracy with a multi-dimensional perspective on justice in agri-food transitions. We reflect upon these insights from the perspective of the three paradigm shifts. In our discussion in Section 4.5, we present six challenges for institutionalization of deep democratic efforts for just agri-food transitions and we point to directions for future research.

4.2 JUSTICE IN TRANSITIONS

The concept of 'just transition' originates from the labor and environmental justice movements' call to consider the economic and employment effects of environmental regulation. The concept was later taken up by climate activists (Stevis and Felli, 2020) and debates on environmental and ecological justice (Pickering, 2019; Schlosberg, 2013; Walker, 2009). Within the field of transition studies, however, it has so far mainly been discussed in the literature on climate and energy transitions (Heffron and McCauley, 2018; Jenkins et al, 2018;). It is argued that further exploring just transitions in agri-food systems is needed (Hebinck et al., 2021a; Whitfield et al., 2021; Kaljonen et al., 2021).

While just transition as a concept remains contested with diverging understandings across these fields (Stevis and Felli, 2020), it is widely acknowledged that just transitions need to be multidimensional and need to reach beyond distributional manners to include social and cultural values and contextual factors of decision making. While acknowledging that other conceptions exist, we consider the following four dimensions of justice highlighted in different combinations in the justice and transition literature: distributive, procedural, recognition and restorative justice[59] (see i.e. Fraser, 1998, 2010; Jenkins et al., 2016; Kaljonen et al., 2020; Kortetmäki, 2016; McCauley and Heffron, 2018). These dimensions embrace that a broad understanding of justice requires reaching beyond mere considerations of distributive justice, and needs to include a participatory and representational dimension as well. Hence this considers both procedural and substantive or outcome-oriented levels of justice (Fraser, 1998; Kortetmäki, 2016). Especially the procedural and recognition dimension highlight the who and how of justice, and therefore allow to critically review politics of framing and issue-setting (Kortetmäki, 2016). Moreover, recognition and restorative justice emphasize the relational nature of justice and put a special emphasis on non-humans (see McCauley and Heffron, 2018; Kaljonen et al., 2021). While the dimensions of justice are conceptually and analytically separate, they are intertwined and overlap in practice (Kortetmäki, 2016).

Distributive justice refers to the fair allocation of material and immaterial harms and benefits but also associated responsibilities of transitions (see Jenkins et al., 2016; Kortetmäki, 2016; Walker, 2009). It highlights the outcome and therefore economic and material dimensions of justice, and helps to assess how benefits and inequalities are distributed. Distributive justice requires to consider the diversity of contexts and (the intersectionality of) identities to ensure distributive justice on a global level, and identify where the most vulnerable and affected communities are and how they can be accounted for (Jenkins et al., 2016; McCauley and Heffron, 2018). With regard to just agri-food transitions, this dimension emphasizes the distribution of risks and benefits associated with large scale changes in the agri-food system, in particular the distribution of access to and security of healthy and nutritious food, land, income, employment, ecosystem services etc. (Tribaldos and Kortetmäki, 2021; Whitfield et al., 2021). Due to the complex, global interlinkages of agri-food systems and their potential effects on future generations, just distribution also requires to consider perspectives and prospects of such ‘distant voices’, unable to directly participate in governance processes of agri-food transitions (Tribaldos and Kortetmäki, 2021, Whitfield et al., 2021). Distributional justice has a rights-based dimension as the rights to food and be free from hunger are recognized under international law (Whitfield et al., 2021).

59 Well established is a three-dimensional view of justice including distributive, recognition and representational justice (Fraser, 1998, 2010; Jenkins et al, 2016; Kortetmäki, 2016). Additionally, we argue that it is essential to consider restorative justice, highlighted for instance by McCauley and Heffron (2018), Timmermann (2020) or Kaljonen et al. (2021). Other dimensions have been proposed as well, for instance contributive justice (Timmermann, 2020), historical justice (Whitfield et al., 2021) or cosmopolitan justice (Kaljonen et al., 2021).

However, as emphasized by Loo (2014), food justice needs to reach beyond a distributional perspective to also include participation and just representation. These aspects are highlighted in procedural or representation justice, which focus on participatory parity, hence the ability of (affected) stakeholders to participate equally and in a non-discriminatory way in decision-making. It should provide equal opportunities for different groups, especially those most affected and vulnerable, to participate and be heard in decision-making (Kortetmäki, 2016). This also includes the right of people to define their own agri-food systems. Hence, institutions from the local to global level are needed that do not restrict, but rather allow for and support communities in working toward self-determined agri-food systems on the ground, as emphasized also in food sovereignty (Patel, 2009). Therefore, procedural justice entails political and participatory aspects of justice, such as appropriate procedural rules and institutions (Jenkins et al., 2016; Kortetmäki, 2016) that can ensure a meaningful participation and inclusion of affected people and communities. Moreover, possibilities for representing non-humans in processes of decision-making should be considered (e.g., Eckersley, 2017; Brown, 2018; Celermajer et al., 2021). Participatory justice points to issues of power, as typical forms of participatory injustice are misrepresentation, misframing or injustice in processes of frame-setting (Fraser, 2010).

Recognition justice entails the fair consideration and respect for different views or values (Fraser, 2010; Jenkins et al., 2016; Kortetmäki, 2016), based on complete and equal political rights (Schlosberg, 2013). Misrecognition would then entail cultural domination, non-recognition or ignorance, and disrespect or disregard (Fraser, 2010; Jenkins et al., 2016; Kortetmäki, 2016). This dimension calls to acknowledge divergent perspectives in social, cultural, ethnic, racial and gender differences (Fraser, 1998; Jenkins et al., 2016; Schlosberg, 2013). Claims for recognition justice can be evaluated with regards to two criteria: the effects of recognition between groups and within groups; hence recognition of one group may not impede equality of other groups (Kortetmäki, 2016). A neglect of recognition justice can lead to the dismissal of important (Indigenous) perspectives or arguments in transition governance and international negotiations (Celermajer et al., 2021; Kortetmäki, 2016). For instance, the UN Food Systems Summit (UNFSS) 2021 has been critiqued by various stakeholders for excluding already marginalized voices, and instead being captured by corporate interests and narratives (Canfield, Anderson et al., 2021). This also relates to challenges in securing procedural justice in design and implementation of the UNFSS, for instance regarding a lack of transparency on the decision-making process (Egermann et al., *forthcoming*).

Moreover, restorative justice has been identified as a particularly important dimension of justice, as it can highlight the need to compensate for harms done not only to individuals or communities but also the environment (Dorsey, 2009, Fox et al., 2016) and the climate (Bernstein, 2016, Posner and Sunstein, 2008). While originally construed as a way to compensate for job losses associated with transitions from fossil to renewable energy (McCauley and Heffron, 2018), it is now more broadly understood, with the aim to repair past damages and redress historical injustices (Whitfield et al., 2021) and to identify where prevention is needed to avoid future harms and account for unforeseen harms throughout processes of transitions (McCauley and Heffron, 2018). This includes not only material reparations for social or environmental damages, but it also has a relational focus on restoring trust and social cohesion after wrongdoings have occurred (Kaljonen et al., 2021; Timmermann, 2020). This is also the case when just distribution cannot be achieved in a satisfactory manner in current transition processes due to *“the highly differentiated exposure and vulnerability of affected actors”* (Kaljonen et al., 2021: 479). For instance, the effects of climate change on agri-food systems have diverse effects across regions and will most strongly affect already vulnerable communities in the Global South (FAO, 2016; FAO et al. 2018). In the context of agri-food transitions, restorative justice could potentially provide an entry point to strengthen decolonial and post-development perspectives in the environmental justice discourse, for instance by allowing for a critique of equal distribution of harms and benefits based on Western understandings of progress, addressing (racial, gender etc.) injustices embedded in current institutions or accounting for past dispossessions (see Álvarez and Coolsaet, 2020; Escobar, 2015). Linking social processes of remediation to environmental restoration (McCauley and Heffron, 2018) can spur just transitions due to improved relations and enhanced trust among actors by rectifying past injustices.

While having distinctly different foci, different dimensions of justice are strongly interlinked. To ensure fair democratic governance processes, distributive, recognition and restorative justice must also be assured. Meaningful participation of stakeholders requires respecting minimum human and participation rights such as free speech and the recognition of various voices and cultural realities to be effective and just. Additionally, for instance, the respective means with regard to time and financial resources are needed, otherwise less privileged groups are often excluded from (time-consuming) processes of decision-making. Conceptions of democracy are incorporated most evidently within the procedural justice dimension. However, as we will argue throughout this chapter, better understanding the complex interrelations between democratization and multiple dimensions of justice might help to provide avenues for transition governance. Before further exploring the relation between justice and democracy in agri-food transitions, let us first develop a more detailed understanding on the role of democracy in the governance of transitions.

4.3 DEMOCRATIZATION OF TRANSITION GOVERNANCE

In this section, we set out to deepen our understanding of efforts to democratize transition governance by first reiterating some key characteristics of transition governance approaches, after which we more thoroughly explore different ways of ‘doing democracy’ in sustainability transitions.

In efforts to combat incumbencies (e.g., Stirling, 2019) and undesirable resilience (e.g., Oliver et al., 2018) of unsustainable and locked-in socio-technical systems (e.g., Geels and Schot, 2007), and to help foster transformative innovations and sustainability transitions, various governance approaches[60] that bridge the gap between knowledge and action (cf. van Kerkhoff and Lebel, 2006) have emerged in recent decades (see overviews by Grin et al., 2010; Köhler et al., 2019; Scoones et al., 2020). While different in scope, focus and underlying philosophy, these approaches share deep commonalities in embracing normative directionalities toward sustainable transformation, focusing on stimulating experimentation, including societal stakeholders in research, innovation and policy making while fostering deliberation, learning and reflection among participating actors. Approaches include for instance Transition Management (Rotmans and Loorbach, 2009); Strategic Niche Management (Kemp et al., 1998); adaptive governance (Folke et al., 2005); reflexive governance (Voß and Bornemann, 2011); deliberative policy making (Hajer, 2003); transdisciplinarity (Lang et al., 2012) and the pathways approach (Leach et al., 2010a,b). They are applied in a wide variety of spaces and contexts, such as Transition Arenas (Loorbach, 2007), (Urban) Living Labs (Hossain et al., 2019; Bulkeley et al., 2016), Real-World Laboratories (McCrory et al., 2020) and socio-technical experiments (see Sengers et al., 2019). Serving as guiding principles rather than blueprints, transition and transformation scholars argue that pluralities of enabling, structural and systemic governance approaches need to be fostered and creatively combined in order to effectively act upon different scales and leverage points to foster sustainable transformation across a wide variety of societal systems (Abson et al., 2017; Scoones et al., 2020; Sievers-Glotzbach and Tschersich, 2019).

There are several arguments for deploying more deliberative and inclusive approaches (see Schmidt et al., 2020 for a recent overview). First, there is a substantive argument stressing that outcomes of multi-stakeholder processes are more effective in catalyzing transformations (Norström et al., 2020) and in diffusing *“innovations that better meet local needs”* (Reed, 2008: 2427). Second, these approaches help foster social learning,

60 As governance arrangements we understand the *“ensemble of rules, processes, and instruments that structure the interactions between public and/or private entities to reali[z]e collective goals”* (Termeer et al., 2011: 161).

trust and reflexivity among participating actors (e.g. Chilvers, 2013; Lang et al., 2012; Van Mierlo and Beers, 2020). Third, co-produced knowledge, innovations and policies might help create social acceptance and provide legitimacy to process outcomes (e.g., Stirling, 2008). Fourth and related, there is a normative argument: inclusive governance of (socio-technical) innovations and the potentialities for transformation they bring along strongly echo calls to *"democratiz[e] the governance of intent"* (Owen et al., 2012: 754) in line with the turn toward the democratization of science in STS (see e.g. Jasanoff, 2003; Latour, 2004; Nowotny, 2003; Reed, 2008).

The normative and democratic foundations of governing innovation and transitions move far beyond traditional understandings of liberal democracies (Wironen et al., 2019; Eckersley, 2017; cf. Brown, 2009; Latour, 2004). Rather than viewing democracy merely as an output or moment (e.g. elections), democracy can be seen as a complex and multilayered concept. Pickering et al. (2022: 2) define democracy as *"a form of political system (or polity), institution or practice where people collectively govern themselves, either through direct participation or (typically elected) representation in decision-making".* Brown (2009) stresses that democratic processes involve multiple modes of being represented, including not only (different) forms of authorization through which knowledge or power of representatives becomes legitimate and accepted by those who are represented, or ensuring (in)formal accountability of governments and institutions, but also representation through direct participation of citizens in decision-making processes with a focus on meaningful and reflexive deliberation (cf. Dryzek, 2002; Jasanoff, 2003). As Brown argues (2009: 237), modes of democratic representation exist in many shapes and degrees and require different types of facilitating institutions.

In their work on sustainable innovations, Smith and Stirling consider democratic processes to evolve around (power dynamics in) social relations and they conceptualize democracy as *"access by the least powerful to the capacities for challenging power"*, which comes to the fore especially when negotiating the directionalities of (transformative) innovations (Smith and Stirling 2018: 74; cf. Stirling, 2014). As such, democratization of socio-technical transitions often evolves around processes of participation and deliberation of citizens, publics or other societal stakeholders in transition experiments and spaces such as transformative labs to reflect upon, co-create or implement transformative (social) innovations (Kok, Gjefsen, et al., 2021; De Hoop, 2020; Wironen et al., 2019; Chilvers and Longhurst, 2016). Importantly, deliberative democratization is considered key to legitimizing transition governance and the radical changes it aspires to bring along (e.g., Wironen et al., 2019; Dryzek and Pickering, 2017). At the same time, scholars also stress that tensions can arise between transition governance approaches and institutions of (traditional) representative democracy. As transition efforts often involve decision-making through emerging (public-private) networks where not all voices are equally represented and public accountabilities of innovations are not always warranted (cf. Genus and Stirling, 2018), the democratic legitimacy of (large-scale, publicly funded) interventions deserves attention (Hendriks, 2009; De Geus et al., 2022).

In addition, the degrees to which representative liberal democratic systems and institutions themselves then need to be re- or transformed to facilitate sustainable transformation is a matter of debate (see Eckersley, 2020; Pickering et al., 2022). Proponents of *Environmental Democracy* mainly seek to reform liberal democracy by strengthening its core norms and institutions, in particular by increasing transparency and accountability of policymakers, enhancing environmental rights and values, and strengthening participation of diverse affected communities. Approaches such as *Ecological Democracy*, on the other hand, pose a more radical critique, i.e. by asserting that core assumptions such as its anthropocentric values, the short timespans of electoral cycles, the scale of the nation state or limited means of representation are insufficient to account both for democratic and ecological concerns in light of transnational environmental challenges (see Eckersley, 2020; Pickering et al, 2020; 2022).

As such, considering different degrees of democratization allows for different pathways for making transition governance more democratic, and raises the question of what forms of democratic institutions and procedures are required to enhance just transitions. At the same time, considering democracy as efforts to empower the least powerful to challenge power (cf. Smith and Stirling, 2018) also illustrates why democratization is such a tricky endeavor (see e.g. Turnhout et al., 2020). For instance, stakeholders can be ‘participating’ in transition experiments (empowering) but with a lack of accountabilities and meaningful deliberation this might effectively lead to oppression (disempowering). And what if citizens are asked to authorize the (outcomes of) transformative processes (and granting these processes legitimacy), but their perspectives and knowledge were not resembled in their design or outcomes? Such political trade-offs between elements of democratic representation beg for rethinking how democratization of transition governance can contribute to distributive, procedural, recognition and restorative justice in agri-food systems.

4.4 THREE PARADIGM SHIFTS FOR DEMOCRATIZING JUST AGRI-FOOD TRANSITIONS

Achieving agri-food transitions requires a fundamental reorganization of socio-ecological systems, challenging their underlying intents or paradigms as central levers of change (Abson et al., 2017; Göpel, 2016). In proposing a framework for a social-ecological transformation based on a comprehensive literature review and synthesis of transformation and transition research, Sievers-Glotzbach and Tschersich (2019) highlighted three incumbent paradigms[61] that need to be overcome in order to achieve fundamental transformation processes toward sustainability. These are the 'expert knowledge and specialization' paradigm, the 'materialistic culture and growth' paradigm and the 'control and autonomy of humans over nature' paradigm. In the following, we will briefly present these paradigms and argue that three respective paradigm shifts are required for just agri-food transitions: (1) From expert toward pluralist understandings of knowledge; (2) from economic materialism toward post-growth strategies; and (3) from anthropocentrism toward reconnecting human-nature relationships. In a second step, we explore what democratic implications can be derived from each of these paradigm shifts for a deepening of democracy in the governance of agri-food transitions from the perspective of the four dimensions of justice.

4.4.1 From expert toward pluralist understandings of knowledge

The 'expert knowledge and specialization' paradigm highlights underlying beliefs about right forms of knowledge creation and use that shape our scientific and socio-political systems. It is argued that a strong authority and legitimacy is attributed to scientific expertise that is implicitly considered as the most relevant type of knowledge (see Cornell et al, 2013; Goldman et al., 2018). Moreover, there is a dominance of Western standards and their scientific institutions (especially from the natural sciences) in shaping norms of knowledge creation and evaluation, at the expense of more marginalized types of knowledge such as tacit, traditional and Indigenous knowledge. In addition, scientific systems are driven by the assumption that specialization is required to solve complex societal problems (Becker, 2010; Göpel, 2016; Norgaard, 2004). In agri-food systems, this is evidenced by the strong reliance on technological and scientific knowledge at the expense of more integrated agroecological perspectives, for instance regarding breeding or cultivation methods, in multilateral negotiations around the International Seed Treaty (see Sievers-Glotzbach, Euler, et al., 2020), or during the multi-stakeholder process at the UNFSS (see Canfield, Duncan et al., 2021). This tendency is further enhanced by technological change toward digital-based farming and genome-editing (Clapp and Purugganan, 2020). Yet, evidence from (transdisciplinary) sustainability science suggests that more integrative approaches including various disciplines and societal actors are required for fostering sustainability transformations (Abson et al., 2017; Lang et al., 2012; Scholz, 2020). Addressing the complexity of agri-food transitions

61 The three paradigms were mainly derived from the Ecological Economics, Sustainability Ethics and transformation literatures (see Sievers-Glotzbach and Tschersich, 2019).

in particular hence calls for a fundamental paradigm shift beyond scientific expertise to incorporate pluralist understandings of knowledge, in order to co-create solutions that are well adapted to local realities and that are both scientifically sound and socially robust (Mauser et al., 2013; Thompson and Scoones, 2009; Turnhout et al., 2020). This requires governance approaches that embrace pluralities of knowledge (beyond technical expertise) and allow these perspectives to interrogate the incumbencies in current governance systems. That does not imply the abandonment of technical expertise, but rather requires creatively combining different knowledges and values, such as diversities of (agroecological) farmers' knowledges, local and citizen perspectives, as well as more deeply engaging with non-Western and Indigenous perspectives[62] (see Jacobi et al., 2020; Lam et al., 2020b; Sovacool and Hess, 2017).

Democratic implications of justice analysis

In light of a multidimensional understanding of justice, a shift from expert toward pluralist understandings of knowledge has several implications for the governance of agri-food transitions. A democratization of transitions needs to address procedural justice, hence it raises questions as to whose voices, values, interests and perspectives are included, and what processes should be used so that all voices are heard and included in a just manner (Hendriks, 2009; Turnhout et al., 2020). While the importance of participation and democracy is highlighted in the transition literature (Chilvers et al., 2018; Hendriks, 2009), transition management approaches in practice often privilege technical or practical expertise and innovation potential, rather than democratic inclusion or representation (cf. Hendriks, 2009; De Geus et al., 2022). Moreover, participation can be conceived as problematic as it can slow down or even hinder transitions. This perception of inclusivity as a potential barrier reflects the authority attributed to scientific expertise, which is perceived as being more effective in bringing about change processes (Hendriks, 2009; Goldman et al., 2018). At the same time, processes of co-production in transitions are highly political and can reproduce incumbent power relationships when these are not explicitly addressed (Pereira et al., 2020; Stirling, 2015; Turnhout et al., 2020). For instance, problem-setting, initiation and definition of scope for participation tend to be dominated by elite actors, such as governments, large NGOs or scientists. Elite actors often contribute from their professional roles and therefore possess more time and resources than other (marginalized) actors, and thereby their arguments are more likely to be considered as valid and important (Turnhout et al., 2020; Frantzeskaki and Rok, 2018). In a study on labs for agri-food system transformation, Kok et al. (2021b) highlight that 'doing inclusion' brings along the challenge to

62 Indigenous and local knowledge can be defined as the *"cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment"* (Berkes, 2018: 8).

consider which actors are to be included as themselves through direct deliberation and who can be speak on behalf of 'larger groups'. Hence recognition justice is important as it highlights political differences such as positions, interests, values and beliefs between participants, or ideas of what it means to be recognized. Transitions therefore should act to empower the marginalized (Ott and Kiteme, 2016), and directly confront power asymmetries, inequality and exclusion (Pereira et al., 2020). To ensure empowering transition processes, inputs to knowledge co-creation and assessment processes should be broadened by including a diversity of perspectives, methods and knowledges, and outputs to decision-making and policy should be opened up to highlight marginalized perspectives and explore hidden and alternative pathways, rather than closing down contestation and conflicts prematurely (Leach et al., 2010b; Montana, 2017; Stirling, 2015). In co-creating a framework to assess agri-food systems sustainability, Jacobi et al. (2020) show that the transdisciplinary process of co-creating knowledge between researchers and practitioners from the Global North and South in Kenya and Bolivia led to a more comprehensive interpretation of "sustainable food systems". They highlight the importance to include social-economic dimensions such as "implementation of the right to food" and "reduction of poverty and inequality", and argue this might *"help to avoid trade-offs between conflicting policy objectives"* (Jacobi et al., 2020: 9).

A deliberative take on democracy can encourage the consideration of multiple values and forms of knowledge, including the representation of nature and environmental rights (Dryzek, 2002; Eckersley, 2020; Smith, 2003). Moreover, it can provide space for communities to discuss issues and formulate their own solutions (Fung and Wright, 2001; Smith, 2003). Considering pluralist perspectives and knowledges helps to enhance experiential and social learning to derive solutions that are adapted to diverse local landscapes, environmental conditions and cultural realities, such as food preferences or local traditions (Cunningham et al., 2013; IPES-Food, 2016; Mukhovi et al., 2020). In light of restorative justice, this can prevent the further loss of traditional knowledge and lifestyles and potentially contribute to restoring declining agrobiodiversity (FAO, 2019). For this purpose, it is essential to protect and enhance deliberate, inclusive spaces across various levels of governance, for instance by strengthening the UN Committee on World Food Security in light of the (threat of) corporate capture of global food governance, and enhancing the institutionalization of (human) rights-based approaches to agri-food systems (transformation) (McKeon, 2021; HLPE, 2020). As indicated above, this deep form of engagement emphasized in the paradigm shift from expert to pluralist understandings of knowledge requires that actors have the means, with regard to time and (financial) resources, to meaningfully engage in participatory processes. Unequal resources otherwise reinforce existing power relations and affect possibilities for democratic engagement. Hence, this requires distributive justice and inherently links the first paradigm to a needed paradigm shift from growth and materialism toward post-growth strategies.

4.4.2 From economic materialism toward post-growth strategies

The ‘materialistic culture and growth’ paradigm highlights that the assumption that perpetual economic growth is needed to raise social welfare is dominant in societal and political discourses (Buch-Hansen, 2018; Escobar, 2015; Göpel, 2016; Jackson, 2011; van den Bergh, 2011). Yet, this assumption and the resulting growth dynamics are a major driver of massive environmental degradation, growing societal inequalities and negative impacts on wellbeing (Easterlin et al., 2010; Escobar, 2015; Jackson, 2011; Kallis et al., 2012; van den Bergh, 2011; van den Bergh and Kallis, 2012). In agri-food systems, this is reflected in the tendency to focus on productivity and increasing yields to tackle food insecurity (rather than for instance redistribution or food sovereignty), evidenced for instance by strategies around ‘sustainable intensification’ (Cunningham et al., 2013; Jackson et al., 2021; Thompson and Scoones, 2009). This has come at high costs for ecological sustainability, fails to address and even aggravates social inequity, as well as injustices and power inequalities (Clapp, 2021; Dutfield, 2018; Emmerson et al., 2016). Perspectives that are critiquing this focus on growth as a core policy objective, such as de-growth and a-growth, are gaining prominence in transition studies (van den Bergh and Kallis, 2012; Vandeventer et al., 2019) and in work on the circular economy (e.g., Bauwens, 2021). Since growth dynamics are deeply embedded in socio-economic systems’ structures and intent, a growth-critical perspective requires fundamentally rethinking and ‘unmaking’ those (capitalist) structures that perpetuate unsustainable and unjust systems dynamics (Feola et al., 2021; Vandeventer et al., 2019). This requires destabilizing incumbent growth-driven industrial farming practices (see van Oers et al., 2021), also by redirecting systemic power relations that stabilize incumbent dynamics (cf. Avelino and Rotmans, 2009; Kok, Loeber, et al., 2021). It also entails exploring underlying functional and structural couplings (e.g. Schot and Kanger, 2018) that stabilize multi-system incumbencies and exist between agri-food systems, energy systems, the wider bioeconomy and mission-oriented innovation systems (Hebinck et al., 2021a) in efforts to move toward post-growth strategies.

Democratic implications of justice analysis

A paradigm shift from economic materialism toward post-growth strategies, from a distributive justice lens, requires the ‘unmaking’ of the current institutional structures that have contributed to immense inequalities in the distribution of food resources, including seeds, land and water and that enable and reinforce pathways of enclosure and commodification (Clapp, 2021; Thompson and Scoones, 2009; Timmermann and Robaey, 2016; Tschersich, 2021). Instead, as emphasized in calls for food sovereignty, fair distribution, control and access to food resources and means of production, including seeds, land, knowledge and technologies are needed (Chappell et al., 2013; Edelman, 2014; Patel, 2009). For instance, Food and Seed Commons are discussed as anti-hegemonic, deeply democratic and empowering alternatives to the dominant neoliberal paradigm (see Sievers-Glotzbach, Tschersich, et al., 2020; Vivero-Pol, 2019). Distribution has implications for participation, as inequality in resources impacts capabilities to meaningfully engage in processes of decision-making and as it influences whose voices are more likely to be heard and accounted for (see i.e. Tribaldos and Kortetmäki, 2021). A fundamental critique and rethinking of the dynamics and structures that support market consolidation and power concentration in the food and seed sector is required, as these prevent actors excluded from powerful networks to effectively defend their positions (Clapp, 2021; IPES-Food, 2016). This includes the recognition of the rights of individuals and communities to fair participation in determining their own food and agricultural policies (Edelman, 2014; Patel, 2009; Via Campesina, 1996), and hence underlines the need to strengthen a rights-based perspective in agri-food transition governance, in particular the right to food, the rights of peasant and farmers' rights (Claeys, 2014; Haugen, 2014).

In linking the first two paradigm shifts, a democratization entails recognizing different ways of understanding progress and imagining post-growth futures, including post-capitalist and post-development perspectives from the Global South such as Buen Vivir (Beling et al., 2018; Escobar, 2015). Moreover, to contribute to restorative justice, it will be essential to challenge the narrative that increasing productivity through the breeding of high-yielding varieties and their cultivation under highly intensive, industrialized conditions with the use external agro-chemical inputs is the panacea for achieving food and nutrition security (Cunningham et al., 2013; Thompson and Scoones, 2009). Approaches such as agroecology could help to re-embed agricultural cultivation in ecological systems to enhance their resilience and avoid future damages (Anderson et al., 2019; Gliessman, 2016). At the same time, a restorative perspective turns the gaze toward restoring environmental degradation caused by current industrialized agriculture, and restoring health and wellbeing for those communities most affected by incumbent economic agri-food dynamics. This includes supporting affected communities in tackling the double burden of obesity and malnutrition through changing dietary patterns (e.g., Popkin and Reardon, 2018), especially given the historically limited attention given to food environments in low- and middle-income countries (Turner et al., 2018). Importantly, Davis et al. (2022) warn that agri-food system transformation efforts should not omit to distribute the benefits to, and mitigate the burdens for small-scale producers and livelihoods of the rural poor.

4.4.3 From anthropocentrism toward reconnecting human-nature relationships

The ‘control and autonomy of humans over nature’ paradigm articulates a disconnection of humans from nature, for instance visible in the intense exploitation of non-renewable resources (‘biospheric disconnection’) or the spatial and temporal disconnections between (food) production and consumption, which reduce the perception of impacts of humans’ actions on ecosystems (Dorninger et al., 2017; Seppelt and Cumming, 2016). These tendencies are enhanced by processes of globalization, technological development and urbanization. In science and technology, nature is often perceived as a passive object of control and domination shaped by humans as autonomous actors (Becker, 2010; Becker et al., 2005). This dualistic depiction of humans and nature is deeply embedded in the system’s intent and has negative impacts on ecological functions (Görg et al, 2017). Accordingly, reconnecting people and nature is seen as a powerful sustainability intervention (Abson et al., 2017; Riechers et al., 2021; Sievers-Glotzbach and Tschersich, 2019). Agri-food systems in particular are highly complex systems that comprise material, ecological, geological and socio-economic dimensions at different spatial scales and levels of aggregation. It is in these systems that the fundamental entanglement of the ‘natural’ and ‘human’ worlds (or rather: the debunking of their ontological Modernist separation, see e.g., Latour, 2004) becomes particularly manifest (see also Bennett, 2010; de la Cadena, 2010; Tsing, 2012). Transition scholars increasingly include non-humans (such as animals, materialities and ecologies) in studying (the politics of) agri-food transitions (e.g. Contesse et al., 2021; Pigford et al., 2018; Rosin et al., 2017; Vermunt et al., 2020), and in developing ecocentrist understandings of human-nature relationships (e.g., Huntjens, 2021). In order to overcome incumbent unsustainable system dynamics, a paradigm shift from anthropocentrism toward reconnecting human-nature relationships is hence required.

Democratic implications of justice analysis

In light of a multidimensional understanding of justice, reconnecting to nature has several implications for the governance of agri-food transitions. In terms of procedural justice, it requires ensuring that non-humans and nature are meaningfully represented in democratic governance of transitions (e.g., Eckersley, 2017), for instance by ensuring that in deliberative and co-creative (policy-making) processes there are representatives of ‘nature’ (Celermajer et al., 2021; Brown, 2018). While non-humans would not be able to participate in ‘citizen panels’ or reflexively deliberate with other stakeholders, Brown (2018: 35) for instance argues that *“just because non-humans cannot assess representative claims does not mean that they have no rights or do not deserve moral consideration”*. He argues that animal rights groups, governmental institutions or political parties could be authorized by voters to represent non-humans and speak on their behalf. In a recent contribution on agri-food Living Labs, Gamache et al. (2020) conclude that transition experimentation should also actively seek ways to include non-humans as part of their collectives, rather than as objects of experimentation. Second, recognition justice implies acknowledging the importance of nature and embracing its different intrinsic values and ecosystem services (or: 'contributions of nature', see Kadykalo et al., 2019) that are affected by the dynamics of incumbent (agri-food) systems (see Borie and Hulme, 2015). This could be institutionalized in formal arrangements for instance by granting legal rights to non-humans, such as the Whanganui river in Aotearoa [New Zealand] that is recognized as a living entity with its own legal rights and whereby (human) river guardians represent the river's interests (see Argyrou and Hummels, 2019). Important too is recognizing that ecologies play an crucial role in driving agri-food transition dynamics, which might help to develop business models that contribute to nature conservation (for instance in dairy farming in the Netherlands, see Vermunt et al., 2020). Third, notions of restorative justice then emphasize the need for transition governance efforts to actively restore (ex-post) the (historical) damages done to the natural world during the Anthropocene (see Whitfield et al., 2021). Agri-food transition governance efforts could more actively draw on the resilience and adaptive capacity of nature and ecosystems by fostering nature-based solutions in urban agriculture (Artmann and Sartison, 2018) or agroecology (e.g., Anderson et al., 2019). Considering distributive justice, reconnecting human-nature relations along food system dimensions (production, consumption, retail, processing) points to the need to redesign and support sustainable supply chains and food environments. Another promising avenue is redesigning animal husbandry systems through multi-stakeholder reflexive design processes that put ecological sustainability and animal welfare at the center (Elzen and Bos, 2019).

As a consequence, agri-food policies should move beyond (elite) socio-economic interests, framings and discourses. Tools such as a sustainability compass that helps explicate and reflexively navigate food system outcomes of policy processes could help connect societal goals on health, equity, economy and the environment (Hebinck et al., 2021b). Importantly, fragmented academic and policy siloes on agri-food and the environment should be connected through integrated food policies (see also Candel and Pereira, 2017; Parsons and Hawkes, 2018; den Boer et al., 2021; De Schutter et al., 2020) in order to foster just transitions that reconnect human-nature relationships.

4.5 DISCUSSION: INSTITUTIONALIZING DEEP DEMOCRATIC GOVERNANCE OF JUST TRANSITIONS

We have argued that doing just agri-food transitions requires three paradigm shifts in transition governance efforts. Institutionalizing these efforts, however, is not straightforward. We present six concrete challenges in transition governance that our take on democracy and justice brings along. In particular, we illustrate the balancing acts involved in governing just agri-food transitions and point to avenues for future research.

4.5.1 Which justice? Balancing multiple dimensions of justice

Throughout our analysis, we have highlighted the various interlinkages between different dimensions of justice, as well as different interpretations of democratizing agri-food transition governance. For instance, enacting procedural justice requires equitable distribution of resources (time, financial, material), while recognition of rights and values and enacting restorative justice depends on the consideration of various voices, including local knowledge or non-human interests, in institutionalized procedures. Hence, there are potential synergies between justice dimensions. Yet, a multidimensional consideration of justice in the governance of agri-food transitions will likely also result in tensions and conflicts between these dimensions. For instance, what if transitions toward sustainable aquaculture (contributing to restoring global fish stocks) threaten capture fisheries culturally preferred and important for food and nutrition security in the Global South, thereby impairing recognition and distribution justice (Belton and Thilsted, 2014)?

At the same time, a deeper understanding of democratization also illuminates the different tensions that can exist within efforts to contribute to procedural justice. For instance, mere participation of stakeholders does not yet warrant their meaningful deliberation, nor does it imply that their inclusion leads to authorization of governance efforts (see for instance Musch and von Streit, 2020, cf. Cooke and Kothari, 2001). While there are valuable methodologies for designing transformative spaces and meaningfully bringing together different (both powerful and marginalized) actors in transition efforts (Pereira et al., 2018a), participation of stakeholders in research, innovation and governance remains a highly political exercise subject to power imbalances (e.g., Turnhout et al., 2020; Kok et al., 2021b). As such, it would be valuable to further explore how multi-actor efforts could be cognizant of and reflexive toward the balancing acts that are required to find synergies and mitigate trade-offs between dimensions of justice, especially in light of democratization ambitions.

4.5.2 Paradox? Balancing democratization and urgency

Second, there is a (perceived) challenge in balancing democratization of transition governance with the urgency that is involved in bringing along large-scale transformations (Skjølsvold and Coenen, 2021). The challenge at hand is that democratization requires resources, and involves time- and energy-consuming efforts in bringing together different (societal) actors around transformative agendas (see e.g., Stirling, 2008; Jasanoff, 2018; Skjølsvold and Coenen, 2021). Democratization could slow down urgently needed sustainability transformations, especially when various actor groups disagree on directions for (policy) pathways or object to specific interventions (such as a meat tax). On the other hand, a well-established insight in transdisciplinary research is that knowledge, policies and innovations that are co-produced in deliberative processes could have more societal support, enhance self-determination, lead to shared responsibilities on innovation process and outcomes, and might better address the needs of the involved stakeholders (e.g., Norström et al., 2020; Schmidt et al., 2020; Stilgoe et al., 2013; Lang et al., 2012). Furthermore, (trans)local food networks and grassroots initiatives that embrace deliberative democratic endeavors could also put forward progressive and transformative pathways (e.g., for sustainable (urban) food policies; Moragues-Faus and Sonnino, 2019). Considering this paradox, Skjølsvold and Coenen (2021: 3, building on Shove and Walker, 2007) argue that "there is a need for more nuanced debates both about inclusivity and temporality in transitions, as well as work that do[es] not take shared social realities for granted, but actively works to produce them around specific issues". Further exploring how balancing and linking efforts of democratization and urgency can be promoted through transition governance might help better foster distributive, recognition and restorative justice and help unravel whether these should - and perhaps, could only - be achieved when procedural justice is also accounted for.

4.5.3 Governance directionalities: Beyond bottom-up and top-down

Democratizing the governance of agri-food transitions, we argued, requires finding ways to represent interests and voices beyond the experts, beyond the powerful and beyond the humans. Stimulating such broad deliberation and participation through grassroots initiatives or transition experiments raises the question on whose behalf transition governance is instigated, and who or what is accountable for the way transition processes unfold. In essence, another challenge thus refers to efforts of combining 'bottom-up' deliberative and 'traditional' representational conceptions of democracy in agri-food transitions. This is further complicated by the multi-level governance dynamics involved in coordinating transition efforts (from neighborhood councils and national parliaments to supranational organizations (e.g., the EU) and global international negotiations and institutions (such as FAO and WHO)). Considering the institutional architecture of environmental governance, Dryzek and Pickering (2017: 358) argue that the *"most promising* *avenue here would involve transcending the centralization/polycentricity binary".* Schlaile et al. (2017: 7) stress that combining top-down and bottom-up approaches in transition governance also *"requires engagement with issues of directionality (what future do we want?), legitimacy (why do we want this future, who defines it?), and responsibility (transformation by and for whom?)".* Transition scholars have pointed out that Mission-oriented (Agricultural) Innovation Systems and Transformative Innovation Policies might provide pathways forward in setting such directionalities to address societal challenges beyond traditional economic-growth focused innovation policies (Hekkert et al., 2020; Klerkx and Begemann, 2020; Schot and Steinmueller, 2018). At the same time, the role of (sectoral) policy mixes and integrated food policies remains crucial (e.g., Candel and Pereira, 2017; Kivimaa and Kern, 2016; Rogge and Reichardt, 2016). Addressing these questions hence begs reflection from transition scholarship on the role of the (liberal) state regarding setting in motion (or hindering) transitions, as well as rethinking and redesigning liberal democracies, topics relatively underexplored in the field. Yet, these are highly relevant from a justice perspective, as *"who the state serves and which interests it seeks to protect is vital to assessing the prospects of more radical and progressive interventions imagined in much transitions scholarship"* (Johnstone and Newell, 2018: 78).

4.5.4 Translocality: Localized interventions and global dynamics

Translocal and cross-scale dynamics in transitions are increasingly gaining attention in transition studies (e.g., Avelino et al., 2020; Coenen et al., 2012; Loorbach et al., 2020; Raven et al., 2012), and in the context of agri-food systems (e.g., Hebinck et al., 2021a; Moragues-Faus and Sonnino, 2019; Oliver et al., 2018). The notion of scale raises several important issues for just transitions.

First, literature on transdisciplinary research and innovation emphasizes the need to better understand wider societal impacts of (often localized) projects and interventions (e.g., Schneider et al., 2019; Lux et al., 2019; Pel et al., 2020). Yet, the relation between local transition experiments, systemic (in)justice(s) and the wider political economy requires more attention (e.g., Pereira et al., 2018a). Enabling just agri-food transitions will then require both local and globally coordinated policy interventions aimed at democratizing agri-food markets and their governance, in particular dismantling global market and power concentration, which have been identified as major causes of lock-in to the current industrial agricultural system (IPES-Food, 2016; McKeon, 2021). Second, connecting local interventions to global transitions is challenging in agri-food governance as interventions should, ideally, mitigate the translocal dynamics of globalized injustices at play. For instance, how should local initiatives grapple with the global destruction of ecosystems (requiring global coordination toward restorative justice)? Third, it points to translocal dynamics and trade-offs in justice across spaces and scales (see also Boillat et al., 2020; Hebinck et al, 2021a). What if an intervention contributes to just transitional dynamics in one particular context, but leads to injustices across transnational scales? For instance: innovations to digitalize agriculture (see Klerkx et al., 2019 for a review) in one country might contribute to transnational dynamics (mobilities of workers or economic effects) negatively impacting agricultural work(ers) in other parts of the world.

Thus, agri-food transition governance should consider and anticipate the effects of interventions on both local and translocal dimensions of justice. This requires further exploration of who (which governments, organizations, industries) should be (made and held) accountable for the translocal dynamics of (in)justice. That relates to unraveling through which mechanisms localized interventions can contribute to large-scale systemic transformations, and how to design deeply democratic global institutions to facilitate (local) transition processes (see e.g., Lam et al., 2020a; Sievers-Glotzbach and Tschersich, 2019).

4.5.5 How just and democratic? Combining idealism with realism

An important normative challenge refers to the degrees in which just transition dynamics can be instigated by governance efforts: is it sufficient if transition governance efforts make agri-food systems a ‘little bit’ more just? We see a challenge in combining both idealism and realism in considering just and democratic dimensions in transition governance.

First, while the importance of less tangible societal impacts (small wins, built capacities) is gaining traction in transition (evaluation) frameworks (e.g., Termeer and Dewulf, 2019; Wolfram, 2016), there is still room to explore how to account for ‘just outcomes’ of transition processes, especially as issues of social justice could otherwise remain below-the-radar (Köhler et al., 2019). Related is the challenge that small advancements toward just transitions that do not challenge underlying system structures might strengthen the system’s adaptive capacity by easing internal tensions and providing legitimacy, which can prevent more fundamental transformations (see Ingram, 2015; Sievers-Glotzbach and Tschersich, 2019; Smith, 2007). Therefore, transition processes need to be reflective of potentially reinforcing structural injustices, and aim to challenge and ‘unmake’ these incumbencies. In the context of short-term focus, effectiveness-orientation (Musch and von Streit, 2020) and projectification (Torrens and von Wirth, 2021) of sustainability science and policy, this raises the question of how we can realize just transitions in a manageable way? And, subsequently, how can the ‘just’ nature and outcomes of short-term projects and governance programs be meaningfully evaluated and accounted for?

Second, democratization should lead to realistic benefits and values for included (marginalized or vulnerable) stakeholders. As reflected upon by Celermajer et al. (2021), for those communities suffering from dehumanization (often with limited or no access to food, water, safety or human dignity) participating in (time-consuming) projects to co-create pathways to just and sustainable development could understandably not be a primary focus. As a consequence, there is a major responsibility for those designing and implementing transition processes to account for the needs of involved stakeholders, and to ensure that these deliver just outcomes especially for marginalized communities. This adds to the need to find ways of creatively combining idealism with practical realism in transition governance, while being attentive to how incumbent injustices might shape the potential to participate in the democratization of agri-food transition governance, and how they might influence outcomes.

4.5.6 The role of scientists: Within or outside incumbent scientific systems?

Finally, the authors of this chapter, are well aware that as researchers from the Global North, we are part of the same scientific system that has contributed to the formation of incumbent agri-food systems. As we have emphasized, just transitions will entail rethinking processes of knowledge generation and giving voice to currently marginalized perspectives and voices. Hence this requires to partially disempower (Western) scientists in favor of a strengthened engagement and consideration of various practitioners as well as scholars from the Global South. This can enhance the inclusion of decolonial perspectives and helps reaching beyond disciplinary research toward transdisciplinary research endeavors. Active engagement in transdisciplinarity requires fostering and developing different values, competences, roles and priorities for researchers and other agri-food system actors (Ingram et al., 2020, cf. Wittmayer and Schäpke, 2014). In addition, scientific systems should foster values like empathy, listening, collaborative cultures and academic self-care (Sellberg et al., 2021; Wiek et al., 2011). Scholars, however, have indicated that incumbent scientific systems often do not sufficiently support collaborative and transdisciplinary efforts required for (agri-food) transitions (e.g., Fazey et al., 2018a; 2020; Kok et al., 2019). For instance, funding structures currently facilitate fragmented agri-food research and innovation across silos and disciplines (Den Boer et al., 2021a), and scientific systems pressure to publish in specialized academic journals that prioritize disciplinary (scientific) knowledge, language and discourses. If researchers are to meaningfully engage with just transitions in agri-food systems, it thus requires turning the gaze to how (global) scientific systems themselves are organized and linked to agri-food systems, for instance by valuing both scientific and traditional agroecological knowledge on equal footing in publications and policy recommendations (including through co-authorships with practitioners), and reforming (scientific) institutions to support such processes. Transition scholarship should hence address systemic power imbalances and strive for just scientific systems (see Lahsen and Turnhout, 2021), that in turn might contribute to more just and democratic sustainability transitions in agri-food systems.

4.6 CONCLUSION

In this chapter, we aimed to contribute to the debate on how transition governance efforts could be democratized in order to facilitate just transitions in agri-food systems. Our main contributions, we contend, are a further clarification of how democratization of transition governance might pave the way for enacting just transitions in agri-food systems, and an elaboration on several key challenges democratization brings along for institutionalizing just transition governance efforts.

We first contended that democratizing the governance of agri-food transition is inherently grounded in and related to the four interrelated dimensions of distributive, procedural, recognition and restorative justice. We argued that three paradigm shifts are required for achieving just agri-food transitions: (1) from expert toward pluralist understandings of knowledge; (2) from economic materialism toward post-growth strategies; and (3) from anthropocentrism toward reconnecting human-nature relationships. We explored what these entail for the democratization of transition governance in agri-food systems from the perspective of justice. Enhancing democracy in transition governance hence requires to institutionalize meaningful participation of a wide variety of voices and perspectives; to move beyond incumbent market and power consolidation in the agri-food sector; and better representing nature, for instance in integrated transition policies that connect policy silos on agri-food, economy and the environment. Connecting the three paradigm shifts necessitates reaching beyond governance through single interventions or experiments toward more integrated efforts that fundamentally rethink and overcome underlying structures, power relations, as well as belief and knowledge systems that perpetuate incumbent injustices.

Yet, we argued, institutionalizing deeply democratic transition governance brings along six different challenges in: (1) balancing (trade-offs between) multiple dimensions of justice; (2) combining democratization efforts with urgencies implied by transition ambitions; (3) moving beyond the bottom-up and top-down dichotomy in setting governance directionalities; (4) navigating the translocal dynamics involved in bringing about just transitions, in particular between local interventions and global dynamics of injustice; (5) finding creative ways to combine realist and idealist demands for just transition governance; and finally, (6) rethinking the role of scientists and scientific systems in how they can best contribute to just transitions.

We believe this requires policymakers and practitioners to find synergies within, and between, the abovementioned balancing acts, and to mitigate trade-offs and dynamics of injustice that might emerge through interventions. Importantly, our work also stresses the many ambiguities involved in the relation between democratization and just transitions, which means that 'democracy' or 'democratization' alone is not the panacea for ensuring just or sustainable transformations. In that light, our work could help to explicate and navigate the abovementioned challenges in democratically governing just transitions. Furthermore, though our contribution focused explicitly on agri-food systems, we also believe that the general points raised in our discussion could inform ongoing work on governing just transitions in other socio-technical systems, such as energy, health and mobility.

We are well aware that our conceptual contribution leaves many questions unanswered, for instance regarding empirical details on context-specific dynamics of globally interconnected, but highly diverse agri-food systems, and also regarding epistemological and normative perspectives raised. We hope that others will see our contribution as an explicit invitation to further engage on this important topic, in efforts to bring along urgently needed transitions toward sustainable, healthy and just agri-food systems.

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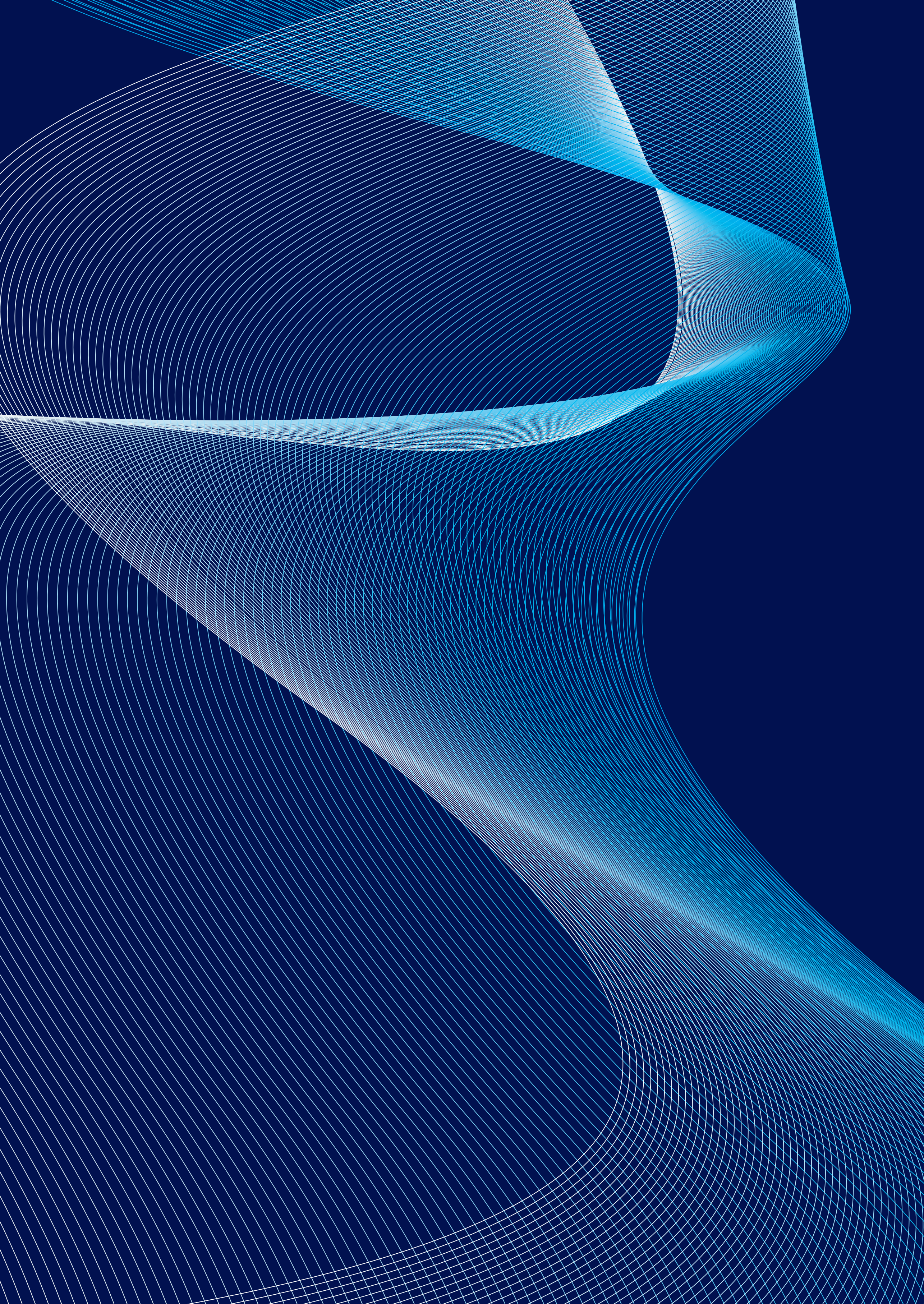

PART III

A TALE OF TWO SYSTEMS

"Down on the borders they are felling trees — good trees. Some of the trees they just cut down and leave to rot — orc-mischief that; but most are hewn up and carried off to feed the fires of Orthanc. There is always a smoke rising from Isengard these days."

Observations by Treebeard
Lord of the Rings: the Two Towers
J.R.R Tolkien, 1954

"It was the best of times, it was the worst of times,
it was the age of wisdom, it was the age of foolishness,
it was the epoch of belief, it was the epoch of incredulity,
it was the season of Light, it was the season of Darkness,
it was the spring of hope, it was the winter of despair,
we had everything before us, we had nothing before us."

A Tale of Two Cities
Charles Dickens, 1859

Throughout history, mankind has told and encapsulated many tales involving dualities where two entities are strongly interrelated yet distinctly unique. An early literary example is the book *De Civitate Dei [on the City of God]* by Augustine of Hippo. This theological work was completed in 426 A.D. and revolves around two cities: one City exemplifies the ideal world while the other City comprises all that is worldly. A tale of two systems: one ideal, the other real. They couldn't be more different, but they are so much alike.

Slightly more modern, but strikingly similar in topic is *A Tale of Two Cities* by Charles Dickens (1859). The cities at play are London and Paris, but at the same time, the work deals with contrasts between two different worlds. Written in 19th century England (against the background of the industrial revolution) but set around the French Revolution, it provides a basis for considering social justice and elaborating on the structural differences between social classes. People live in the same world, yet in two different ones. Hope for the future, despair in the present. Darkness and light. Again, a tale of two systems.

The point is: by explicating a duality of two systems, the relationship between the two becomes more clear. Importantly, at the same time, elaborating on the state of one system, could help to better understand the how and why of the other. This PhD thesis deals with transitions toward sustainable societies, yet the tale of two systems here does not only refer to the dualism between locked-in unsustainable systems (now) and potential sustainable systems (in the future). Rather, this part is also about the fundamental entanglement between two very specific, yet distinctly different societal systems around which this thesis evolves. This part presents the tale of food systems and their entanglement to R&I systems.

In Chapter 5, we discuss which types of R&I (and under what systemic conditions) can contribute to catalyzing transitions in food systems. In Chapter 6 then, we further explicate this argument and we present a coupled-systems perspective. We argue that there is a need for a double transformation: in order to enact transitions in food systems, we need to transform the R&I systems coupled to them as well.

5

Research and innovation as a catalyst for food system transformation

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ABSTRACT

Background: Food systems are associated with severe and persistent problems worldwide. Governance approaches aiming to foster sustainable transformation of food systems face several challenges due to the complex nature of food systems.

Scope and approach: In this commentary we argue that addressing these governance challenges requires the development and adoption of novel research and innovation (R&I) approaches that will provide evidence to inform food system transformation and will serve as catalysts for change. We first elaborate on the complexity of food systems (transformation) and stress the need to move beyond traditional linear R&I approaches to be able to respond to persistent problems that affect food systems. Though integrated transdisciplinary approaches are promising, current R&I systems do not sufficiently support such endeavors. As such, we argue, we need strategies that trigger a double transformation – of food systems and of their R&I systems.

Key findings and conclusions: Seizing the opportunities to transform R&I systems has implications for how research is done – pointing to the need for competence development among researchers, policy makers and society in general – and requires specific governance interventions that stimulate a systemic approach. Such interventions should foster transdisciplinary and transformative research agendas that stimulate portfolios of projects that will reinforce one another, and stimulate innovative experiments to shape conditions for systemic change. In short, a thorough rethinking of the role of R&I as well as how it is funded is a crucial step toward the development of the integrative policies that are necessary to engender systemic change – in the food system and beyond.

5.1 INTRODUCTION

Food systems evolved successfully during the 20th century in response to the growing and changing demand for food but are currently associated with severe and persistent problems worldwide. These include, inter alia, diet-related poor health outcomes, high greenhouse gas emissions, environmental degradation, biodiversity loss, and food losses and waste (Table 5.1). These problems are amplified by long-term drivers of change, such as climate change, urbanization, population growth, and consumerism (Haddad et al., 2016). Responding to these intertwined dynamics is critical to achieve the United Nation's Sustainable Development Goals (SDGs) and the targets of the Paris Climate Agreement (Caron et al., 2018) and points to the need to combine all possible levers to foster transformation (Editorial, 2019). But implementing effective intervention strategies is challenging: though food systems are linked globally, many challenges and solutions are context-dependent and there are differences between the global North and the global South, as well as between urban and rural areas (Willett et al., 2019). Hence, there are no blueprint interventions in food systems that work toward the SDGs, even though food systems are interconnected globally. Furthermore, governance approaches that foster sustainable transformation face challenges due to the complex nature of food systems. Major challenges include increasingly problematic trade-offs and interdependencies within and beyond food systems, difficulties in integrating and aligning responses at different scale levels, conflicting values and interests, and problematic power imbalances (Moragues-Faus et al., 2017).

Table 5.1 | Persistent challenges in the food system worldwide.

Persistent challenges	Evidence (worldwide)
Undernourishment	821 million in 2019 (FAO et al. 2019)
Adult obesity	Over 600 million (13.2%) in 2016 (FAO et al. 2019)
Childhood overweight and obesity	40 million children under five were overweight in 2018 (FAO et al., 2017)
Greenhouse gas emissions	Agriculture's net emissions are the equivalent of 5.0–5.8 GtCO2 per year (IPCC, 2019)
Water scarcity	Agriculture's share of water usage: 75–84% (Wada, et al. 2011)
Biodiversity loss	16.5% of vertebrates and pollinators threatened with extinction (FAO, 2019)
Food losses and waste	1.3 million tons yearly (Gustavsson et al, 2011)

Addressing these governance challenges requires the development and adoption of novel research and innovation (R&I) approaches that will provide evidence to inform food system transformation and will serve as catalysts for change (Gill et al., 2018). Such R&I approaches should move beyond a narrow focus on production or consumption to embrace complexity and account for different actors, sectors, governance levels, and academic and policy fields. In short, we argue that to deliver a 'Great Food System Transformation', as referred to by the EAT-Lancet Commission (Willett et al., 2019), R&I systems need to be changed fundamentally as well.

In this chapter, we will first elaborate on the complex nature of food systems and their transformations. Then we will discuss what kind of R&I efforts can serve as catalysts for enabling food system transformation and will also explain why current R&I systems do not sufficiently support these efforts. We will conclude by highlighting some implications for research practice and governance.

5.2 COMPLEX FOOD SYSTEM TRANSFORMATION

Food systems are increasingly conceptualized as complex systems (Zhang et al., 2018) comprising multiple actors (e.g., consumers, policymakers, farmers, researchers, industry), encompassing multiple processes and practices (e.g., food production, processing, packaging, distribution, consumption), spanning multiple policy sectors (e.g., agriculture, environment, health), and having multiple societal functions (e.g., food security, welfare, environmental conservation) that are connected at and between multiple governance levels (e.g., local, regional, national, global). As defined by the EC FOOD 2030 Expert Group (2018), food systems can thus be conceptualized as incorporating *"all elements and activities that relate to the production, processing, distribution, preparation and consumption of food, as well as its disposal. This includes the environment, people, processes, infrastructure, institutions and the effects of their activities on our society, economy, landscape and climate"*. The interactions between all these elements are key to understanding food system dynamics (Ingram, 2011). Acknowledging the fundamentally complex interactions between food system components means moving beyond both linear and circular conceptualizations of food systems, such as the value chain, the supply chain, or food-cycle conceptualizations, which do not adequately capture the complex dynamics of food systems (HLPE, 2014; Ingram, 2011; Jagustović et al., 2019). These different 'modes' of thinking about systemic structure and dynamics are depicted in Figure 5.1.

Although there are many views on what exactly constitutes a 'complex system' (Ladyman et al., 2013), it is generally recognized that 'complex systems thinking' emphasizes (1) the dynamics of the system as being emergent, meaning that one needs to consider the behavioral complexity of the whole system rather than focusing on its constituent components (Behl and Ferreira, 2014), and (2) the interrelatedness of components and processes in the system that result in (responsive) non-linear dynamics (Jagustović et al., 2019). Applying complex systems thinking to food allows for the identification of non-linear dynamics between different elements in food systems, such as systemic feedback loops, that can generate synergies but also trade-offs and, subsequently, unintended consequences of specific (policy) interventions (Oliver et al., 2018; Zhang et al., 2018). An example of such a complex trade-off is competition for land use between agricultural, social, and economic needs, while implicating the environment too (EEA, 2017).

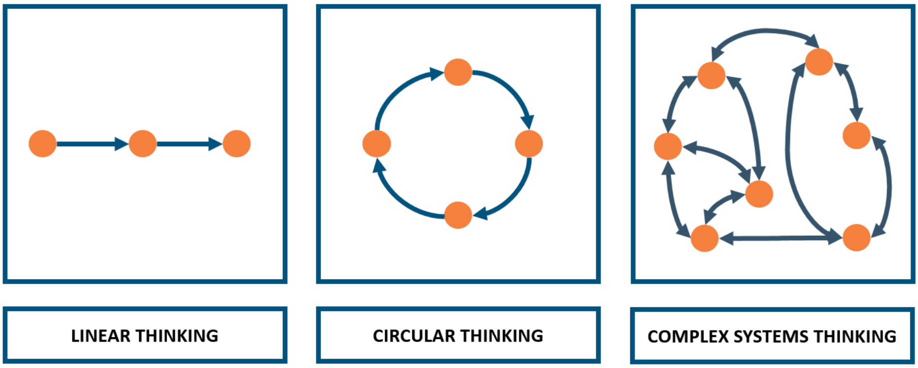

Figure 5.1 | Schematic depiction of conceptualizations of food systems representing different modes of thinking about the structure and dynamics of food systems.

Complex characterizations of food systems also encompass their undesirable resilience, whereby dominant regimes and unsustainable system configurations tend to reproduce themselves into locked-in states, making sustainable transformation difficult (Geels, 2002; Grin et al., 2010). It is increasingly being recognized that both inertia and transformative dynamics in food systems are co-shaped by power relations in the system (Grin et al., 2010; Rossi et al., 2019; Spaargaren et al., 2013). Problematic power imbalances can further reinforce vested interests and status quo configurations (Avelino and Rotmans, 2009; Grin et al., 2010). This, for instance, entails a shift in power from primary producers to input providers (seed, fertilizer and pesticide manufacturers), food companies, and retailers (Rayner et al., 2008), allowing retailers and supermarkets to *"dictate the terms of contracts and act as gatekeepers to (and by implication buyers for) the large majority of food consumers"* (Rayner et al., 2008: 155).

These complexities call for the development, implementation and evaluation of integrated governance strategies. There are many different definitions of governance (see also Kooiman, 1999), and we understand governance to refer to the *"ensemble of rules, processes, and instruments that structure the interactions between public and/or* *private entities to realize collective goals"* (Termeer et al., 2011: 161). This means that governance moves beyond 'formal arrangements by governments', but includes the collaborative efforts of networks of government agencies, societal stakeholders and private entities at and across (local, regional, national, supranational) governance levels. Multi-level governance efforts are needed to develop integrated food policies that can mitigate negative trade-offs, while enhancing synergies between different sectors and policy fields (Moragues-Faus et al., 2017; Parsons and Hawkes, 2018; SAPEA, 2020). As Candel and Pereira (2017: 89) explain, while in the past *"food policy was primarily used to indicate the whole range of policy efforts that affect food system outcomes, the notion has more and more come to be used to emphasize the need for integrative strategies that align these policy efforts into a concerted whole".* Food policy integration also raises the need for novel ways of using and combining policy instruments in policy mixes for food system transformation (Galli et al., 2020). A concrete examples of such interventions is the development of urban and regional Food Policy Councils (FPCs) that aim to integrate and develop holistic local food policies by fostering collaboration between a range of stakeholders (Mendes and Sonnino, 2018: 543–560).

To be able to transform and future-proof complex food systems through integrated governance interventions, it is necessary to better understand the technological, biophysical, political, economic and social dimensions of the dynamics that shape food systems and to identify the leverage points where intervention will be most effective. Identifying these points requires a systemic approach that takes into account multiple actors, governance levels, and policy fields (EEA, 2017), which also raises the need for novel transformative R&I policies and strategies (Schot and Steinmueller, 2018). R&I efforts are of paramount importance to identify systemic interdependencies, lock-ins, as well as possible solutions and leverage points. Indeed, the R&I system can act as a catalyst in shaping future food systems, provided that R&I (policy) efforts are aligned and well equipped to contribute effectively to complex food system transformations. As addressing complexity implies moving away from "one size fits all" solutions and considering contextual specificity, designing and implementing transformative pathways are knowledge intensive processes calling for original learning approaches that embed scientific knowledge into local innovation systems (Caron et al., 2014).

5.3 WHAT KIND OF R&I DO WE NEED FOR FOOD SYSTEM TRANSFORMATION?

The urgent problems in food systems and associated governance challenges point to the need to develop and adopt R&I approaches that embrace complexity and stimulate different ways of knowledge production and usage. Recently, Schmidt-Traub et al. (2019) argued that we could "fix the broken food system" by developing integrated approaches that simultaneously consider the following: 1) Efficient and resilient agriculture systems, 2) Conservation and restoration of biodiversity, and 3) Food security and healthy diets. Such integrated approaches should stimulate (global) coordination and knowledge sharing between different scientific and technical communities, aligning and integrating different methods, models, and tools. As several scholars have recently highlighted (Abson et al., 2017; Boström et al., 2018), experimenting with such approaches can help us to learn how to stimulate transformative change.

We argue that such integrated approaches need to be even more ambitious if food system transformation is to be achieved. Embracing complexity not only requires a shift from mono- and multidisciplinary research approaches toward interdisciplinary ones; it also requires a shift toward transdisciplinary research approaches (Figure 5.2) that are action- and solution-oriented, bring together different epistemics or communities of knowledge (including non-academic actors such as policymakers, entrepreneurs, civil society organizations, farmers, and citizens), and form a 'real-world laboratory' for experimentation (Luederitz et al., 2017).

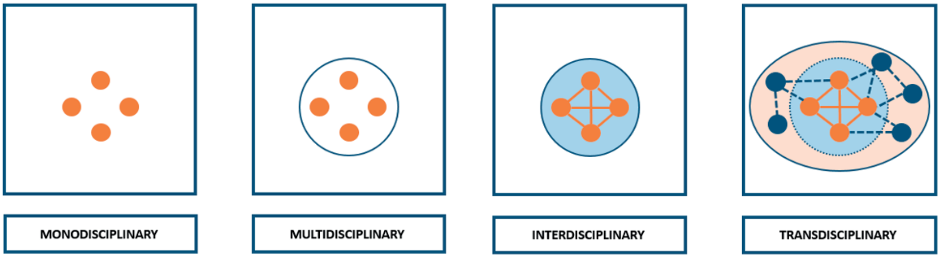

Figure 5.2 | From mono-, multi-, and interdisciplinary approaches toward holistic transdisciplinary research and innovative approaches for food system transformation.

Bringing together different types of actors is essential to understand a system and focus on solutions and the implementation of change via processes of knowledge co-creation (Abson et al., 2017; Fazey et al., 2018a). Strong R&I frameworks based on holistic and participatory approaches involving all stakeholders may help to identify opportunities but also vulnerabilities nested in the system, which are vital starting points from which to formulate resilience strategies (FAO, 2014). Furthermore, transdisciplinary approaches ideally provide space for underrepresented actors and their perspectives (Abson et al., 2017) and stimulate processes of individual and collective transformative learning (Luederitz et al., 2017), which are crucial to unlock inertia and, consequently, to accelerate food system transformation (Boström et al., 2018). An example of a real-world laboratory that aims to work as an incubator for innovation at the city level is the so-called 'Urban Transition Lab' (Nevens et al., 2013), which focuses on transdisciplinary research approaches to stimulate learning and reflexivity among a diverse range of actors. System analysis, visioning and an investigation of how different multi-level interventions might result in synergies or trade-offs form key activities within Urban Transition Labs, which essentially function as governance experiments focused on long-term envisioning as well as actual multi-actor experimentation for transformation (Nevens et al., 2013). Although research is needed to investigate the long-term impact of such real-world laboratories, studies already point out that those urban experiments contribute to more sustainable structures, cultures and practices within cities, by spreading knowledge, innovative practices and potential solutions beyond the labs' boundaries (e.g. by initiating spin-offs elsewhere and spreading innovative business models) (Von Wirth et al., 2019).

Multi-actor experimentation also becomes visible within specific types of innovative initiatives for food system transformation, such as the Italian Solidarity Purchasing Groups (GAS, 'Gruppi di acquisto solidale') (Grasseni and Hankins, 2014). These are fluid networks in which different types of actors co-design and co-create new systems of food provisioning that stimulate short supply chains and local food production. Through initiatives of this kind, citizens are encouraged to adopt active roles in transforming their food systems. Finally, socio-technical innovations can also originate from transdisciplinary or collaborative efforts. For instance, in the Netherlands collaborations between farmers, architects, animal welfare consultants, policy makers and researchers have led to the development of novel poultry husbandry systems (the Roundel hen housing system) that were designed to be more sustainable and animal-friendly than the conventional ones. The collaborative process behind these initiatives was facilitated through the methods of reflexive interactive design, which, again, confirms the importance of fostering reflexive learning amongst stakeholders (Groot Koerkamp and Bos, 2008).

5.4 CHALLENGES OF CURRENT R&I STRATEGIES

Conventional R&I systems fail to adequately respond to urgent systemic challenges in food systems precisely because they do not support transdisciplinarity (Gill et al., 2018). We provide below a non-exhaustive overview of limitations of current R&I systems, pointing to three issues that need to be addressed to maximize the potential of R&I systems as levers for food system transformation.

First, the food system R&I landscape is highly fragmented with regard to the scientific as well as the policy domain (Reardon et al., 2019; SCAR, 2018; Serraj and Pingali, 2019). So far, linear and siloed R&I efforts have contributed to improving specific parts of the food system, such as agricultural production and food safety, but have largely failed to offer solutions to persistent problems that affect food systems due to their lack of engagement with trade-offs, unforeseen and undesired side-effects, and systemic feedback loops (Zhang et al., 2018).

Second, R&I (funding) structures are not well aligned; indeed, investments are distributed unevenly across sectors and disciplines and there is a lack of incentives to develop holistic, integrated R&I approaches. A disproportionally high proportion of public R&I investments are directed toward production processes and food security (SCAR, 2018), while other parts of food systems, such as logistics and consumption, are underrepresented (Pray and Fuglie, 2015). Private investment, although considerable, is also fragmented, and investment in integrated food systems approaches is modest (Serraj and Pingali, 2019). Moreover, public and private funding are often not well aligned (Pray and Fuglie, 2015; EC FOOD 2030 Expert Group, 2018) and they often fail to invest in the interconnectedness between the different elements within food systems (Haddad et al., 2016). As a result, R&I input is too low, especially when it comes to food consumption and healthy diets (Haddad et al., 2016), food waste, and distribution processes – including their interactions with production processes – and the impact of these diets and processes on the ecological, economic, and social dimensions of sustainability. In addition, academic incentive structures often do not support or reward integrated transdisciplinary research efforts that cross sectoral and disciplinary boundaries (FEC, 2018).

Third, R&I processes are traditionally the realm of researchers and policymakers, with an increasing involvement of industry actors – the so-called Triple Helix (Etzkowitz and Leydesdorff, 2000). Active involvement of societal stakeholders such as citizens, civil society organizations (CSOs), farmers, teachers, and consumers (FEC, 2018), who co-constitute the Quadruple Helix (Carayannis and Campbell, 2010), is rare and is often given low priority (EC FOOD 2030 Expert Group, 2018). Given these actors' central role in food systems and the importance of understanding the different values and perceptions within these systems, it is important to actively engage them in food system R&I (SCAR, 2018). This raises the need for a better understanding of how to organize and stimulate stakeholder interactions during the research process and how to interpret the outcomes of these interactions (FEC, 2018).

5.5 CONNECTING FOOD RESEARCH AND POLICY

Given the above-mentioned limitations, we need strategies that will trigger a double transformation – of the food systems and of their R&I systems (Kok et al., 2019). Seizing the opportunities to transform R&I systems, we argue, has implications for research practice (how research is done) and requires specific governance interventions.

5.5.1 Research practices and competence building

As mentioned earlier, transdisciplinary R&I approaches to food system transformation are fundamentally different from linear and disciplinary approaches, and this raises the need for a different type of R&I organization (Boström et al., 2018; Luederitz et al., 2017). In practice, knowledge integration and engaged stakeholder collaboration are challenging; what knowledge is actually needed and legitimate, which stakeholders need to be involved at what stages of the research process, and which methodologies or strategies would be most effective to stimulate knowledge co-production and transformative learning (Abson et al., 2017) are issues that cannot be properly addressed without a thorough rethinking of the role of researchers and the role of science more generally. Examples of roles other than that of 'traditional scientist' include 'change agent' (actual normative participation of researchers to stimulate change in practice), 'knowledge broker' (intermediation between different epistemics), and 'reflexive process facilitator' (the facilitation of transformative learning) (Fazey et al., 2018a; Wittmayer and Schäpke, 2014) – these are all roles that can be interpreted differently when applied in practice and can entail different (and even conflicting) expectations. The fact that such roles require specific organizational and inter-personal competences in terms of attitude, knowledge, and skills (Mauser et al., 2013), especially for practitioners managing innovative R&I and governance experiments, adds to the difficulty of adopting them in real-world situations (Nevens et al., 2013).

Recently, several projects have been developed that aim to contribute to competence building. For example, the IFSTAL project (Innovative Food Systems Training and Learning) has been training postgraduate students in 'food systems thinking' since 2015 in a cross-disciplinary multi-university program in the United Kingdom (Ingram et al., 2020). Another example is the Horizon 2020 FIT4FOOD2030 project, that has established 14 City and Food Labs in European cities and regions. In these Labs, food system stakeholders have co-created and tested educational modules for different audiences (citizens, professionals, students, school children), which aim to contribute to competence development in food system thinking and transdisciplinary research (Kok et al., 2019).

To be able to stimulate researchers to adopt such new roles and engage in novel R&I approaches to food system transformation, there is a need for a paradigm shift within the research and education communities (O'Brien et al., 2013) but also within the policy community and wider society. A first vital step toward this is competence building for researchers, policymakers, and society in general.

5.5.2 Research programs and funding

Several governance intervention strategies can be utilized to reorientate R&I systems toward food system transformation and to create an enabling context for transdisciplinary research approaches.

1. **Fostering transdisciplinary research.** Alongside traditional R&I, there is a need to develop transdisciplinary research approaches by investing in the creation of meaningful interactions between researchers, societal actors, and policymakers, but also by stimulating different academic incentive structures. For example, to stimulate changes in food consumption practices, R&I should not only focus on individual factors but also on contextual factors (in particular the dynamics that shape food environments) and policy factors (Gill et al., 2018). Such transdisciplinary research is crucial to build an evidence base for the development of integrative food policies that embrace the entire food system and calls for strong investment in the social sciences. Large-scale transformations cannot be achieved exclusively through technological investment. The production of knowledge on the interplay between technological, social, economic, cultural, and political factors is vital to understand and govern complex societal systems. Furthermore, social sciences can help to articulate dilemmas and formulate policy recommendations to mitigate negative effects of trade-offs in future pathways for transformation. This also requires fostering R&I programs and collaborations that aim to bridge the gap between 'hard' and 'soft' (or quantitative and qualitative) approaches in food systems research (Jansen, 2009). For example, systems-modelling approaches, such as agent-based modelling, are important tools for assessing the impact of policies and interventions that aim to change consumption practices and could complement traditional and transdisciplinary research approaches.

2. **Fostering transformative research agendas.** Both private and public funders can support the transformative potential of food systems R&I by establishing more integrated transdisciplinary and mission-driven R&I funding programs. Novel funding programs need to go beyond the basic idea of funding individual transdisciplinary research projects and stimulate portfolios of projects that will reinforce one another over time, at different governance levels and with regard to different sectors and

thematic (policy) fields. A promising example of an integrated food systems R&I approach is nutrition-sensitive agriculture (NSA), which focuses on the different pathways through which agriculture can influence the underlying determinants of nutrition outcomes. NSA practices are characterized by the engagement of different types of actors and by a systemic perspective to account for the substantial impact of contextual factors on the relationship between agriculture and nutrition outcomes (Ruel et al., 2018). Fostering transformative research agendas includes expanding research on integrated food systems approaches such as NSA to create more empirical evidence with regard to processes and outcomes. This is important not just to progress research on sustainability, impact at scale and cost-effectiveness, but also to explore how these integrated approaches could stimulate effective food system governance by informing integrated food policies and funding schemes (Ruel et al., 2018). Stimulating integrated food systems R&I approaches calls for creating more (free from conflict of interest) public–private partnerships that would provide an opportunity to better align public and private funding efforts (Townsend et al., 2018). However, since issues that attract a high level of public interest do not always attract private sector investment (Pray and Fuglie, 2015; Heisey and Fuglie, 2018) it is of crucial importance to build strong and independent public R&I systems that can address market and system failures and engage with dominant and established pathways that are difficult to transform (FEC, 2018). Connecting and aligning R&I policies and experimenting with novel funding programs is happening, for instance, within the context of the EU FIT4FOOD2030 project. In experimenting with both novel ways of funding and doing R&I for food system transformation, 'Policy Labs' are adopting co-creation methods with a wide variety of stakeholders in 11 EU member states (Kok et al., 2019).

3. **Stimulating innovative experiments.** Public institutions need to find ways to combine top-down policy pathways with bottom-up experimentation to shape conditions for systemic change. The latter can be stimulated through approaches such as strategic niche management (Schot and Geels, 2008) and transition management (Loorbach, 2007) that focus on creating space for novel innovations, enable learning between diverse multi-stakeholder groups, and explore future pathways for system transformation. The worldwide rise in food policy networks, including multi-stakeholder food policy councils, is an example of innovative experiments that need to be supported because of their potential to link bottom-up initiatives with evidence-based food policies (Sonnino et al., 2019). R&I has an important role to play in fostering the inclusiveness and effectiveness of innovative food system governance experiments such as food policy councils and real-world laboratories via participative monitoring and evaluation efforts. This is key to be able to scale-up

learning experiences, connect local experiments with each other and with higher governance scales and inspire the collaborative design and implementation of effective multi-level interventions and integrated food policies (Sonnino et al., 2019; Gupta et al., 2018; Nevens et al., 2013).

5.6 CONCLUDING REMARKS

R&I could be a catalyst for a much-needed food system transformation, especially in situations of great uncertainty, like the one generated by the COVID-19 pandemic, when exploring all possible futures lies at the heart of innovative transformation. Yet, releasing its potential requires moving beyond traditional approaches that, although valuable from a sectoral perspective, have shown substantial limitations when responding to some persistent problems that affect food systems. Against this background, in this chapter we have explored issues that need to be addressed to develop more transdisciplinary and transformative R&I efforts and governance interventions that we consider necessary to support such efforts. The transformation of the food system, like the transformation of any complex system, offers an exciting opportunity for crossing the boundaries within and between science, policy, and society. A thorough rethinking of the role of R&I is a crucial step toward the development of the integrative policies that are necessary to engender systemic change – in the food system and beyond.

CHAPTER ACKNOWLEDGEMENTS

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6

Transforming research and innovation for sustainable food systems: A coupled-systems perspective

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ABSTRACT

Current research and innovation (R&I) systems are not equipped to fully serve as catalysts for the urgently needed transformation of food systems. Though research on food systems transformation (first order: 'what?') and transformative research (second order: 'how to') are rapidly gaining traction in academic and policy environments, current efforts fail to explicitly recognize the systemic nature of the challenges associated with performing transformative second-order research. To recognize these manifold and interlinked challenges embedded in R&I systems, there is a need for a coupled-systems perspective. Transformations are needed in food systems as well as R&I systems ('how to do the "how to"'). We set out to conceptualize an approach that aims to trigger double transformations by nurturing innovations at the boundaries of R&I systems and food systems that act upon systemic leverage points, so that their multisystem interactions can better support food system transformations. We exemplify this coupled-systems approach by introducing the FIT4FOOD2030 project with its 25 Living Labs as a promising multilevel boundary innovation at the cross-section of R&I and food systems. We illustrate how this approach paves the way for double systems transformations, and therefore for an R&I system that is fit for future-proofing food systems.

6.1 INTRODUCTION

Current food systems increasingly (re)produce a set of interlinked and persistent problems. Despite efforts to tackle these interlinked problems, profound transformation is yet to be realized (see, for example the EAT Lancet Report, Willett et al., 2019). Currently, food systems account for 21%–37% of greenhouse gas emissions (IPCC, 2019) and 70% of freshwater use (FAO, 2017), and lie at the heart of land-use conflicts, in both the global North and South (Garciá-Ruiz and Lasanta, 1993; Rulli et al., 2013). Excessive agricultural pesticide and herbicide use further contributes to soil degradation and biodiversity loss (Silva et al., 2019) as 16% of pollinators are threatened with global extinction (FAO, 2019). Unhealthy diets lead to the triple burden of malnutrition (Shrimpton and Rokx, 2012) with 11% of the world population being undernourished, 39% overweight, 13% considered obese, and 26% suffering from micronutrient deficiency (Dary and Hurrell, 2006; WHO, 2012; FAO, 2018). Diet-related non-communicable diseases (NCDs), such as cardiovascular diseases, diabetes, and certain cancers, are on the rise globally and already lead to an estimated 40 million deaths per year (WHO, 2018).

In recent years, it has been recognized that food systems can best be understood as complex systems (Ericksen, 2008; Ingram, 2011; Kuhmonen, 2017; Zhang et al., 2018; Oliver et al., 2018; FOOD2030 Expert Group, 2018; Jagustović et al., 2019), pointing to the need to understand the dynamics of systems as a whole, rather than focusing only on their constitutive parts. Holistic conceptualizations of food systems therefore aim to move beyond traditional divisions between production-oriented and consumption-oriented approaches by emphasizing the need to include all relevant processes (e.g., food production, distribution, consumption), actors (e.g., farmers, researchers, consumers), policy sectors (e.g., health, agriculture, environment), governance levels (e.g., local, national, global), and functionalities (e.g., healthy diets, access to food, employment, fostering commensality, and cultural identity) in research and policy efforts. Such conceptualizations point to the need to move beyond linear models (such as value or supply chains) and circular food system models (such as food cycles) since they do not adequately capture the complex structural and dynamic properties of food systems (Zhang et al., 2018; Ruben et al., 2019). The many interacting elements of complex (food) systems give rise to properties such as resilient or locked-in system states, adaptivity, emergent behavior, self-organization, and non-linear dynamics, such as systemic feedback loops, synergies, and trade-offs (Zhang et al., 2018; Oliver et al., 2018; FOOD 2030 Expert Group, 2018; Jagustović et al., 2019). Such holistic food systems approaches are increasingly gaining ground in policy environments globally (see e.g., EC, 2017; HLPE, 2017; FEC, 2018; Parsons and Hawkes, 2018).

In the domain of research and innovation (R&I), the emerging field of transition studies offers analytical tools for both understanding ('what?') and governing ('how to') sustainability transformations of complex societal systems(Grin et al., 2010; Markard et al., 2012; Turnheim et al., 2015; Köhler et al., 2019). These transformations - called transitions in transition studies - are characterized as non-linear processes of structural change (Geels and Schot, 2007; Rotmans and Loorbach, 2010) that entail *a "profound change in various or all aspects of a system's functioning"* (De Haan, 2010: 59) and lead to *"far-reaching changes in the system along different dimensions: technological, material, organizational, institutional, political, economic, and socio-cultural"* (Markard et al., 2012: 956). Research on transformations of (agri-)food systems using a transition studies perspective is rapidly gaining traction (Ruben et al., 2019; Spaargaren et al., 2013; El Bilali, 2019a,b).

In a recent work, Fazey et al. (2018a) refer to such transformation research and explore a characterization of first-order ('what?') and second-order ('how to') approaches. While first-order research is concerned with understanding the mechanisms of societal transformation, and generally considers researchers to be rather independent observers, second-order approaches aim to contribute to societal transformation through research as an intervention and acknowledge that the researcher is part of the system she aims to transform. Such transformative second-order research, according to Fazey et al. (2018a: 54), *"includes mode 2, transdisciplinarity, post-normal, participatory, sustainability science, and action research".* Though it is increasingly recognized that such approaches might contribute effectively to societal transformations by generating societal impact (Schneider et al., 2019), doing transformative research is not a straightforward endeavor and involves many challenges. For transformative second-order research, the challenges are especially problematic and relate to R&I processes, as well as to the associated systemic environments in which these processes are embedded (Lang et al., 2012; Brandt et al., 2013; Fazey et al., 2018b; Ribeiro et al., 2019). Surprisingly, although scholars often emphasize the challenges they encounter in transformative efforts, they largely ignore the systemic nature of these challenges and do not provide systemic approaches to tackle them. We posit that if R&I is to live up to its full potential as a catalyst for food systems transformation, the challenges of doing second-order research need to be resolved (see also Gill et al., 2018). Henceforth, the goal of this conceptual chapter is to develop an action-oriented approach to tackling those challenges by explaining 'how to do the "how to"'—which we call a coupled-systems transformation approach.

In pursuit of developing an approach to answer the 'how to do the "how to"' question, in Section 6.2 we first reflect upon food systems transformation literature through the lens of Fazey et al.'s (2018a) categorization of two orders of transformation research, and we explore the manifold and interlinked challenges of transformative second-order research. Subsequently, in Section 6.3 we posit that such manifold and interlinked challenges are crying out for the adoption of a systemic perspective to R&I. To this end, we set out to conceptualize an approach that aims to trigger double transformations by nurturing innovations at the boundaries of R&I and food systems so that their systemic interactions can better support food system transformations. We exemplify this coupled-systems approach in Section 6.4 by introducing the EU FIT4FOOD2030 project as an instrument designed to foster double transformations. FIT4FOOD2030 is a Horizon 2020 project that supports the European Commission (EC) in the implementation of the FOOD 2030 policy framework. It aims to contribute to food systems transformation through research and innovation (FOOD 2030 Expert Group; EC, 2017). Finally in Section 6.5, we conclude this chapter and present an outlook.

6.2 TWO ORDERS OF FOOD SYSTEMS TRANSFORMATION RESEARCH

6.2.1 First order: understanding mechanisms of system transformation

Within transformation research, first-order approaches are the most dominant (Fazey et al., 2018a). First-order approaches aim to understand and describe the mechanisms driving the dynamics of societal transformations. In doing so, they tend to consider research *as "being conducted from without the subject of study, as if looking at the issue or system from the outside"* (Fazey et al., 2018a: 58), assuming that researchers can be independent observers of the system they study. According to Fazey et al (2018a: 58), this leads the focus of the research toward the *"explanatory problem solving of natural and social science questions relating to social change and environmental sustainability"* while assuming that researchers are the actors most fit to know what kind of knowledge needs to be produced for it to contribute to system transformation. It is then generally considered the responsibility of societal actors to utilize this knowledge toward system transformations. First-order research is important and valuable since it not only yields insights into mechanisms of transformation, but also helps to articulate the urgency of the required societal transformations.

When it comes to (agri-)food systems research, first-order approaches use a wide variety of conceptual frameworks. Below, we present an exploratory overview of recent literature, that aims to highlight this variety of frameworks in studying dynamics and transformations, or transitions, in (agri-)food systems. We rely on recent (2015–2019) key overviews of the field (Turnheim et al., 2015; Loorbach et al., 2017; Köhler et al., 2019) in identifying several influential conceptual frameworks for understanding (mechanisms of) societal transformations. We then illustrate each of these frameworks with some empirical examples of research in the domain of (agri-) food systems, which were identified in a scoping exercise.

Research with a distinct socio-technical perspective, for instance, employs (historical) analyses to understand the dynamics of sustainable transformations by using the increasingly popular multi-level perspective (MLP) (see Geels and Schot, 2007; cf. Köhler et al., 2019; Markard et al., 2012; El Bilali, 2019b). Such an analytical gaze can help, for example, to better understand the dynamics of agri-food regimes (e.g., Morrissey et al., 2014) and multi-sectoral interactions between health care and agriculture in care farming (e.g., Iancu et al., 2014; Hassink et al., 2018). It might also help to understand the role of pioneers in the emergence of organic agricultural practices (e.g., Hauser and Lindtner, 2017), and to conceptualize the structural properties of diversified production systems (e.g., Gaitán-Cremaschi et al., 2019). Socio-ecological perspectives that can be used to understand the complexity of systemic dynamics are also considered an important approach in transformation research (Loorbach et al., 2017) and focus on a range of empirical topics, from grasping the dynamics of dietary behaviours (e.g., Robinson, 2008) to managing small-scale fisheries (e.g., McClanahan et al., 2009). Other qualitative analytical approaches that aim to understand the (technological) dynamics of food systems include technological innovation systems research (e.g., König et al., 2018; Randeli and Rocchi, 2017; Reardon et al., 2019), social practice approaches (e.g., Spaargaren et al., 2013; Cohen and Ilieva, 2015; Hoffman and Loeber, 2016), and research focusing on the multitude of values involved in food systems transformation (e.g., Plumecocq et al., 2018; De Krom and Muilwijk, 2019).

Another type of approach used in first-order transformation research relies on quantitative systems science. This includes the development of models and metrics for measuring sustainability, risks, and climate change, and their relation to (global) food system performance (e.g., Zhang et al., 2018; Perrot et al., 2011; Pasqualino et al., 2019; Rutten et al., 2018; Allen and Prosperi, 2016). Furthermore, there are schools of agro-economic research that focus on modelling cropping, farming systems, supply-chain dynamics, land-use, as well as those efforts focused on modelling consumption behavior, nutrition (security), and their relation to food environments and health (e.g., Allen and Prosperi, 2016; Van der Vorst et al., 2000; Hammond, 2009; Hammond and Dubé, 2011; Xue et al., 2018).

Finally, the role of governance, power, and agency is gaining increasing attention in the field (see Markard et al., 2012; Köhler et al., 2019). The analytical turn toward acknowledging the role of power is crucial, since recent work has indicated how understanding power and agency might help to understand systemic stasis and foster change (Avelino and Rotmans, 2009; Grin, 2010). Understanding power imbalances can, for instance, explain how regime actors contribute to enforcing status quo configurations in food systems (Grin, 2013; Rossi et al., 2019). Such an understanding also helps to indicate the shift in power from primary producers to input providers, large food companies, and retail (Rayner et al., 2008; Sonnino et al., 2014). Furthermore, empirical studies, for example, focus on how actors strategically draw upon their agency (e.g., in public procurement in UK universities catering systems, Stahlbrand, 2016), but also focus on the role of non-human agency in system dynamics (e.g., in New Zealand wine production (Rosin et al., 2017).

6.2.2 Second order: Intervening in and contributing to societal transformations

Second-order efforts focus not only on unravelling systemic dynamics, but also contribute to system transformation through research as an act of intervention. Focusing research on both knowing and doing challenges multiple ontological and epistemological assumptions about what research 'should do' and moves beyond traditional linear and positivist approaches in the realm of R&I (Fazey et al., 2018a,b). Second-order efforts acknowledge that researchers are inevitability part of the system they study and are therefore likely to always intervene in the system of interest as *"one of the many actors in the process of change"* (Fazey et al., 2018a: 58).

Second-order approaches also recognize the importance of interdisciplinarity and stakeholder engagement in developing the problem perceptions and shaping the research process, as well as contributing to transformations (transdisciplinarity). This leads to new roles for researchers engaging in second-order processes, as well as to a need for them to recognize normative aspects and to be reflexive regarding their own knowledge, values, and interpretations.

For food systems, transformative second-order research is considered to provide effective and useful contributions to understanding and governing, for example, the upscaling of, and knowledge exchange within, novel agroecological practices (Mendéz et al., 2013; Cuéllar-Padilla and Calle-Collado, 2011), the co-production of relevant (local) knowledge in organic agriculture (Aeberhard and Rist, 2009), the creation of collaborative advantages for both farmers and researchers in participatory technology development processes (Broerse and Bunders, 2000; Hoffmann et al., 2007; Hoes et al., 2008), and the co-designing of governance strategies with small-scale fisheries (Chuenpagdee and Jentoft, 2019; Bower et al., 2019).

To illustrate in more detail some of the key features of such transformative second-order efforts, and their use in different analytical approaches to guiding food systems transformation, we provide three examples that could be considered transformative second-order approaches, grounded in the principles of transdisciplinarity. The first example is an approach that originates from attempts to modernize and transform Dutch animal husbandry (Bos and Grin, 2008; Groot Koerkamp and Bos, 2008; Bos et al., 2009) through multi-stakeholder efforts: reflexive interactive design (RID). The RID approach was used recently to facilitate transformation of livestock systems on the Galapagos Islands (Puente-Rodríguez et al., 2019: 168) *as "a way to structure a knowledge–practice interface in which reflection and dialogue are facilitated for managing (heterogeneous) knowledge and reflecting on practice".* This action-oriented approach aims to have multi-stakeholder collaborations co-designing problem spaces, to focus on the (knowledge) needs of different actors, to conduct an analysis of the system, to develop shared visions of the system's future, and in the meantime to form a diverse reflexive network to foster structural systemic transformations.

Another example of a transdisciplinary approach developed first in Dutch agricultural R&I is reflexive monitoring in action (RMA, Van Mierlo et al., 2010a,b). The RMA approach focuses on enhancing deep learning and reflexivity in transformative projects while at the same time fostering systemic transformations. In RMA, an actor (the 'reflexive monitor') aims to facilitate participants of the project to reflect upon the ambitions of the project and the current (unsustainable) practices (and how they are institutionally embedded), as well as to identify opportunities in the system that foster sustainable innovation (Van Mierlo et al., 2010a: 11). Within RMA, researchers can perform the role of the reflexive monitor, but that requires them to adopt a new role, which in turn requires specific skills and competences (Fazey et al., 2018a; Wittmayer and Schäpke, 2014; Mauser et al, 2013; Regeer et al., 2009).

A final example considers transition management (TM; see e.g., Rotmans and Loorbach, 2009; 2010) approaches. This approach was employed, for instance, in the project Accelerating and Rescaling Transitions to Sustainability (ARTS), which aimed to understand and contribute to the role of (civil society in) urban sustainability transitions (including the role of food and urban agriculture) in five different city regions across Europe (Gorissen et al., 2018) Rooted in a TM approach which focuses on *"activities directed toward creating and furthering new practices in a sector"* (van Raak. 2010: 76), there is a strong emphasis on the role of experimentation dubbed 'transition initiatives' (Gorissen et al., 2018) or 'transition experiments' (Rotmans and Loorbach, 2009). In the case of Genk (Belgium) in the ARTS project, local transition arena for experimentation involving *"co-creation and co-design of urban patterns of production and consumption […],* *new solutions for urban challenges can provide a new boost in creativity and new ways to organize local governance and local economy"* (Gorissen et al., 2018: 182). TM efforts also explicitly require researchers and other actors to adopt new roles (Scholz, 2017; De Haan and Rotmans, 2018) in order to effectively steer toward systemic transformations.

6.2.3 Challenges to transformative second-order research

Despite their potential to contribute to sustainable (food) systems transformation, the challenges of conducting transformative second-order research are manifold. Based on a scoping exercise, we argue that at least seven clusters of challenges can be identified, most of which are featured in reflections on transdisciplinary research.

First, the way in which knowledge production is (and has been historically) organized is limiting the uptake of transformative second-order research. Knowledge production is traditionally structured in silos of disciplines and sectors (Reardon et al., 2019; Haddad et al., 2016; Serraj and Pingalu, 2019), leaving little room for the exploration of collaborations across disciplinary and sectoral silos. In addition, public and private partnerships fostering food systems transformation are still relatively rare (Townsend et al., 2018).

Second, funding structures do not sufficiently support transdisciplinary and action-oriented research, which limits the uptake of such efforts and the transformative innovations that could originate from them. While the call for transformative research policy is emerging it is relatively new and most R&D funding is still traditional and linear (cf. Schot and Steinmueller, 2018). For example, agricultural R&I investments in the EU are mostly targeted at food production and food security (SCAR, 2018). This means that other parts of food systems such as processing, logistics, and retail are underrepresented (Reardon et al., 2019) and that the interconnectedness of the different elements within food systems is not sufficiently recognized and not reflected in current R&I investments (Haddad et al., 2016). Therefore, both first- and second-order approaches that take systemic perspectives and advocate systemic transformation are disadvantaged.

Furthermore, academic incentive structures do not support transformative collaboration, favouring disciplinary endeavours that are focused on high publication outputs in high-impact journals. According to Wiek et al. (2012:22), the *"dominant institutional structures that govern academic research, from funding schemes to promotion and tenure policies […] are, in the majority of cases, not conducive to this new type of research, which limits the full development and impact of transformational sustainability research".* This also means that *"the disciplinary organization of scientific knowledge production remains largely unchanged"* (Jerneck et al., 2011: 70). These academic structures limit the impact of transformative research (Schoolman et al., 2012).

Fourth, (research) cultures across the globe do not sufficiently value the (outcomes of) transdisciplinary research, arguing that transdisciplinary research does not lead to objective or scientific knowledge or that the outcomes are not sufficiently legitimate (Lang et al., 2012; Zuiderent-Jerak, 2015). This is exemplified by Schoolman et al. (2012), who show that transformative research is often not published in high-impact journals; this is inherently related to the third challenge regarding incentive structures. This severe undervaluation leads Castree (2016) to argue that we need a new social contract in order to re-legitimize the new role of research (that is, transformative research) in society. Although a number of studies have explored ways to appraise the outcomes of transition experiments (as examples of transformative research), coordinating efforts are widely lacking (Luederitz et al., 2017).

Fifth, transformative research is evolving as a field and there are clear methodological and conceptual challenges within transdisciplinary research itself. Major challenges in the field include a lack of coherent framing and positioning as a field (Brandt et al., 2013) and a lack of coherent methods, with methods being used without being tailored properly to the relevant process phases or knowledge types (Lang et al., 2012; Brandt et al., 2013; Wiek et al., 2012). In addition, there is a gap between 'best practice' transdisciplinary research and what is published in scientific journals (Brandt et al., 2013). Furthermore, knowledge integration in practice faces challenges related to social, organizational, communicative, cognitive, and technical aspects (e.g., Pohl, 2011), and the role of reflexivity in transdisciplinary research is still under-conceptualized (Popa et al., 2015).

Sixth, it is challenging to engage all relevant stakeholders in transformative efforts and to continually keep them engaged (Lang et al., 2012). Related to the low uptake of transformative food systems R&I is the limited active involvement of, for example, citizens and farmers (FOOD 2030 Expert Group, 2018; FEC, 2018; ISDC, 2015). Given their central role in food systems, it is important to further engage these actors in food systems R&I (SCAR, 2018). This is not straightforward since it is challenging to work *"across differences in background, training, experiences, needs, ideologies, and interests […] finding agreement on a consensual framework for the research, on methods, standards of work, and priorities, being confronted with different ontologies and epistemologies"* (Moser, 2016: 111) or even with distrust and institutionalized conflicts (Huchzermeyer and Misselwitz, 2016). At the same time, such processes can be heavily constrained by the limited time and resources of non-academics who may need to engage in the co-production of knowledge (Moser, 2016).

Finally, we observe challenges in R&I practice since researchers and innovators lack the competences needed to engage in transformative second-order efforts, and so do policymakers (e.g., for collaborating across silos and embracing reflexivity and system thinking). Such engagement requires adopting roles in R&I processes other than those of traditional scientists, innovators, or policymakers. It requires new roles such as 'change agents' (researchers participating in practice to foster change), 'capacity builders' (supporting participants' transformative capacity building) and 'reflexive process facilitators' (facilitating transformative learning) (see e.g., Wittmayer and Schäpke, 2014; Sarkki et al., 2013). Adopting these roles in practice is challenging because of differences in the understanding and expectations of each role and because of possible conflicts between them. As such there is an additional challenge for those taking up these roles, which points to the need for capacity building (Mauser et al., 2013; Verwoerd et al., 2020).

Taken together, these challenges are even more difficult to overcome due to their entangled, mutually reinforcing, and self-reproducing nature (Fazey et al., 2018b: 203). Such a fundamentally interwoven set of challenges points to their truly systemic nature; they involve practices, structural and cultural dimensions of R&I efforts as well as the actors involved in R&I. As a means of dealing with another layer of complexity - in addition to the complexity of food systems and in order to explore possible solutions to overcome this new set of wicked challenges - we employ a systems perspective for food systems as well as the associated R&I systems that aim to serve as catalysts for fostering food systems transformation.

6.3 HOW TO DO THE HOW TO? CONCEPTUALIZING INTERVENTIONS FOR TRIGGERING DOUBLE TRANSFORMATIONS

6.3.1 Systemic perspective on research and innovation: The need for double transformations

It can be beneficial to acknowledge the systemic nature of the above-mentioned challenges and of R&I efforts more generally, since that allows us to understand the structural problems within these R&I systems that are related to their capacity to contribute to food systems transformation. A systemic take on R&I is rather common for those studying the interplay between science and society: scholars regularly speak of 'knowledge systems' (Cash et al., 2003; Van Kerkhoff and Szlezák, 2016), 'national innovation systems' (Freeman, 1995), 'technological innovation systems' (Bergek et al., 2008a; 2015; Markard et al., 2015), 'science systems and innovation systems' (Tödttling and Kaufmann, 2001), 'knowledge and innovation ecosystems' (Carayannis and Campbell, 2009), 'agricultural innovation systems' (e.g., Klerkx et al., 2010), 'knowledge production and use systems'

(Fazey et al., 2018b), 'knowledge and innovation systems' (Kuhlmann and Rip, 2018), 'agricultural innovation ecosystems' (Pigford et al., 2018), or—to adopt an umbrella term, which we do—research and innovation (R&I) systems. Adopting a systemic perspective on R&I, we argue, gives rise to at least three questions: (1) what does a systemic take on R&I mean?; (2) what do R&I systems consist of?'; and (3) what are the consequences of a systemic take on both R&I and food systems for conceptualizing how R&I can contribute to food systems transformation?

First, reiterating the foundations of complex societal systems, we follow De Haan and Rotmans' (2011) definition of a societal system as a part of society with a particular function that aims to fulfil a societal need. Functions of R&I systems can be, for instance, producing knowledge, communicating knowledge, innovating products or processes, disseminating research, informing policymakers, etc. Societal systems such as R&I systems consist of multiple interacting components: structures, cultures, and practices, as well as the actors involved in them (Van Raak, 2010; De Haan and Rotmans, 2011). The complexity of such systems is exemplified by their non-linear dynamical behavior, which can be seen as the product of emergent self-organizing processes evolving from the interaction networks of the components in the system. Regarding R&I systems, this is in line with observations of the complex nature *of "systems, networks, and sectors of innovation that is driven by increasingly complex, non-linear and dynamic processes of knowledge creation"* (Carayannis and Campbell, 2009: 202).

Second, following this line of reasoning, R&I systems consist, then, of structural components such as laws, funding structures, universities and research centers, laboratories, industry networks, scientific journals, ministries, cultural components such as the values and norms that relate to innovation and technology, ideas on the role of research in society, political environments, practices such as peer review, education, scientific processes, science–industry collaborations, mono-, multi-, inter- and transdisciplinary R&I processes, and of course a multitude of actors such as researchers, policymakers, consumers, producers, industry actors, and innovators. Although there is quite a lot of overlap between actors and other components in R&I systems and the thematic areas they work in (e.g., food, energy, health), there are also clear differences. For example, many countries have separate ministries, and therefore policies, policymakers, and cultures for R&I, decoupled from the sectoral ministries. The same can be observed in supranational entities like the EC, which at the time of writing (November 2019) has separate General Directorates for Research and Innovation (DG RTD), Agriculture and Rural Development (DG AGRI), and Health and Food Safety (DG SANTE). These structures, cultures, practices, and actors together co-constitute the systemic functioning of R&I systems.

Finally, what consequences does a coupled systemic take have when it comes to the role of transformative R&I in realizing food systems transformation? The many challenges, as elaborated in Section 6.2.3, indicate that some of the desired functions of R&I systems are currently not being fulfilled, because the interactions between the components of R&I systems do not lead R&I systems as a whole to contribute efficiently to food systems transformation. Such a view has several implications for efforts aiming to alter the interactions between R&I systems and other societal systems. Those efforts should explicitly acknowledge:

- the systemic, complex, and dynamic nature of the challenges of transformative second-order research by introducing a coupled-systems perspective that connects the system of interest to a systemic perspective on R&I.
- that for R&I efforts to serve as catalysts for transformation in another societal system, there is a need for systemic reflection on the interactions between R&I systems and the system of interest. That in turn means that there is a need to explore double transformations. This echoes recent calls (Schot, 2016; Schot and Kanger, 2018; Papachristos et al., 2013) to explore underlying mechanisms of inertia and the inter-systemic leverage points of transformative dynamics.
- that researchers and other actors are entangled in multiple systems at once, which means they also have to navigate in, actively and reflexively engage with, and act to transform multiple systems. This also requires researchers and innovators to transcend multiple logics, understand multiple systems, and establish transformative interactions between multiple systems.

Therefore, to answer our third question about the implications of this coupled-systems take on transformation, we argue there is a need for (R&I) efforts to realize transformations in R&I systems themselves as well as in the system(s) they aim to transform through transformative second-order efforts. A schematic overview of the two orders of transformation research, assumptions about the relation between the researcher and the system, and a visualization of an explicit coupled-systems perspective are depicted in Figure 6.1.

6.3.2 How to do the how to: Designing boundary interventions on leverage points

Acknowledging the need for double transformations is one thing; achieving them is another. Before elaborating on how to empirically design a transformative intervention to trigger double transformations, let us first highlight two notions which we think can contribute to our understanding of the mechanisms through which transformative interventions can contribute to double transformation on a more fundamental level: (1) boundary innovations and (2) leverage points.

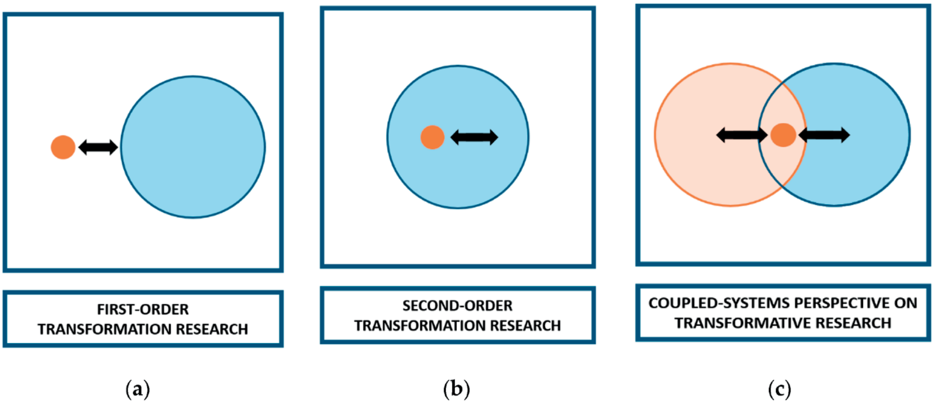

Figure 6.1 | Schematic depiction of the different orders of transformation research and the relation between the 'researcher' (orange dot), the societal system of interest (e.g., the food system: blue circle), the R&I system (orange circle), and the flow of interactions (black arrows); (**a**) first order: the researcher as independent observer studies the system of interest; (**b**) second order: the researcher is engaged in the system of interest and tries to understand and transform it; (**c**) coupled-systems perspective: the researcher is engaged in the system of interest as well as in the R&I system; she acknowledges this multisystemic complexity and aims to understand and transform both systems by changing their interactions.

The first notion—'boundary innovations'—concerns the locus of the intervention and its relation to societal transformation. The importance of a cross-boundary innovation as an instrument for fostering sustainable transformation is increasingly recognized (Hassink et al., 2018; Pigford et al., 2018; Walrave et al., 2018). It refers to an innovation that *"crosses systemic boundaries (that is the innovation interacts with different sectoral systems), but it also fundamentally changes the type of relation between those systems"* (Raven and Verbong, 2009: 85), for example, it results in competition between different systems or in opportunities for creating symbiosis. Realizing symbiotic systemic interactions is challenging; actors or networks at such systemic boundaries are confronted with multiple sets of logics, actors, rules, practices, cultures, and structures (Hassink et al., 2018; Ingram, 2018). Schot and Kanger (2018) in their work on Deep Transitions, elaborate on the importance of coupling cross-systemic structures, functionalities, and logics to realize multisystem transitions. One explicit task of boundary innovations can be, then, to connect and align cross-systemic logics, practices, cultures, and structures (see also Raven and Verbong, 2009). For example, Schot and Kanger (2018: 1054) consider coupling *"a waste management system provid[ing] an input into the energy system"* to be a functional coupling and these systems sharing an R&D facility as an example of structural coupling. Furthermore, Hassink et al. (2018) point to the importance, capacity, and agency of actors engaged in cross-boundary innovations in overcoming the challenges of multisystem interactions. This relates to what we indicated in the previous section and highlights the importance of supporting actors involved in boundary innovations to reflexively navigate multiple systems and establish transformative interactions between multiple systems. This requires interventions that foster boundary innovations to employ methodologies that enhance learning and reflexivity. But while the concept of boundary innovation points to the locus of the intervention, it does not explicitly reveal how the involved actors should design instruments for fostering double transformations.

Therefore, we employ the second notion—'leverage points'—to operationalize and focus the direction of transformative interventions. One major challenge for multisystem transformations lies in the identification of *"the mechanisms, processes and actors, which influence the evolution of a sociotechnical system and may or may not be part of it"* (Papachristos et al., 2013: 2). We therefore deploy the notion of leverage points to operationalize how boundary innovations can aim to redirect the interactions between R&I systems and food systems. The importance of identifying and acting upon leverage points for complex societal systems transformation was introduced by Meadows (1999). Leverage points are *"places within a complex system where a small shift in one thing can produce big changes in everything"* (ibid: 1). In a recent revaluation of her work, Abson et al. (2017), as well as Fischer and Riechers (2018), follow and adapt Meadows' hierarchy of places of intervention in complex systems to achieve sustainability transformations. They identify 12 orders (in four realms) of intervention on leverage points, from very 'shallow' Parameters or Materiality (altering rewards and material flows) via Processes (changing feedbacks), and Design (redefining goals, information flows, and self-organization) to the most impactful 'deep leverage points' in the realm of Intent (changing mindsets and paradigms). Such a conceptualization is useful since it helps to identify where intervention can be most effective and where it is perhaps hardest to realize and serves to provide *"a common entry point for academics from different disciplines and other societal stakeholders to work together"* (Fischer and Riechers, 2018: 115). The hypothesis Fischer and Riechers (2018) present is that if the interactions of leverage points are taken into account properly, this might lead to clever intervention strategies being implemented at 'chains of leverage points' (both deep and shallow), potentially leading to transformative dynamics.

To summarize, and based on the above discussion, one approach to tackling the 'how to do the "how to"' question could be

- to foster boundary innovations at the cross-section of R&I systems and food systems
- that aim to trigger double transformations by identifying specific leverage points and intervening at these points in R&I systems (and food systems)
- with the objective of better aligning the inter-systemic interactions between them
- so that R&I systems can serve as more effective catalysts of food systems transformation.

The dynamics of a coupled-systems approach to fostering double transformations through boundary interventions is schematically depicted in Figure 6.2.

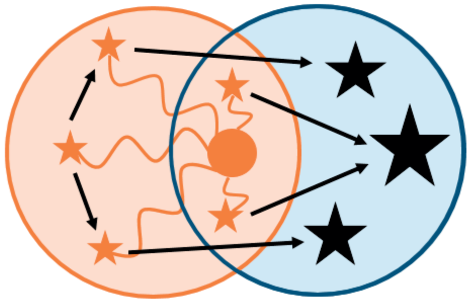

Figure 6.2 | Schematic depiction of the dynamics of a coupled-systems approach: a cross-boundary innovation (orange dot) located at the boundaries of the R&I system (orange circle) and the food system (blue circle) identifies and intervenes on chains of leverage points in R&I systems (orange stars) that aim to change the inter-systemic interactions so that R&I systems can more effectively contribute to food systems transformation (black stars).

6.4 AN EXAMPLE OF HOW DO TO THE HOW TO: THE FIT4FOOD2030 APPROACH

'Fostering Integration and Transformation for FOOD 2030' (FIT4FOOD2030) is a Coordination and Support Action project funded through Horizon 2020 (2017–2020) for further development and implementation of the EC's FOOD 2030 policy framework (EC, 2017; FIT4FOOD2030, 2018; 2019). In line with the aim of FOOD 2030, FIT4FOOD2030's mission is to contribute to the transformation of European food systems through R&I to make them 'future-proof', i.e., sustainable, resilient, responsible, diverse, competitive, and inclusive. The three-year project has 16 partner institutions across Europe, including universities, research funders, technology and innovation platforms, industry networks, and science engagement organizations. The transdisciplinary consortium therefore represents the quadruple helix, including stakeholders from the domains of research, policy, industry, and civil society (Carayannis and Campbell, 2009) and acts at the boundaries of food systems and R&I systems in the EU. At the time of writing, the project is still ongoing. Therefore, our elaboration mainly focuses on illustrating the design and mechanisms, not on the final outcomes of the project.

The project builds on the above-mentioned reasoning in stressing that though R&I systems in Europe have contributed to providing solutions to food systems' problems, they are currently unfit to fully contribute to large-scale sustainable transformations. The project cites the challenges of fragmented funding structures: little involvement of societal stakeholders, citizens, and primary producers in food systems R&I, a lack of competences of researchers and policymakers to facilitate such involvement, modest and fragmented private R&I investments, and academic incentive structures that hinder transdisciplinary collaborations (FIT4FOOD2030, 2018; 2019; Hoes et al., 2019). It is not surprising that these challenges are similar to those formulated in Section 6.2.3 that represent the challenges of transformative second-order efforts. The main objective of FIT4FOOD2030 is to tackle these challenges through the establishment of a sustainable, multi-stakeholder FOOD 2030 Platform, mobilizing a wide variety of stakeholders from different sectors at the levels of cities, regions, countries, and Europe. The FOOD 2030 platform aims to contribute to

- strengthening R&I policies' coherence and alignment to respond to a variety of actors' needs;
- building competences of current and future researchers, entrepreneurs, policymakers, and society at large; and
- raising awareness in support of the initiatives and action plan.

To guide the realization of these main objectives, the project designed three structures to foster transformation at three different levels: (1) an 'EU Think Tank' that acts as a link between the EC and member states and associated countries, with global outreach; (2) 'Policy Labs' on the national level that mobilize stakeholders in order to align R&I policies and investment schemes and integrate existing networks; and (3) 'City Labs' and 'Food Labs' on the local and regional levels that develop and pilot hands-on (in)formal training for students and professionals by bringing a wide diversity of actors together. An overview of the FOOD 2030 Platform is presented in Figure 2.2.

6.4.1. Designing boundary innovations in practice

Through this example, we posit that the design and establishment of the FIT4FOOD2030 project and its Platform and activities can be seen as an effort to trigger double transformations. Here, the FIT4FOOD2030 project is an experiment that crosses the boundaries of European R&I systems and food systems. As a boundary innovation it deploys several instruments, with associated key elements that aim to intervene at leverage points in order to realize profound transformation. The overall architecture of the leverage points, the challenges they aim to address, and what specific instruments the project uses to intervene are depicted in Table 6.1.

Note that all these leverage points are within the realm of 'deep leverage points', aiming to transform the structural design and (paradigmatic) intent of R&I system components. However, some of the main instruments—or key elements of the main instruments—can be seen as interventions on more shallow leverage points (such as processes or parameters; e.g., organizing 120 workshops, establishing new feedback loops of 'information' about designing learning processes) that together co-constitute interventions on deeper levels. It can be argued that successful intervention on the deeper leverage points enables the project to more effectively organize interventions on the shallower leverage points as well. This exemplifies the point of Fischer and Riechers (2018) that different leverage points (deep and shallow) can interact and therefore enable or constrain each other.

Table 6.1 | Overview of the FIT4FOOD2030 design, including leverage points, addressed challenges, main instruments, and key elements within those instruments.

Deep Leverage Points	Addressing Challenges	FIT4FOOD2030 Main Instruments	FIT4FOOD2030 Key Elements
Engaged FOOD 2030 Platform	All	FOOD 2030 Platform	Lab approach (Tools for) system analysis and facilitating activities in (FIT4FOOD2030) Living Labs
Competence Development	Lack of stakeholder engagement; lack of competences needed for transformation	7 City Labs 7 Food Labs	- Establishment of local networks to engage stakeholders and ensure sustainability - Workshops with stakeholders (on visioning, system analysis, pathways for transformation, and mandate for change) - Co-creating, testing, and implementing 19 educational modules - Influencing local/regional R&I/food policy agendas - Mutual learning and exchange between the Labs
R&I Policy Alignment and Coherence	Academic silos; fragmented funding structures; hindering of academic incentive structures	11 Policy Labs EU Think Tank	- Establishment of national networks to engage stakeholders and ensure sustainability - Workshops aligning different ministries on national levels (on visioning, system analysis, pathways for transformation, experimentation) - Co-creating R&I policy experiments such as (1) national transformative R&I agendas or visions; (2) nationally aligned R&I strategies across ministries; and (3 funding programs for transformative food systems R&I
Raising Awareness	Unsupportive research cultures; aims to contribute to tackling all other challenges	EU Think Tank Communication & dissemination strategy	- Policy briefs by the EU Think Tank targeting policymakers. - Strategies for engagement through the self-sustaining FOOD 2030 Platform - Online repository of Tools for Transformation - Channels: webinars, newsletters, deliverables, scientific articles, website, social media
Enhancing Transformative Capacity of R&I Processes	Challenges internal to transdisciplinary processes	Methodological development and monitoring	- Continual learning, monitoring, and evaluation via RMA and DLA approaches - Tools for system understanding, visioning, and building pathways for transformation - (Tools for) guiding experimentation - Supporting Community of Practice (CoP) of labs, their coordinators and the project consortium through mutual learning and training sessions

In the following section, we highlight how this reflexive approach, with the main instruments of the project (City, Food, and Policy Labs) being experimentation spaces, while at the same time conducting experiments themselves can be seen as a multilevel boundary intervention approach.

6.4.2 Multilevel boundary intervention: Labs as instruments for transformation

The main loci of intervention within the project are 25 Labs, on national and regional/local levels. These Labs build on the concept of Living Labs. While acknowledging that there are many views on what exactly constitutes a Living Lab (Leminen, 2015; Lehmann et al., 2015), we extrapolate our approach to Living Labs from Bergvall-Kårrborn et al. (2009: 9): that they facilitate *“open and distributed innovation processes engaging all relevant partners in real-life contexts, aiming to create sustainable values”.* There are many different kinds of ‘open innovation networks’ (e.g., Leminen et al., 2012; Lamine et al., 2012) that share the common characteristics of (1) involving diverse actors as co-creators on equal grounds and (2) experimenting in real-world settings (Almirall et al., 2009). The FIT4FOOD2030 project has various kinds of Labs, which were established after multiple open calls and selected for their innovative capacity and their motivation to engage stakeholders in order to contribute to transformation. The Labs serve as couplings between food systems and R&I systems operating at different levels and explicitly link functionalities, structures, and actors. Therefore, different kinds of labs work on distinctly different sets of leverage points and take different organizational shapes (FIT4FOOD2030, 2018; 2019).

Firstly, FIT4FOOD2030's City and Food Labs are examples of (peri-) urban Living Labs, which are rapidly gaining ground as instruments for fostering sustainability transitions on local (urban) levels (Bulkeley et al., 2016; Von Wirth et al., 2019; Nesti, 2018). To avoid a narrow urban focus, given the importance of connecting urban and rural areas when it comes to food systems transformation (FOOD2030 Expert Group, 2018; Marsden et al., 2018), the Labs are encouraged to have a peri-urban focus on metropolitan regions more broadly. The seven City Labs are embedded in science engagement organizations such as science shops, science museums, and science centers. These Labs build multi-stakeholder networks that aim to engage in continual dialogues and collaboration on the visioning of (1) a future-proof food system, (2) the role of R&I in a future-proof food system, and (3) the competences (knowledge, attitude, and skills) required for individuals engaged in R&I processes relating to a future-proof food system (Magarini and Porecca, 2018). In a later stage of the project, an additional seven Food Labs were recruited. These take on a different role and are following another timeline. While the trajectories of the City and Food Labs differ as a result of different contextual factors (e.g., the number of food-system related-initiatives in a specific region and the institution and design of the lab itself), all labs aim to contribute to building competences for the R&I processes of a future-proof food system by developing, testing, and implementing educational modules through playful co-creation with their locally established multi-stakeholder networks (cf. Van der Meij et al., 2017a). These modules can be targeted toward different stakeholders (e.g., schoolchildren, students, researchers, policymakers, entrepreneurs, or the general public) and are based either on light-learning (e.g., one- or two-hour workshop) or on deep-learning approaches (e.g., academic course lasting several weeks). Competences targeted within these modules include key competences needed for sustainability transformations (Wiek et al., 2011; Tassone et al., 2018) such as futures- and value-sensitivity, systems and strategic thinking, multi-actor collaboration, and integrated problem solving. Besides module development, local food systems transformation is stimulated via the development of local food-related R&I agendas to support innovative and integrative food policies and partnership building (Magarini and Porecca, 2019).

The project has also introduced Policy Labs. These Labs are situated on the national or regional level and are coordinated mainly by governmental policymakers; they are supported by multiple national ministries related to food and R&I. These Labs work toward R&I policy coherence*: "the process where policymakers design a set of policies in a way that, if properly implemented, they can potentially achieve a larger goal*" (Cejudo and Michel, 2017: 750), which can be organized at the levels of (1) objectives, (2) strategies and mechanisms, and (3) outcomes (Forster and Stokke, 1999). The 11 FIT4FOOD2030 Policy Labs engage in transition experiments that aim to construct novel institutional innovations or pathways for national governments to follow to reorganize their R&I system, and in particular its interaction with food systems. The Labs and their evolving networks serve as transition arenas (Rotmans and Loorbach, 2010: 157), which *"provide room for long-term reflection and prolonged experimentation"*. The timeline of the Policy Labs consists of three action phases: (1) system awareness and system understanding, (2) future outlook and agenda setting, and (3) policy experimentation. Parallel to these process phases is the continual activity of building engaged multi-stakeholder networks. In addition, reflexive learning and monitoring processes are supported by the project, and these are both important activities in transition experiments (Loorbach, 2007). By explicitly linking incumbent regimes and dominant actors to societal stakeholders and policy experimentation, these labs provide an interesting opportunity to co-create pathways that lead toward novel R&I systems that support sustainable food systems transformation.

The City, Food, and Policy Lab processes also contribute to transformative competence building among the Lab coordinators and the different stakeholders involved. The development of transformative competences is considered an important leverage point for creating a sustainable impact (Schneider et al., 2019) and it is important for stimulating actors to adopt different actor roles (see Section 6.4.3)

Finally, the EU Think Tank, comprising a transdisciplinary team of experts, aims to connect the EU level with the global, national, and regional levels by integrating and linking the Labs' results to the EU level, thereby potentially acting as a transformative network in itself. The EU Think Tank aims to stimulate the required transformation in food systems R&I in particular by identifying and highlighting promising pathways to stimulating the development of innovative European, national and regional R&I funding systems, as well as identifying what types of first- and second-order research these systems need to stimulate to deliver food systems transformation.

6.4.3 Four pillars of transformative learning

For City and Food Labs, as well as Policy Labs, learning within and between labs forms an important part of the process and guides efforts to upscale experiments and practices. Firstly, the project follows a multilevel approach to establishing learning among and between multiple levels: peer-to-peer, experiential, and experiment-to-experiment learning regarding Lab activities and outputs between Lab coordinators, within the transdisciplinary consortium, and between consortium members, the Labs, and their activities and outputs too. An overview of this multilevel learning process is presented in Figure 6.3.

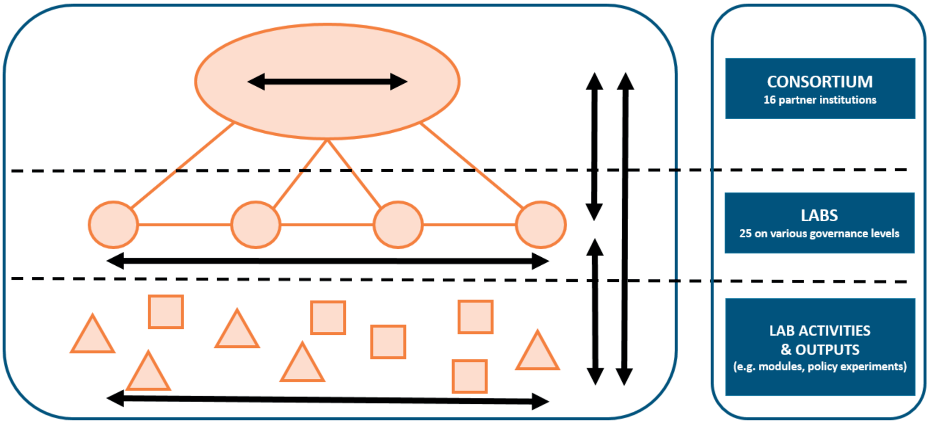

Figure 6.3 | Three levels of experimentation in FIT4FOOD2030 exemplifying the multilevel learning design. The black arrows indicate the learning processes taking place in the project.

Learning, reflexivity, and monitoring comprise four complementary pillars. First, an important part of facilitating learning between the Labs is the formation of communities of practice (CoPs) (cf. Wenger, 1998; Li et al., 2009). A CoP is a learning community of actors who share a similar passion, a sense of urgency or interest. This informal learning network stimulates reflection in action, out-of-the-box thinking, flexibility and adaptivity in action planning and taking, and the development of collaborative relationships. Through mutual engagement, CoP members create innovative solutions and new practices.

Second, the formation of a CoP and learning are stimulated through multiple training sessions for Lab coordinators. During these training sessions, competences are trained that are needed for the different roles that coordinators can adopt during the Lab activities (such as reflexive monitor, process facilitator, honest broker) and coordinators are familiarized with the tools that are used to facilitate transition experiments. These include tools for system analysis, stakeholder engagement, network building, visioning, and developing roadmaps and transformation pathways, as well as tools for the scaling up and sustainability of Lab activities and outputs.

Third, an important method for ensuring continual learning between Lab coordinators is the dynamic learning agenda (DLA): an open and interactive learning method for facilitating reflexivity in change processes (Regeer, 2009). Topics covered in monthly online DLA sessions vary from reflecting upon strategies that aim to engage stakeholders and the challenges of running Lab activities to sharing experiences of identifying systemic barriers to transformation or formulating visions.

Finally, as an overall methodology for monitoring and evaluation, FIT4FOOD2030 relies on the reflexive monitoring in action (RMA) approach as introduced in Section 6.2.2. RMA facilitates learning and reflection within experiments, like the Labs and their activities. It does so by encouraging participants to keep reflecting on the relationships between the ambitions of the project and the (institutionalized) practices used as well as the developments in the system that offer opportunities for realizing the ambitions of system transformation. Within RMA, the monitoring is not an ex-post activity, but an integrated part of the entire transformation process itself. Additionally, the insights gained from the monitoring are tried out and experimented with in the project’s new activities. It therefore allows for identification and implementation of interventions in the experiment, based on a selection of tools (see further below) and the preferences of the actors and/or monitor (Van Mierlo et al., 2010a,b).

When combined, these four pillars of enhancing learning and transformation aim to contribute to the stability, success, and, ultimately, the sustainability of the Labs as well as their (upscaling of) experiments.

6.5 CONCLUDING REMARKS AND OUTLOOK

In this chapter we argued that in order to tackle the manifold and interlinked challenges related to doing second-order ('how to') transformative research that contributes to food systems transformations, there is a need for a coupled-systems perspective to realize double transformations in both R&I systems and food systems ('how to do the "how to"'). We set out to conceptualize an approach that aims to trigger double transformations by nurturing innovations at the boundaries of R&I systems and food systems that act upon systemic leverage points so that their multisystem interactions better support food systems transformations. We exemplified this double systemic approach by introducing the FIT4FOOD2030 project as a promising multilevel boundary innovation at the cross-section of R&I systems and food systems.

By emphasizing the need for interventions at system boundaries, where actors engage in transformative second-order efforts in order to stimulate the reconfiguration of R&I systems, we hope to inspire transformation practices in three ways. First, while non-transformative and first-order transformation research are valuable and crucial if we want to better understand the mechanisms of system dynamics and articulate the urgency of persistent problems in global food systems, our approach focuses on the importance of optimizing R&I systems to better support second-order transformative efforts. Second, where thematic policy interventions (regulations, taxes, etc.) as well as bottom-up initiatives remain extremely important to stimulating food systems transformation, our conceptualization adds the need to intervene at the boundaries of R&I systems and food systems to unlock the potential of R&I as a true catalyst for food systems transformation. Finally, we encourage more transformative researchers to adopt an explicit coupled-systems perspective and to work toward realizing double transformations.

With regard to our empirical illustration, an innovative and adaptive multisystem and multilevel innovation, such as the FIT4FOOD2030 project, naturally gives rise to new challenges and questions. Major challenges, and the opportunities for learning that they lead to, relate to the question of how interventions targeting different leverage points (deep and shallow) could be optimally aligned to increase effectiveness and create real transformative change. As the project is still ongoing, it is highly adaptive in moving toward achieving double transformations, as well as to meeting the (local) needs of the Labs. Those local needs include developing strategies to ensure the sustainability of the activities and outputs of the labs in terms of future funding and institutionalization of the networks, modules, and policy experiments.

Moreover, boundary innovations such as FIT4FOOD2030 could provide insight into the effectiveness of the (combination of) instruments that aim to target deep leverage points for transformation on different (governance) levels. Furthermore, insights into how the multilevel nature of such interventions influences their transformative capacity might give rise to a better understanding of how multilevel governance arrangements in R&I systems can be designed (e.g., in relation to funding programs). In addition, such innovations might lead to a better understanding of how to more effectively link R&I efforts to thematic food policies. The need to develop integrated food policies is increasingly emphasized in both policy environments and academia (see e.g., Parsons and Hawkes, 2018; Parsons et al., 2019). Strategies for multilevel interventions can therefore feed into policy debates on, for example, the common agricultural policy (CAP) in the EU but can also inform national and local governments regarding developing integrated food policies that foster sustainable and healthy food systems.

Another interesting opportunity for enhancing our understanding of *doing* multilevel boundary innovation lies in the plurality and variety of the Living Labs involved in the project. In this plurality lies also the challenge of balancing Labs' autonomy and the context-specific nature of experimentation on the one hand and generalizing results as well as ensuring the transferability of lab outputs, such as specific policy experiments and educational modules, on the other hand. Future research—as well as monitoring, evaluation, and learning within the project—might also yield new insights into understanding how coordinators learn in a CoP, what competences are required for which roles in multilevel boundary innovations, how power dynamics shape the emergence of local networks, and how strategies for continual engagement of stakeholders play out in theory and practice. In these respects, the FIT4FOOD2030 project is an experiment that is just starting.

While the persistent problems in food systems are severe and ever increasing, it is promising that new conceptualizations of food systems as complex systems, as well as transformative research agendas, are getting traction in academia and in policy environments. If R&I systems truly aim to contribute to sustainable food systems transformation, researchers, policymakers, and other actors should not hesitate to reflect not only upon their own role, but also upon the role of the multisystemic environments they are operating in. Such an explicit double gaze paves the way for double systems transformations and therefore for R&I systems that are fit for future-proofing food systems.

CHAPTER ACKNOWLEDGEMENTS

We would like to acknowledge the participants of the FOOD 2030 Platform (including Lab coordinators, consortium members, the EU Think Tank and our Advisory Board) for the fruitful and many discussions on realizing double systems transformations.

PART IV

EMPIRICAL ELABORATIONS

The Head of Salomon's House on (a selection of) different members of the House:

"We have three that try new experiments, such as themselves think good.
These we call pioneers or miners.
[...]
"We have three that bend themselves, looking into the experiments of their fellows, and cast about how to draw out of them things of use and practice for man's life and knowledge, as well for works as for plain demonstration of causes, means of natural divinations, and the easy and clear discovery of the virtues and parts of bodies.
These we call dowry–men or benefactors.
[...]
Lastly, we have three that raise the former discoveries by experiments into greater observations, axioms, and aphorisms.
These we call interpreters of nature."

New Atlantis
Sir Francis Bacon, 1626

In Part II and III, we have sketched a theoretical exploration on the politics of transition governance, and we elaborated on a conceptual understanding of R&I systems as being entangled to food systems. In Part IV, let us now dive into the empirical depths of the FIT4FOOD2030 project.

In this endeavor, we were fulfilling a number of different roles (Chapters 2 and 11). However, they bear some striking resemblance to some of the roles of those working at the universities as envisioned by the Head of Salomon's House in Bacon's famous and Utopian work *New Atlantis* (1626) (see previous page for the quotation). As part of our project management roles in FIT4FOOD2030, we can be seen as the ones conducting the experiments (the "pioneers" and the "miners"). By being engaged in, and investigating, the work done by the Labs of the project, we can also be seen as those looking into the experiments of our fellows (which would be the Lab coordinators who did the actual work of running the Labs). Though I would not dare to describe ourselves as "dowry (wo) men" or "benefactors", we were actively engaged in ongoing experiments and aimed to contribute to those experiments through our engagement. Finally, through our abductive endeavors, throughout the work presented in this part we aimed to contribute to theory development. Hence, one could argue that we were also acting as "interpreters of (social) nature". Almost four centuries (!) after Bacon's work, one might start to wonder whether transdisciplinarity is actually an old wheel re-invented?

In any case, after an intermezzo where we introduce the different co-creation tools used in the project and elaborating on the project's network (Chapter 7), we present three different, complementary takes on the project. The first zooms in on the role of Lab coordinators as those 'doing inclusion' (Chapter 8) and aims to capture the highly political and challenging nature of those endeavors. Then, we turn our gaze from inclusion to impact, and we consider how the practice of 'doing Labs' relates to the different transformative impacts Labs aim to realize through their activities (Chapter 9). Finally, we consider the different Labs in the context of the project as transition experiments that can be connected across space and scale. We present our take on the translocal dynamics in the project in Chapter 10.

7

INTERMEZZO

FIT4FOOD2030: Future-proofing Europe's food systems with Tools for Transformation and a Sustainable Food Systems Network

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Minor updates have been added to reflect latest developments regarding the project.

ABSTRACT

Food systems are not fit for purpose, transgressing planetary boundaries, causing unhealthy consumption patterns and are rife with inequality. Research and Innovation (R&I) are central to tackling these food systems challenges, yet R&I systems are equally not fit for purpose, often lacking systemic and participatory approaches to food systems transformation. Therefore, there is a need for novel R&I approaches that adopt systemic and more participatory methods to engage with a wider range of food systems stakeholders. However, the lack of competencies and tools concerning novel R&I approaches for food systems transformation is a key hindrance to the deployment of such approaches in practice. These competencies and tools are vital for guiding and supporting food systems stakeholders dedicated to contributing to its transformation whether they are policymakers, researchers or citizens. This chapter presents the tangible results of the European (EU) Horizon 2020 funded *FIT4FOOD2030* project. As a response to the challenges food and R&I systems face as well as the gap in competencies and tools surrounding these issues, the project has developed a growing online hub of *Tools for Transformation* applicable to a broad range of transformation challenges and contexts (*e.g*. food, health or energy) and a *Sustainable Food Systems Network* to equip food system stakeholders with practical hands-on materials to '*do*' food systems transformation.

7.1 FUTURE-PROOFING EUROPEAN FOOD SYSTEMS THROUGH RESEARCH AND INNOVATION

Food systems must be transformed urgently to stay within planetary boundaries (Rockström et al., 2020). Globally, we are confronted with an extensive list of urgent food systems-related problems. Severe environmental problems include resource scarcity, biodiversity loss, decreased soil quality as well as excessive greenhouse gas emissions (FAO, 2019; Willett et al., 2019). Unhealthy consumption patterns have led to dietary risks becoming the third largest cause of death globally and malnutrition a leading risk factor for healthy life years lost (GBD, 2020). Additionally, the current COVID-19 pandemic has further amplified the interrelationships between health and food systems, highlighting the fragility and complexity of our current food systems and the urgent need for transformation toward systems that have the ability to adapt to future shocks, including pandemics and natural disasters, as mentioned in the European Commission (EC)'s Farm to Fork Strategy (European Commission, 2020a).

Food systems are best seen as complex adaptive systems characterized as multi-stakeholder, multi-level, and multi-functional and exhibiting dynamics such as trade-offs, synergies and systemic feedback loops (Zhang et al., 2018). The interactions between all these elements and processes are key to understanding food systems dynamics (Ingram, 2011). Yet directing complex system transformation is challenging, since it involves managing these interactions (Grin et al., 2010), integrating divergent and conflicting perspectives on desired outcomes of, and pathways toward, sustainable futures (van Bers et al., 2019), restructuring existing power relations to foster transformative change (Kok et al., 2021a), and aligning responses at various levels (from local to global; Moragues-Faus et al., 2017).

Traditionally, Research and Innovation (R&I) contribute to the production of new knowledge and to progressing innovation through the development or improvement of products, processes and services (EC, 2017). However, it is increasingly argued that R&I can also play a crucial role in identifying and supporting high-impact solutions to persistent food systems-related challenges and can contribute to systems transformation (Den Boer et al., 2021a; Herrero et al., 2020). While traditional R&I efforts have been successful in contributing to solutions within specific, compartmentalized parts of food systems, such as agricultural production or consumption, engagement with wider parts of food systems is still lacking. Current R&I systems are not fully equipped to contribute to food systems transformation, precisely because traditional approaches are unable to effectively address the complex dynamics of food systems. This can result in undesired and unintended consequences of the implementation of (socio-technical) innovations (Genus and Stirling, 2018; Gibbons, 1970; Rosner, 2004).

To deal with the inextricable linkages within and beyond food systems, the associated governance challenges, and to unlock the potential of R&I to serve as a catalyst for change, R&I systems should be inclusive, transparent, intersectoral, multi-stakeholder, multi-factorial, interdisciplinary and transdisciplinary (Den Boer et al., 2021). Alongside traditional R&I, there is a need for novel R&I efforts that adopt systemic approaches where different stakeholder groups, sectors, governance levels, and policy fields are included during the whole R&I process (Abson et al., 2017) to align outcomes with the values, needs and expectations of society (EC, 2014). This also calls for processes that involve co-development of knowledge where reflection upon different values, perspectives, interests and power imbalances are encouraged (Popa et al., 2015). If well designed and executed, such multi-stakeholder processes could lead to more socially relevant knowledge and innovations, provide legitimacy to R&I processes and outcomes, stimulate learning and reflection among stakeholders and contribute to the democratization of R&I (Lang et al., 2012; Schmidt et al., 2020) However, such transformative approaches are far from easy to adopt in practice. They require stakeholders to both fundamentally think and act in different ways and deal with systemic environments – skills which are barely stimulated in more traditional R&I approaches (Fazey et al., 2020). This means that for R&I systems to more effectively contribute to transforming food systems, R&I systems themselves must also be transformed toward those that better facilitate transdisciplinary and inclusive R&I efforts. Thus, there is a need for a double transformation in both food and R&I systems (Kok et al., 2019). A particular challenge affecting both the adoption of more inclusive and transdisciplinary R&I approaches and food systems transformation is the lack of competences (knowledge, skills and attitude) among R&I practitioners (Carriers and Gartzlaff, 2019) and tools to deploy such approaches in practice. Therefore, it is vital to encourage competence development among different stakeholders, for example researchers and policymakers (Ingram et al., 2020) and the creation and uptake of experimental and participatory methods and tools that facilitate the adoption of more inclusive practices (Hebinck et al., 2018; Pereira et al., 2018b). Such tools are important for guiding and supporting stakeholders dedicated to contributing to the urgent and difficult task of stimulating food and R&I systems transformation by helping them create 'transformative spaces for reflection and action' (Pereira et al., 2018b).

This chapter introduces the FOOD 2030 policy framework and the accompanying FIT4FOOD2030 project (2017–2020), a response to the challenges of transforming both food and R&I systems. It describes the Tools for Transformation developed by FIT4FOOD2030 to provide a multitude of stakeholders with hands-on resources to 'do' food systems transformation using more inclusive R&I methods. Examples of how these tools could be used in practice based on the experiences of the project's 25 Labs are also presented. Finally, we introduce the Sustainable Food Systems Network (https://sustainable-food-systems-network.mobilize.io/registrations/groups/42013), which aims to become an accelerator of change by stimulating stakeholders at multiple levels to experiment with and disseminate tools for food systems transformation.

7.2 IMPLEMENTING FOOD 2030: FIT4FOOD2030

'FOOD 2030' is the EC's R&I policy framework responding to international policy developments (e.g. Sustainable Development Goals and Conference of the Parties (COP) 21 Commitments). The framework proposes a systemic food systems approach to R&I policy, bringing together and providing direction to a fragmented EU R&I landscape (European Commission, 2020b). Driven by transdisciplinary research, multi-level innovation and investment, open science and international collaboration, the FOOD 2030 R&I policy framework aim to prioritize and integrate R&I within four key Food and Nutrition Security (FNS) priorities in order to future-proof European food systems, making them sustainable, resilient, diverse, inclusive and competitive for the benefit of society (Figure 7.1; European Commission, 2018).

FIT4FOOD2030, a Coordination and Support Action project, was established to facilitate the further development and support of the implementation of the FOOD 2030 policy framework, through the transformation of R&I systems at European, national and local levels (FIT4FOOD2030, 2019). FIT4FOOD2030 specifically aimed to contribute to (1) raising awareness of the FOOD 2030 priorities, (2) building competencies among current and future researchers, entrepreneurs, policymakers and society at large to contribute to system transformation, and (3) improving the coherence and alignment of R&I policies on FNS. As such, FIT4FOOD2030 can be considered a multi-level intervention acting upon multiple leverage points[63] to trigger transformation in the R&I systems coupled to EU food systems (see Kok et al., 2019). To achieve its mission, FIT4FOOD2030 brought together 16 institutions from across Europe, representing universities, research funders, technology and innovation platforms, industry networks and science engagement organizations to create a sustainable, multi-stakeholder platform called the FOOD 2030 Platform, mobilizing a network of European food system stakeholders.

63 Here we follow Meadows' (1999) conceptualization of creating systemic change in complex systems by intervening at leverage points in the system where intervention is most likely to trigger fundamental change. Those leverage points can be on the level of parameters, feedback, design and intent, see also Fischer and Riechers (2019).

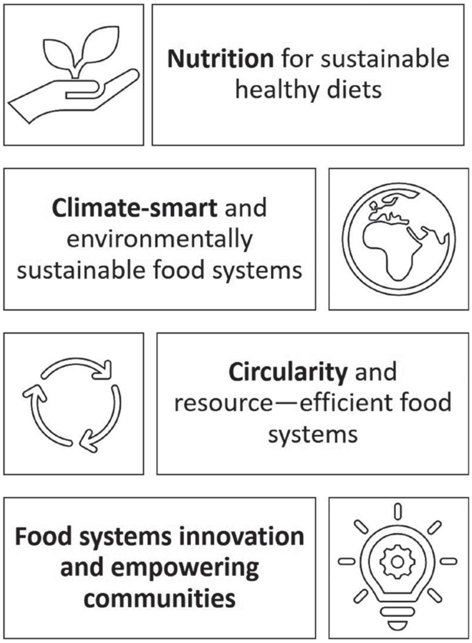

Figure 7.1 | FOOD 2030 four Food and Nutrition Security priorities (Source: EC, 2018).

7.3 THE FOOD 2030 PLATFORM

Guiding the project's objectives was the platform's three multi-level structures: the European Think Tank (EU-TT), Policy Labs and City and Food Labs, which fostered transformation across all levels (local to national; Figure 2.2). These structures interacted regularly to exchange information and learnings, linking the project's results to the wider EU level. Building upon this invaluable network and the expected R&I needs of the EU Green Deal and Farm to Fork Strategy, the project has now launched its new online platform called the Sustainable Food Systems Network, see later section).

7.3.1 Innovative Labs for food systems transformation

In efforts to facilitate transitions toward sustainable systems, real-life laboratories such as Living Labs, (Urban) Transition Labs and Real-World Labs have emerged as instruments to tackle sustainability challenges through multi-stakeholder experimentation (McCrory et al., 2020; Schäpke et al., 2018). While there exists no uniform definition for these 'Labs', they are considered spaces that facilitate experimentation relevant for real-life contexts and are characterized by their equal involvement of diverse stakeholders in creating concrete and sustainable societal value (Almirall et al., 2012; Bulkeley et al., 2016; Schäpke et al., 2018). It has been shown that such multi-stakeholder Labs can lead to a wide variety of (transformative) impacts, for instance in building local transformative networks, experimenting and designing novel innovations and activities, connecting and accelerating ongoing initiatives, and integration into policy (agendas; for examples see Bergmann et al., 2021; McCrory et al., 2020; Nevens et al., 2013).

Central to the FOOD 2030 Platform are 25 such multi-stakeholders real-life context Labs. These Labs have built networks fostering sustainability transitions through food systems interventions on the local/regional (City Labs, Food Labs) and national levels (R&I Policy Labs; Kok et al., 2019). Through the use of participatory methodologies and reflective learning[64], the project's Labs brought together networks of diverse groups of stakeholders (policymakers, researchers, educators, practitioners and citizens), including stakeholder groups often excluded (e.g. civil society organizations (CSO), farmers).

Through their work with FIT4FOOD2030, the Labs' host organizations and coordinators received a general framework, adapted to the individual Lab's needs, host institution's expertise, and the established local partnerships, as well as training, coaching and spaces to reflect. A number of tools were developed to support the Labs in their efforts to increase system understanding and foster transformation, such as setting up stakeholder networks, understanding local food systems and educational needs of R&I for food systems stakeholders, and identifying underlying barriers and opportunities for transformation (see also EC (2021) for additional key learnings and recommendations from the project). These tools were later applied by the lab coordinators within their labs with multiple stakeholders and updated based on feedback and are available as Tools for Transformation in the FIT4FOOD2030 Knowledge Hub (see later section).

City and Food Labs

City Labs were hosted by diverse organizations, from science centers and museums to previously established Living Labs. The concept was later expanded to seven more Food Labs representing peri-urban settings, differing slightly in their roles and timelines. These were hosted by universities, research centers, an NGO and a museum. The Labs' commonality included their commitment to building competences for more inclusive local food systems R&I by developing and piloting hands-on and local-oriented (in)formal education and training modules for students, researchers and professionals, such as navigating the complexity of local food systems, building critical thinking and future studies abilities and enabling transdisciplinary collaboration. The Labs co-created 19 modules (included in Tools for Transformation), which have been piloted by 800+ citizens and used by 2000+ recipients. For instance, City Lab Amsterdam transformed courses for university students, including the Bachelor's course, 'Analysis of Governmental Policy'

64 For more on the process see Svare et al. (2020a).

and the Master's course, 'Governance for Global Health', resulting in policy recommendations by the students to the Food Council of the Metropolitan Region Amsterdam and the Municipality of Amsterdam, respectively. Other modules such as 'Eat it, Don't Skip it!' developed the entrepreneurial skills of students, which led to a business model for healthy, sustainable 'grEATboxes' (snack boxes) by high school students (City Lab Athens) and a business plan to establish school Green Zones, providing spaces for students to eat healthy sustainable meals, recycle and share knowledge about food systems (City Lab Sofia; Fenollosa and Paca, 2020). Through this process, the City and Food Labs have contributed to transformative competence building among the Lab coordinators as well as the various stakeholders involved (Kok et al., 2019).

R&I Policy Labs

The project's 11 Policy Labs responded to the call to develop innovative R&I policies (for example see Schot and Steinmueller 2018) and aimed to 'increase the alignment of the public/private R&I (such as policies, programs and investment schemes) to FNS and the FOOD 2030 goals' (Wagner, 2019). They operate on national or regional levels and are coordinated by governmental policymakers with formal (written) support of multiple national ministries related to food and R&I. The Policy Labs were set up as participatory and experimental spaces, bringing together a diverse group of food system stakeholders. Through a series of meetings, Policy Labs and their (growing) networks analyzed current food systems, related R&I landscapes, barriers and opportunities and worked to strengthen R&I policy by defining a shared vision and translating this into concrete actions (or experiments) toward more alignment and impact on the transformation of food systems. For this purpose, they employed innovative tools such as the impact pathways exercise to co-design robust strategies and concrete measures together with diverse stakeholder groups (see Box 7.7). Concrete outputs of the R&I Policy Labs include the launch of transdisciplinary food systems calls, development of a holistic food systems research agenda and feeding into a consumer information campaign on food waste. Equally as important are the less tangible impacts, such as raising awareness about the systems approach and initiating or improving collaboration between ministries, as well as other food system actors. These novel R&I Policy Labs have shown their effectiveness as tools themselves in a variety of settings to increase the impact of R&I systems on food systems transformation, in particular through improving policy coherence (Kok et al., 2019).

EU Think Tank

The EU-Think Tank (EU-TT) brought together 15 members, representing a wide range of food systems' stakeholders (e.g. nutrition, food policy, agriculture, R&I). The group acted as a strategic hub and sounding board to the project, proactively drawing overarching lessons, translating them into EU level policy briefs (Gill et al., 2018; 2019; 2020; Sonnino et al., 2020) and working to facilitate communication and dissemination between the EC and the FOOD 2030 platform.

7.3.2 Trends, policies and breakthroughs

The activities of the Labs and EU-TT were supported by research into a series of analytical tools and data sets that served as instruments and building blocks for stakeholder engagement, vision development, systems understanding, road-mapping and action planning throughout the project as well as to inform future R&I activities on FNS. These tools provide insights into food system trends[65], EU and national food systems-related policies, and potential breakthroughs[66] in food systems R&I. For example, the collection of food system trends has evolved into an engaging card game, as well as an extensive inventory of trends compiled through stakeholder interviews, desk research, a workshop and online consultations (Wepner et al., 2018). In addition, an overview of European food policies has been collated into a free database and a card game (Biondi et al., 2019). These games can facilitate group discussions on the topic of food systems and the related challenges. Lastly, an interactive inventory of possible R&I breakthroughs has been published relating to identified showcases and trends (Lazaro-Mojica et al., 2019).

7.4 FIT4FOOD2030 TOOLS FOR TRANSFORMATION: HANDS-ON MATERIALS FOR FUTURE-PROOFING EUROPE'S FOOD SYSTEMS.

The systemic transformation toward the implementation of transdisciplinary and inclusive R&I practices in food systems requires the inclusive convening of local, national and international stakeholders from across food systems. These different food systems stakeholders can take on the role of facilitators or change agents and enable transformation through collaboration, planning and problem-solving. Nonetheless, bringing together all relevant stakeholders effectively and successfully requires training and tools.

The training tools developed for lab coordinators, the modules developed by FIT4FOOD2030's Labs, the work on trends, R&I breakthroughs, the overview of European policies, along with communication and dissemination materials all represent the hands-on and FIT4FOOD2030 tested Tools for Transformation, which have been collated to form a growing repository called the FIT4FOOD2030 Knowledge Hub (https://www.knowledgehub.fit4food2030.eu/). These tools aim to provide practical advice, manuals,

65 FIT4FOOD2030 defines a 'trend' as a general direction of a development over time.

66 FIT4FOOD2030 defines R&I 'breakthroughs' as potential, significant achievements that can create large impacts on current initiatives in the field of FNS and lead to radical changes in the food system, making it more sustainable and resilient.

guidelines and formats for online and in-person interactions that cover a range of topics on food systems transformation and R&I in the contexts of the users' local or national food systems. They were developed in response to the project's ambitions (Table 7.1) and as a response to the evolving needs FIT4FOOD2030 identified by working with the Labs and other R&I food system stakeholders. While the four categories of tools are classified into two types of tools, tools within categories such as 'Exploring and understanding the food system' could also be used as process-oriented tools.

Table 7.1 | Tools for Transformation categories and their relation to FIT4FOOD2030 priorities.

Overarching FIT4FOOD2030 priorities	Types of tools	Tool categories
Establishing Labs and developing innovative Research & Innovation (R&I) policies on Food and Nutrition Security	Process-oriented tools	Running a Lab R&I policy alignment and innovation
Increasing competencies and awareness of food system stakeholders Raising awareness of the FOOD 2030 priorities	Awareness-raising-oriented tools	Exploring and understanding the food system Educating or training people for food systems transformation

The FIT4FOOD2030 Knowledge Hub contains dozens of Tools for Transformation which includes:

- short exercises for collaborative reflection and co-creation;
- training and reflection modules for professionals;
- educational modules and videos;
- data sets on food system trends, breakthroughs and policies;
- webinars; and
- policy briefs.

7.4.1 Using the FIT4FOOD2030 Tools for Transformation

The FIT4FOOD2030 Tools for Transformation are freely available to stakeholders and adapted or adaptable to varying levels of expertise, interests, aims and contexts. While many of the tools were developed as part of a sequence, all tools have been designed to be used as individual tools (Figure 7.2). While the tools were designed for transformation of R&I in food systems, they are applicable to other transformation processes that address social, economic and environmental challenges and are in need of innovations, such as health-, or energy-related transformation processes. In all these areas, transformation facilitators are faced with complex issues that cut across sectors: stakeholders who have different opinions or competing interests, and significant uncertainties with regards to the way forward for scientific, technological and social change.

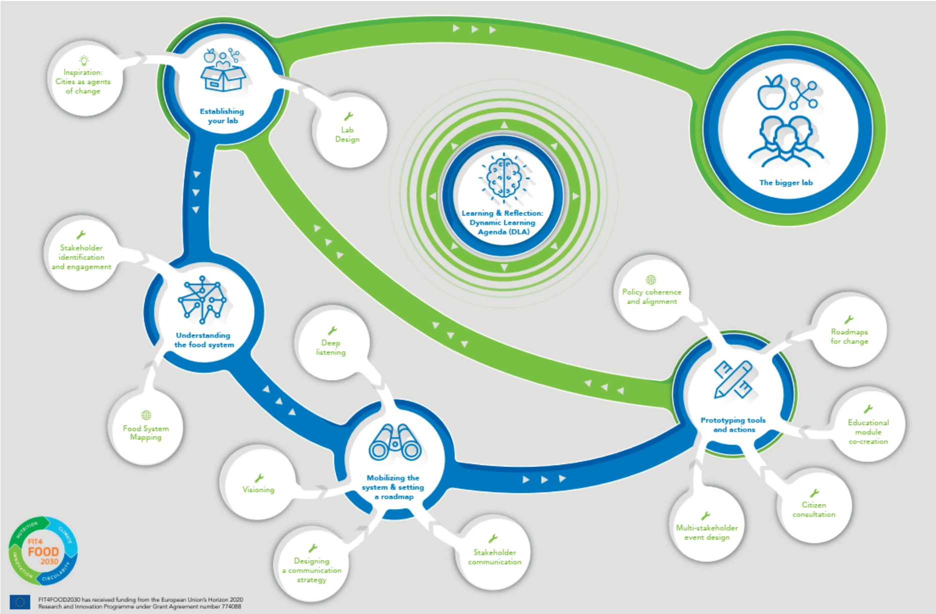

Figure 7.2: Visual representation navigating the relationship between the phases required to set up and run a city or food lab (blue circles) and the *FIT4FOOD2030 Tools for Transformation* (green circles) used in the process. The Dynamic Learning Agenda (DLA)[67] is continuously updated and is therefore part of all phases. Visual representations of the additional categories can be found on *FIT4FOOD2030* Knowledge Hub. (Developed by Marjoleine van der Meij, Cristina Paca, Graphic design by Global Concept Consulting. This illustration is licensed under a Creative Commons Attribution-No Derivatives 4.0 International License.)

Stakeholders interested in adopting more inclusive R&I to contribute to food systems transformation more effectively may find that their traditional R&I roles (e.g. researcher, policymaker, manager, educator) increasingly require complementary new roles, such as those of ‘change agent’, ‘knowledge broker’ and ‘process or transformation facilitator’ (Fazey et al., 2018a; Wittmayer and Schäpke 2014). While these new roles require specific sets of competences (e.g. systems or anticipatory thinking), it could be argued that through the use of tools, such as FIT4FOOD2030’s Tools for Transformation and the process of competency development, these roles can be adopted by traditional R&I stakeholders. In practice, this means that the stakeholders’ roles become less clearly defined and could lead to conflicting aims and role understanding (Wittmayer and Schäpke 2014). For example, researchers and policymakers can actively encourage a ‘process-oriented and multi-stakeholder approach’ by adopting these new roles and the sets of required competences (e.g. transdisciplinary collaboration, conflict resolution, systems thinking) in practice (Wittmayer and Schäpke, 2014). Depending on the

67 For an introduction to the conceptual background for and practical approaches to using DLA, see van Mierlo et al. (2010). For a practical approach developed specifically for FIT4FOOD2030, see Svare (2018).

specific (institutional) context, the aims of the process and the required competences, a stakeholder may decide which role to adopt and which set of tools to use.

The sections below provide an overview and introduction to some of the Tools for Transformation according to four categories: (1) Running a Lab; (2) Improving R&I policy coherence and alignment; (3) Exploring and understanding food systems; and (4) Educating or training people for food systems transformation. As the FIT4FOOD2030 Knowledge Hub continues to evolve, users are invited to interact on the Knowledge Hub and Sustainable Food Systems Network (see later section) by posting their experiences and tips for using the tools in a variety of contexts.

7.4.2 Process-oriented tools

Running a Lab

Labs are promising instruments used for tackling complex problems that more traditional governance efforts do not manage to solve. For policymakers, researchers or educators who aim to make profound and lasting impacts on, for example, R&I and food systems, setting up a Lab can be a good tool for transformative change. However, 'running a Lab' requires the ability to connect and engage a diverse set of stakeholders, while also developing participatory and experimental spaces to test novel ideas and nurture innovation (Nevens et al., 2013). The tools in Box 7.1 and 7.2 provide advice on setting up Labs, as well as initial exercises.

R&I policy alignment and innovation

R&I policy and programs are fragmented within and among ministries and funding agencies and often only deal with one aspect of the food system and/or one segment of the knowledge chain. Achieving systemic change in such policy-making structures and impactful R&I policy alignment requires a process of participation, experimentation and discussion with a wide network of stakeholders. Key phases include: (1) building a diverse stakeholder network; (2) mapping and understanding the local food system, R&I programs/policies and their synergies, as well as the knowledge needs of stakeholders; (3) co-developing future visions and potential pathways; (4) experimentation and innovation of potential improvements in processes and regulation (e.g., a transdisciplinary call for proposals or including a citizen panel) in practice; and lastly (5) reflection and evaluation of outcomes for successful legacy (FIT4FOOD2030, 2021). Tools related to these phases can be found on the Knowledge Hub. The tools in Box 7.3 and 7.4 help with identifying breakthrough areas and making steps toward change more concrete, helpful for phase 2 and 3, respectively.

Box 7.1 Policy Lab Handbook

What: This handbook helps you to set up and run a Lab that is aimed at aligning and innovating R&I policy for increased impact on the food system. It guides you through the phases of bringing together a diverse group of stakeholders, analyzing the current food system and related R&I landscape, defining barriers and opportunities, and experimenting with new ways of conducting R&I.

How: The handbook is an overarching tool that provides examples, tips and tricks, and links to the various tools that could be useful along the way.

Who: Stakeholders at the national, regional, local, even the supranational policy level can use this tool. Ideally, a Policy Lab is coordinated by someone involved in policy development.

Box 7.2 Stakeholder Identification and Engagement

What: This tool offers a starting point for identifying who to engage and how to effectively get in touch with different stakeholders. The tool includes concrete exercises for identifying, empathizing and understanding the perspectives of others, providing crucial support for facilitators hoping to create meaningful dialogue, engagement and collaborative actions.

How: It provides activities on desk research and relationship-building, such as conversation techniques. The tool provides brief, simple activities to support facilitators who are unfamiliar with stakeholder engagement and is thus also a resource for anticipating and addressing potential issues facilitators may face when seeking to bring different groups into shared activities.

Who: All facilitators engaged in food systems transformation.

Box 7.3 Identifying Potential Breakthroughs

What: This tool helps stakeholders identify potential (R&I) breakthroughs which are necessary to achieve the envisioned future-proof food system and stimulate thinking about what is needed from R&I to support these breakthroughs.

How: Participants map breakthroughs they think are necessary to realise their vision and identify educational and/or policy needs to improve the R&I system. The set of breakthrough cards can be used to facilitate discussion and provide inspiration.

Who: Stakeholders (e.g. policymakers, researchers, business, funders, NGO/CSO etc.) interested in exploring breakthroughs needed to support change.

Box 7.4 Co-designing pathways for food systems transformation
What: This tool helps policymakers develop a range of innovative pathways, co-created by diverse stakeholders, to support the realization of food systems transformation. Participants gain insights into the challenges and barriers in food systems, a range of options to support food systems transformation and a better understanding of how and what they can contribute toward various solutions.
How: Stakeholders design pathways by defining a goal and strategy, then mapping relevant steps toward realizing their goal. Each step consists of policy instruments, relevant stakeholders and supporting trends.
Who: Suitable for stakeholders (e.g. civil servants, farmers, food company owners, food innovators, etc.) interested in food system transition and policies to support it.

7.4.3 Awareness-raising-oriented tools

Exploring and understanding the food system

Comprehensive understanding of how systems work is key to changing them. Questions such as: what is specific about the food/R&I system in a region or country?; how does this relate to the wider food/R&I system?; what is working well and should be promoted, what is not, and how is it connected?, help to develop this understanding. Analyses such as these should be a group process carried out within a stakeholder network, incorporating and utilizing all views and knowledge, allowing for an encompassing overview of food/R&I systems and a common understanding. The tools in Box 7.5 and 7.6 provide ideas on how to analyze the food system.

Box 7.5 Trends in the food system – The card game
What: This tool offers an interactive game based on work conducted on trends in food systems. It includes over 60 trends from a variety of sectors in and beyond food systems such as agricultural production, food processing, consumer trends, economy and retail.
How: The card game can be used as an icebreaker for dialogue sessions to create meaningful engagement and collaboration. The game is linked to a report on the various trends, their drivers and further inspiration on how to use the trends in interactive settings.
Who: The accessible nature of the cards means that they can be used by most stakeholders interested in interactive activities to spark dialogue around food systems and related trends.

Box 7.6 Visioning

What: This tool offers a host of exercises and facilitation tips on developing written and visualised statements of long-term goals and strategic objectives related to food systems. This process can ultimately lead to recommendations and transformations in, for example, food systems R&I policies, priorities, strategies, behaviors, attitudes and education.

How: The visioning process is a participatory tool developed to create a sense of shared vision of the future. Through the process, different stakeholders are brought together to co-create a vision of a preferred future food system.

Who: Stakeholders (e.g. policymakers, researchers, business, funders, NGO/CSO etc.) who are interested in engaging in a visioning process.

Educating or training people for food systems transformation

Integrating inclusive R&I approaches to transform food systems calls for activities that educate, engage, and influence both present and future traditional R&I stakeholders (e.g. researchers, policymakers) and more non-traditional R&I stakeholders (e.g. civil society organizations, farmers). These stakeholders require the right competencies and tools to ‘do’ food system transformation. In FIT4FOOD2030, these objectives were mainly pursued by City/Food Labs, where systematic visioning around desired food system futures with diverse audiences fosters transformative change through new competencies and actions. Central to these efforts is the need to balance engaging activities with substantial learning and meaningful participation, fostering first order learning about subject knowledge, as well as second order learning which stimulates reflexive questioning of one’s own place and assumptions within wider societal systems in need of change (van der Meij et al., 2017b). The two tools in Box 7.7 and 7.8 provide ideas for educational modules and an agenda for helping facilitators ‘do’ food systems transformation.

Box 7.7. Educational modules for food system transformation awareness-raising and capacity building
What: This tool provides an overview of 19 educational modules covering food systems understanding and action with hands-on activities on topics such as food waste, laboratory exercises in food chemistry and agenda setting for change. Facilitators can find easy-to-use activities they can implement in their own organisation or project, as well as inspiration for additional activities and pointers on how to plan, carry out and evaluate stakeholder activities.
How: Modules are classified according to topic types, target audience and size, and offer step-by-step guidelines on how to conduct activities and suggestions for how they can be adapted to different needs or target groups.
Who: Educators as well as science museums and centres.

Box 7.8. Dynamic Learning Agenda (DLA)
What: A DLA is a continuously updated agenda tracking relevant challenges, strategies and experiences, to make group dialogue productive and focused on the aims and means of their activities. The DLA allows a project facilitator to maintain focus, plan actions and continuously strengthen a group's understanding of barriers to their shared project and improve their strategies for addressing them.
How: The DLA helps groups identify which aspects of challenges pertaining to complex processes are available to influence and worthy of attention and effort. It also gives pointers to transformation facilitators on how they can stimulate dialogue and develop shared understandings of underlying issues, thereby helping groups develop transformation strategies.
Who: DLAs can be used by facilitators of and participants in any transformation process.

7.5 SUSTAINABLE FOOD SYSTEMS NETWORK

In parallel to the Tools for Transformation, a continuation of the FOOD 2030 platform, called the Sustainable Food Systems Network is a vehicle for providing stakeholders interested in food systems transformation the opportunity to connect, collaborate and engage in online discussions, through a discussion board, promotion of events, opportunities, webinars and resources. Impactful communication and collaboration among a diversity of stakeholders at local, regional, EU level is a prerequisite for transforming food systems. In doing this, the network enables valuable cross-sharing of knowledge and resources, including amplifying outreach of the FIT4FOOD2030 project outcomes to relevant audiences through the exhibition and stimulation of experimentation with the Tools for Transformation. In its first months, the network has reached 1000+ members. To become part of this growing and multi-disciplinary network of food systems transformation change agents, visit the FIT4FOOD2030 website to join.

7.6 CONCLUSION

Research and Innovation could be a key driver in the transformation toward more sustainable food systems and thus represents a key strategic area in the Farm to Fork Strategy and EU Green Deal (De Froidmont-Goertz et al., 2020). Investing and contributing to the competency development and tools for R&I food systems stakeholders to ‘do’ food system transformation is vital for supporting this transformation. Responding to this gap, the FIT4FOOD2030 project has provided tools to boost competencies among food systems stakeholders through the creation of the FIT4FOOD2030 Knowledge Hub and the growing Sustainable Food Systems Network. The project invites all readers whether they work with food-, health- or energy-related transformational processes to use, adapt and incorporate the Tools for Transformation to adopt more inclusive, transdisciplinary, and systemic approaches to the demanding challenges we face today.

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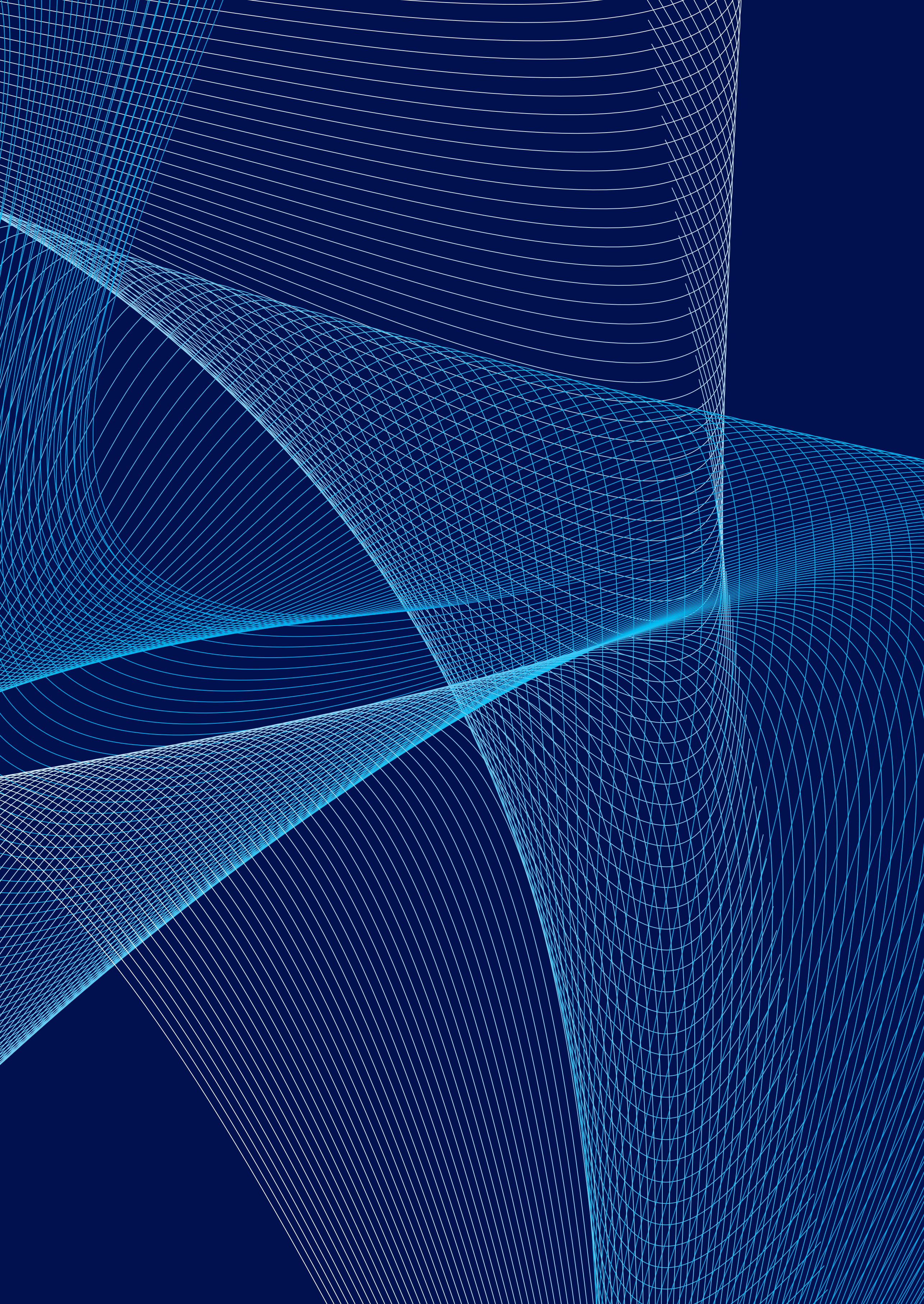

8

Unraveling the politics of ‘doing inclusion’ in transdisciplinarity for sustainable transformation

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ABSTRACT

Transdisciplinary research and innovation (R&I) efforts have emerged as a means to address challenges to sustainable transformation. One of the main elements of transdisciplinary efforts is the ‘inclusion’ of different stakeholders, values and perspectives in participatory R&I processes. In practice, however, ‘doing inclusion’ raises a number of challenges. In this chapter, we aim to contribute to re-politicizing inclusion in transdisciplinarity for transformation, by (1) empirically unraveling four key challenges that emerge in the political practice of ‘doing inclusion’, (2) illustrating how facilitators of inclusion processes perform balancing acts when confronted with these challenges, and (3) reflecting on what the unfolding dynamics suggests about the politics of stakeholder inclusion for societal transformation. In doing so, we analyze the transdisciplinary FIT4FOOD2030 project (2017–2020)—an EU-funded project that aimed to contribute to fostering EU R&I systems’ ability to catalyze food system transformation through stakeholder engagement in 25 Living Labs. Based on 3 years of action-research (including interviews, workshops and field observations), we identified four inherent political challenges to ‘doing inclusion’ in FIT4FOOD2030: (1) the challenge to meaningfully bring together powerful and marginalized stakeholders; (2) combining representation and deliberation of different stakeholder groups; (3) balancing diversities of inclusion with directionalities implied by transformative efforts; and (4) navigating the complexities of establishing boundaries of inclusion processes. We argue that by understanding ‘doing inclusion’ as a political practice, necessitating specificity about the (normative) ambitions in different inclusion settings, facilitators may better grasp and address challenges in transdisciplinarity for transformation.

8.1 INTRODUCTION

Research and innovation (R&I) processes can help foster urgently needed sustainable and just transformations in socio-ecological and socio-technical systems (Fazey et al., 2018; 2020; Norström et al., 2020; West et al., 2020). Transdisciplinary approaches show particular promise by including societal stakeholders in research, innovation and governance efforts (Miller et al., 2014; Lang and Wiek, 2021). Various inclusive R&I approaches aim to bridge the gap between 'knowledge and action' (van Kerkhoff and Lebel, 2006; West et al., 2019), including Transition Management (Loorbach, 2007), Responsible Research and Innovation (RRI, see Owen et al., 2012), transformative research (Fazey et al., 2018a) and transdisciplinarity (Klein et al., 2001; Lang et al., 2012). Though different in approach and underlying philosophies, these approaches share deep commonalities, among them the notion that problem-driven, iterative R&I efforts could—more effectively than traditional linear processes—contribute to tackling societal challenges by co-producing knowledge with researchers and societal stakeholders through processes that acknowledge diversity of knowledges and values while fostering learning and reflexivity among participating actors (Lang et al., 2012; Caniglia et al., 2020; Lang and Wiek, 2021).

Undervaluing the intrinsic political nature of 'doing inclusion' risks losing sight of how the politics of participation drives the dynamics of transdisciplinary processes (Chilvers and Kearnes, 2020; Stirling, 2008). However, in a recent review, Turnhout et al. (2020) indicate that the political dynamics of transdisciplinary processes aimed at transformation often remain underemphasized in both practice and research, and most scholarship tends to focus on addressing and enacting practical, methodological or institutional aspects of transdisciplinarity (such as in Pohl and Hadorn, 2008; Lang et al., 2012; Brandt et al., 2013). This focus seems likely to intensify within the recently observed turn toward effectiveness-orientation in, and functionalization of, stakeholder inclusion in transdisciplinarity (Musch and von Streit, 2020; Chilvers and Kearnes, 2020; Schmidt et al., 2020). This emphasis on 'effectiveness' in transdisciplinarity arises in part due to the *"trend that funding agencies increasingly favour transdisciplinary projects focusing on directly applicable outputs"* (Musch and von Streit, 2020: 63). Stakeholder inclusion might devolve into 'tick-the-box' requirements, or worse: lead to tokenism or oppression through participation (e.g., Cooke and Kothrari, 2001). This functional turn is rather surprising as other rationales for doing stakeholder inclusion, such as promoting social learning and reflexivity, enhancing legitimacy of R&I processes and outcomes, as well as efforts for democratizing R&I in response to socially unjust outcomes, lie at the very core of transdisciplinarity (see, e.g., Jasanoff, 2003; Van Kerkhoff and Lebel, 2006; Brown, 2009; Bunders et al., 2010; Schmidt et al., 2020). Critiques of the functional turn (see Chilvers and Kearnes, 2020) also led scholars to argue that there is a need *"for a new phase of 'democratization of science'"* (Cornell et al., 2013: 68) that entails a *thorough "re-thinking and a repoliticization"* (Turnhout et al., 2020: 18) of inclusion for transformation.

In this chapter, we aim to contribute to re-politicizing inclusion in transdisciplinarity for transformation, by (1) empirically unraveling four key challenges that emerge in the political practice of 'doing inclusion', (2) illustrating how facilitators of inclusion processes perform balancing acts when confronted with these challenges, and (3) reflecting on what the unfolding dynamics suggests about the politics of stakeholder inclusion for societal transformation.

Empirically, our puzzle unfolds around 'doing inclusion' in the FIT4FOOD2030 project (2017–2020), a Horizon 2020 Coordination and Support Action (CSA) that supported the European Commission (EC) in implementing the FOOD 2030 policy framework. The project's main goal was to set up a transformative network (including 25 Living Labs on local, regional and national levels) in a move toward transdisciplinary inclusion to better enable incumbent R&I systems to facilitate transformations toward sustainable and healthy food systems (see EC, 2021; Kok et al., 2019). Before elaborating on our empirical case and analysis, we first set out to further explore the politics of inclusion in transdisciplinary processes aimed at societal transformation.

8.2 THE POLITICS OF INCLUSION IN TRANSDISCIPLINARITY FOR TRANSFORMATION

In efforts to contribute to tackling complex and wicked societal challenges (Arkesteijn et al., 2015; Kampelmann et al., 2018, cp. Rittel and Webber, 1973), transdisciplinarity for transformation seeks to include societal stakeholders in R&I efforts. This section relates complex system transformation to transdisciplinarity, elaborates on different rationales for doing 'stakeholder inclusion', and presents key aspects of the politics of inclusion.

8.2.1 Transdisciplinarity for complex societal transformation

Sustainability transitions are long-term processes of structural systemic change and *imply "far-reaching changes along different dimensions: technological, material, organizational, institutional, political, economic, and socio-cultural"* (Markard et al., 2012: 956). Instigating desired transition pathways (Geels and Schot, 2007) or sustainability pathways (Leach et al., 2010a) means confronting undesirable resilience (Oliver et al., 2018), incumbency (Stirling, 2019), and locked-in equilibrium states (Geels, 2002; Grin et al., 2010). In response to such dynamics, scholars have suggested modes of governance (among them Strategic Niche Management, Kemp et al., 1998; Transition Management, see Loorbach, 2007) to facilitate processes of experimentation and co-creation. Sengers et al. (2019: 161) conceptualize such processes of experimentation as *“inclusive, practice-based and challenge-led initiative[s] designed to promote system innovation through social learning under conditions of uncertainty and ambiguity”.* Experiments are important as they might serve as protected spaces for building lasting multi-stakeholder networks, co-designing novel solutions and transition pathways, while stimulating learning and reflexivity among participants (Grin et al., 2010; Fazey et al., 2018a; Sengers et al., 2019).

Transdisciplinary R&I efforts have emerged in recent decades as a *“new form of learning and problem solving involving cooperation among different parts of society and academia in order to meet complex challenges of society”* (Klein et al., 2001: 7). Inclusive transdisciplinary approaches underlying experimentation and co-creation for sustainable transformation are rapidly gaining ground in academic and policy environments (Fazey et al., 2020; Norström et al., 2020) and form an integral part of transition studies (Grin et al., 2010; Fazey et al., 2018a). An overview by Köhler et al. (2019: 19, drawing on Schneidewind et al., 2016; Luederitz et al., 2017; Kampelmann et al., 2018) points to an *“increasing commitment to research that not only describes societal transformation processes, but initiates and catalyzes them”.* One key element in (transformative) transdisciplinarity concerns the inclusion of a wide variety of stakeholders from different scientific disciplines as well as societal actors such as policy makers, businesses, civil society and citizens (the Quadruple Helix, see, e.g., Leydesdorff, 2012).

8.2.2 Doing inclusion in transdisciplinarity

Including societal stakeholders in R&I processes is neither a ‘tick-the-box’ activity, nor the panacea for ensuring that R&I processes are democratic, responsible or legitimate (e.g., Cooke and Kothari, 2001; Few et al., 2007; Genus and Stirling, 2018; Brand and Blok, 2019; Van Mierlo et al., 2020; Stelzer, 2020). Yet, meaningful societal stakeholder engagement can provide ‘better’, more socially robust R&I processes and outcomes (Jasanoff, 2003; Bunders et al., 2010; Owen et al., 2012).

In a recent contribution, Schmidt et al. (2020) indicate that literature generally considers four different arguments for doing inclusion. The first is a democratic or normative one, building on, i.e., Arnstein (1969), Fiorino (1990) and Stirling (2008), and stating that those affected by R&I (outcomes) should also have the opportunity to be involved in the process (‘nothing about us without us!’). This argument reflects insights on democratic foundations of public deliberation and participation (see Habermas, 1981; Dryzek, 2002; Collins and Evans, 2002; Cash et al., 2003; Nowotny et al., 2003; Jasanoff, 2003; Latour, 2004). A second argument is a substantive one, namely that R&I that is co-produced between science and society can lead to 'better' R&I outcomes. Examples might include more socially robust innovations that are better equipped to provide solutions to real-world challenges, due to the integration of different (stakeholder) perspectives, values and knowledge (Nowotny et al., 2003; Lang et al., 2012). This is especially relevant for designing transformation pathways toward sustainability (Fazey et al., 2018; 2020; Caniglia et al., 2020; West et al., 2020; Den Boer et al., 2021a). A third argument is that transdisciplinary co-production of R&I leads to increased legitimacy of processes and outcomes, especially in the context of implementation of R&I interventions (Van Kerkhoff and Lebel, 2006; Stirling, 2008; Lang et al., 2012). This argument also lies at the core of efforts to make R&I more responsible (for instance in RRI; see Von Schomberg, 2013; Owen et al., 2012; Stilgoe et al., 2013). Schmidt et al. (2020: 3) contend that *"the experience of having had influence on the research process can create a feeling of ownership, increase trust and stimulate commitment among participants in the project and its outcomes".* The fourth argument concerns social learning and reflection. Bringing together stakeholders from different backgrounds in co-creation processes can stimulate learning, reflexivity and build trust and understanding between participants (Innes and Booher, 2004; Hirsch Hadorn et al., 2006; Mathur et al., 2008; Reed et al., 2010; Westberg and Polk, 2016). This collective learning is a key element of experimentation for sustainable transformation (Loeber et al., 2007; Grin et al., 2010; Luederitz et al., 2017; Van Mierlo and Beers, 2020).

While often central to the opening up of R&I processes (Owen et al., 2012), increasing attention is also paid to how 'inclusion' relates to processes of exclusion and the (empirical) limits of transdisciplinary efforts (Stirling, 2008; de Hoop et al., 2016; Genus and Stirling, 2018; Valkenburg et al., 2020; Van Mierlo et al., 2020, Koch, 2020). Recent scholarship questions whether 'inclusion' is always desirable, given the corresponding necessity of processes for closing down (Van Mierlo et al., 2020).

8.2.3 Politics and power in inclusion for transformation

Against the backdrop of the functional turn in participatory approaches, Chilvers and Kearnes (2020) indicate that 'doing inclusion' is a deeply political act as it raises the question of who or what decides who is to participate in what way. These questions are also addressed in long-standing debates within Science and Technology Studies on deliberative versus representative democratic principles and the role of lay-publics versus experts (see Collins and Evans, 2002; Dryzek, 2002; Jasanoff, 2003; Latour, 2004; Meadowcroft, 2004; Brown, 2009; Turnhout et al., 2010; Chilvers and Longhurst, 2016).

It is thus not surprising that scholars point to the role of power (gradients) and agency[68] in shaping, enhancing, and/or obstructing participatory processes (e.g., Schmidt and Pröpper, 2017; Siebenhüner, 2018; Bréthaut et al., 2019; Turnhout et al., 2020; Dannecker, 2020) and sustainable transformation processes (e.g., Avelino and Rotmans, 2009; Grin, 2010; Ahlborg, 2017; Stirling, 2019; Kok et al., 2021a; Avelino, 2021). If R&I processes are depoliticized or do not address unequal power relations, inclusive (research) efforts risks reproducing incumbent interests and systemic inequities (Cooke and Kothari, 2001; Nadasdy, 2003, Turnhout et al., 2020). These political dynamics especially matter in the context of transformation, where transdisciplinary processes are not just about providing *"discursive spaces, [but are] attempts to explicitly intervene in system change"* (Chilvers and Longhurst, 2016: 587). This in turn relations requires *"finding ways of working with and around the power relations, which shape and are being shaped by the emerging community"* (Van Breda and Swilling, 2019: 834-835).

What adds to this challenge is the need to both draw upon and redirect power relations in building transformative agency within emerging transdisciplinary networks, to contribute to system transformations (see, e.g., Westley et al., 2013; Avelino and Rotmans, 2009; Bulkeley et al., 2016; Kok et al., 2021a). Such an interventionist take on R&I (see also Zuiderent-Jerak, 2015; Fazey et al., 2018a) raises questions concerning the legitimacy of transdisciplinary processes and the accountability for both transformation processes and outcomes (Hendriks, 2008; Hendriks and Grin, 2007; Brown, 2009). Though 'inclusion' could enhance the legitimacy of R&I processes, and lead to shared responsibility and accountability between societal stakeholders and researchers (Nowotny et al., 2003; Lang et al., 2012; Von Schomberg, 2013; Owen et al., 2012), in messy transdisciplinary practice it is not necessarily clear to whom or what the processes should be accountable (Maasen and Lieven, 2006) and on what (democratic) basis accountabilities open up R&I or *"reinforce (rather than fully interrogate) political closures"* (Genus and Stirling, 2018: 63, drawing on Chilvers, 2008).

8.3 CASE: FIT4FOOD2030 AS AN INCLUSIVE INSTRUMENT FOR SYSTEM TRANSFORMATION

In response to the urgent need to set in motion the transformation toward more sustainable and healthier (EU) food systems (e.g., Willett et al., 2019; Rockström et al., 2020),

68 Scholars agree that there are many different manifestations of the contested concepts agency and power (see, e.g., Dahl, 1957; Bachrach and Baratz, 1962; Foucault, 1980; Giddens, 1984; Emirbayer and Mische, 1998; Archer, 2000; VeneKlasen et al., 2002; Arts and van Tatenhove, 2004; Latour, 2004; Lukes, 2004).

the EC through its Directorate General of Research and Innovation launched the FOOD 2030 policy framework in 2016 (EC, 2017). The FOOD 2030 policy framework aimed to

> *“tackle the [Food and Nutrition Security] challenge with research and innovation (R&I) policies designed to future-proof our food systems to make them sustainable, resilient, diverse, inclusive and competitive for the benefit of society.”* (EC, 2017: 4).

To support the EC in delivering FOOD 2030, the FIT4FOOD2030 project was launched in 2017. The transdisciplinary project brought together 16 partner institutions across Europe from research, industry, science communication and civil society, and had the explicit aim of establishing a

> *“sustainable, balanced, multi-stakeholder, multi-level platform—called the FOOD2030 Platform—that will support the EC to further develop and implement the FOOD 2030 policy framework and its action plan”* (FIT4FOOD2030, 2017: 143).

The project’s main instrument for instigating multi-stakeholder engagement in the transformation of R&I systems was a highly diverse set of 25 Labs. They built on the concept of Living Labs, that are conceptualized virtual or socio-physical spaces for facilitating experimentation processes focused on tackling complex societal challenges by co-developing and co-testing solutions or innovations through the involvement of a diversity of stakeholders (see Almirall and Wareham, 2008; Hossain et al., 2019). Under labels as Real-World Laboratories and (Urban) Transition Labs, such spaces are increasingly used as instruments for (local) sustainable transformation (e.g., Bulkeley et al., 2016; Schäpke et al., 2018; McCrory et al., 2020).

In the beginning of the project, seven Policy Labs and seven City Labs were established to, respectively, experiment with national-level policy related to food systems R&I, and work with citizens, students and other actors on city and regional levels via engagement and educational activities. In the second half of the project, 11 additional Labs (four Policy Labs and seven Food Labs[69]) were appointed, following an open call. In both rounds, organizations were selected based on their willingness to engage with transformation processes and/or their experience with stakeholder engagement. In accordance with specifications in the EC call, the project sought to achieve geographical diversity in its appointment of Labs, and to support engagement of diverse actors.

69 The project sought to move beyond an urban focus and thus labeled the additional regional Labs ‘Food Labs’ instead of City Labs.

Each Lab had one or more 'coordinators', responsible for the design, execution, and often the facilitation, of the Lab processes and activities. Policy Labs were coordinated mainly by employees of national ministries, while City and Food Labs were coordinated by science museums, science centers and universities. The Labs' subsequent decisions regarding network building and stakeholder engagement were largely up to individual coordinators, informed by general guidance from the consortium regarding the desirability of including actors not usually represented in local food and R&I networks and initiatives, as well as from horizontal learning between coordinators through regular learning sessions where coordinators shared experiences and approaches (EC, 2021). The consortium supported coordinators through structured discussion organized around a Dynamic Learning Agenda (van Mierlo et al., 2010a; Svare et al., 2020a), as well as learning sessions, trainings, and materials on topics such as stakeholder diversity and engagement. Coordinators received modest project funding and a high degree of autonomy in finding synergies between content, aims and suggestions from FIT4FOOD2030, and activities, strategies, and initiatives within their host organizations and national or local contexts. An overview of Lab locations is shown in Figure 2.2. An overview of Lab types, activities, and selected outcomes is shown in Table 8.1.

Table 8.1 | Overview of the different types of Labs and their key features.

Lab Type	Focus	Locations	Examples of activities and outcomes
City Labs and Food Labs	Educational module co-creation (City Labs) and implementation (City Labs and Food Labs) Transformative network building	City Labs: Amsterdam, Athens, Barcelona, Budapest, Milan, Sofia, Tartu Food Labs: Aarhus, Azores, Birmingham, Dublin, Graz, Trentino, Vilnius	• Local policy agenda setting, co-developing policy strategies • 19 educational modules (implemented in schools, science museums, universities) engaging 1400+ students and school children • Modules for instance focused on food waste reduction, systems thinking or healthy diets • 1000+ stakeholders *engaged* in the Labs
Policy Labs	Policy innovations Transformative network building	Austria, Basque Country, Estonia, Flanders, Hungary, Ireland, Italy, Lithuania, the Netherlands, Norway, Romania	• Co-developed R&I strategies and visions • Established new transdisciplinary funding programs • Cross-sectoral collaborations between governance sectors and levels • 600+ stakeholders *engaged* in the Labs

The Labs were the main site of 'doing inclusion' in FIT4FOOD2030. They followed rigorous but context sensitive methodologies, developed or adapted[70] by the project. These supported the Labs in four project phases:

70 Methodologies used in FIT4FOOD2030 to support multi-stakeholder experimentation in the Labs were adapted from, e.g., Transition Management (TM, see Loorbach, 2007); Reflexive Monitoring in Action (RMA, see van Mierlo et al., 2010).

(1) Network building and system understanding: Labs mobilized local stakeholder networks to work on developing collective system understandings of their local food and R&I systems.
(2) Visioning and developing roadmaps: Labs co-created visions for (the role of R&I in) future food systems and co-designed pathways and roadmaps toward sustainable futures.
(3) Action planning and experimentation: Labs conducted different 'transition experiments', see examples in Table 8.1.
(4) Sustaining and scaling: Labs developed and enacted strategies for sustaining their activities, networks or experiments beyond the project's lifetime.

While it is beyond the scope of this chapter to report exhaustively on the differences between Labs, such differences certainly surfaced during the project, both in relation to inclusion and other topics. For example, coordinators (and their national and local contexts) differed in their familiarity with, and responses to, the project's goals of stakeholder inclusion for the purpose of system transformation. Such differences were manifest in differences of personal experience with doing stakeholder engagement, but also emerged from differences in historical–political, geographical (North–West, Eastern, Southern Europe) and organizational contexts (universities, ministries, science museums) in which the Labs operated. These different experiences were in turn incorporated into structured dialogue and learning facilitated by the consortium. Overall, FIT4FOOD2030's approach was one of high flexibility, aiming to be sensitive and adaptive to the local needs of the Labs, but at the same time provide a highly structured multi-phase methodology, along with the necessary training and practical tools to support the (coordinators of the) Labs.

8.4 RESEARCH DESIGN AND METHODOLOGY

In this chapter, we present an embedded case study (see Baxter and Jack, 2008), where we study the dynamics of 25 Labs as sub-units within the overarching context of the FIT4FOOD2030 project. This helps to distill lessons and findings not only within, but also across the different Labs to better unravel the 'how and why' of empirical dynamics (Yin, 2003). During the project (2017–2020), we were involved in the management of the project (authors 1, 3 and 4), training of the Lab coordinators of the 25 Labs as well as monitoring and evaluation efforts (authors 1, 2 and 3). As the authors, we were not objective observers, but 'immersed' in the project and by taking an active role in fostering transformation efforts our research can be characterized as in situ and engaging (see Lang and Wiek, 2021). Our research design was, therefore, grounded in transdisciplinary action-oriented research (Pohl and Hadorn, 2007; Lang et al., 2012; Fazey et al., 2018a). For researchers, to actively engage with society in action-oriented research is important as *“transformations are fundamentally about experimentation, learning, and doing something that has never been done before”* (Bradbury et al. 2019: 8). Action-oriented approaches are *“more likely to view action, learning and the generation of new knowledge as being more closely intertwined”* (Fazey et al., 2018a: 58) and bring along the acknowledgment that researchers are part of the system they study; the act of research thus becoming an intervention (e.g., Fazey et al., 2018a). This required us as researchers to embrace the pluralities of knowledge and values of the project partners and Lab coordinators, and to reflect upon our emerging research design and our own (multiple) roles in the project.

In these efforts, we co-designed, organized and attended (more than weekly) internal project meetings, and dozens of workshops and training sessions. In addition, the authors 1 and 2 co-conducted 28 in-depth semi-structured interviews with Lab coordinators and project partners, using a flexible interview guide, to stimulate context-specific conversations and allowing to further explore unexpected empirical insights. Questions focused on the challenges, impacts, learnings and functions of the Labs, the project and the interviewees personally. The data were selectively transcribed verbatim and coded with Atlas.ti.

Our approach to the data was an abductive one (see, e.g., Dubois and Gadde, 2002) which is a style of reasoning that emphasizes theory-building through empirical observations and is a *“continuous process based on the interplay between theories and data”* (Le Gall and Langley 2015: 38). Abduction is considered appropriate in the case of transdisciplinary action-research and semi-structured interviews (Stirling, 2015), especially in the context of studying complex systems (Schlüter et al., 2019). Informed by the literature, we thus identified patterns in the empirical challenges that the Lab coordinators encountered, and discussed these together with the coordinators and project partners during the activities of the project. As researchers, we clustered the observed challenges into four major themes to construct more general conceptualizations. Data sources are summarized in Table 8.2. The supportive data are not used explicitly, but supplied the authors with insights into the empirical context.

Table 8.2 | Details on the data used for the analysis presented in this chapter.

Data source	**Level of analysis**	Function	**Details**
28 (online) interviews	Transcribed and coded	Main data source	15 interviews with Lab coordinators 13 interviews with core project partners involved in project coordination or Lab training
2 surveys	Coded	Main data source	Lab coordinator surveys as part of project monitoring and evaluation
Training sessions for City Lab (5 sessions), Food Lab (2) and Policy Lab (7) coordinators	Selectively transcribed and coded Participant observation	Main data source Supportive	Two-day sessions, designed in consultation with coordinators to support the Labs in addressing challenges
3 reflection sessions	Systematic field notes, coded	Main data source	3-h focus groups were organized with Policy Lab coordinators to reflect on their learnings and the impact of their Labs
21 Dynamic Learning Agenda sessions	Systematic field notes, not coded	Supportive	1–2 h (online) sessions, facilitated or observed by author 2
3 interactive webinars	1 selectively transcribed and coded 2 non-systematic field notes, not coded	Main data source Supportive	3 interactive 2-h webinars were organized. One focused on 'power' in stakeholder engagement, and was selectively transcribed and coded
Project meetings	Non-systematic field notes, not coded Participant observation	Supportive Supportive	Numerous project meetings, workshops, conferences and bilateral conversations
Written project materials	Not coded	Supportive	Project deliverables, publications, reports

8.5 ANALYSIS: UNRAVELING POLITICAL BALANCING ACTS OF DOING INCLUSION

In this section, we present four different challenges to doing inclusion in FIT4FOOD2030. While some impacts of the FIT4FOOD2030 Labs are detailed elsewhere (e.g., EC, 2021), we here focus on certain patterns of challenges across different Labs, which emerged in response to ambitions for transdisciplinarity that the project sought to stimulate. Each challenge is structured around three elements: the overarching challenge, the corresponding response (or balancing act) of Lab coordinators in FIT4FOOD2030, and the implications for the politics of inclusion.

8.5.1 Can we bring together the powerful and the marginalized?

The challenge

Bringing together both powerful and marginalized stakeholders in meaningful co-production processes was a key challenge in FIT4FOOD2030. Inclusion of established and well-connected actors or organizations could enhance the transformative capacity of Labs, for instance by providing credibility to Labs' outcomes, and enhancing possibilities to link to ongoing transformation efforts, for instance at (local) government levels. One Policy Lab coordinator describes:

> *"The involvement of these [large enterprises and government agencies] would have a greater impact and increased awareness on sustainable food systems".*

On the other hand, inclusion of underrepresented voices broadens perspectives, increases societal support, and provides legitimacy to the process. According to a City Lab coordinator

> *"The food system is rich and we want a richness of voices to understand better what they would like to embed in the activity [of the Lab]."*

Marginalized but engaged stakeholders are also important for transformation as they *"will help you more than someone who has power but not interest"* (City Lab coordinator).

The balancing act

In practice, balancing these (groups of) stakeholders leads to tensions. For example, a City Lab coordinator described that during a workshop a powerful stakeholder ended up at a table with clearly less powerful stakeholders. The discussion became unproductive and coordinators observed that

> *"he started making comments and […] he was annoyed because there were other powerful stakeholders at other tables."* (City Lab coordinator)

Such difficulties could be overcome by strategically designing multi-stakeholder events (see, e.g., Hendriks, 2008; and more recently Pereira et al., 2018a). Effective too in this regard were the project's creative tools and methodologies (visioning exercises, co-creative pathway building exercises, see EC, 2021; Baungaard et al., 2021; based on for instance van Mierlo et al., 2010; Hyysalo et al., 2019) that sought to enable equitable level playing fields in workshop settings. The effectiveness of these aids sometimes surprised Policy Lab coordinators, who observed, for instance, that high-level ministerial policy makers were happily drafting post-its and making drawings in their workshops. However, even if one strategically designs groups of stakeholders and provides appropriate tools, there is still a need for moderators to intervene in processes and discussions to ensure a certain degree of equitable participation, for instance by *“raising the level of the discussion so that the person with the weaker weight is stronger”* (City Lab coordinator).

Managing power imbalances is even more challenging when it comes to engaging stakeholders during long-term Lab (or transformation) processes. In general, FIT4FOOD2030 Labs reported a high degree of stakeholder diversity as well as the establishment of vibrant transformative networks (see, e.g., EC, 2021). As one Policy Lab coordinator indicated*: “I can see the difference between these kind of meetings and other types of meetings that I’ve been to.”*

Despite the enthusiasm of those who joined the Lab activities, Lab coordinators do indicate that it was not straightforward to ensure commitment of powerful stakeholders. Some of the relevant “*policy makers [were] not very interested as generally they don’t seek feedback, but implement food related policies”* (City Lab coordinator), or even were *“afraid of the plurality and action-participatory approach [the Lab] had”* (Policy Lab coordinator). In addition, food industry sometimes did *“not see the value of such sort of activities and they may have [had] other priorities”* (Policy Lab coordinator) and farmer-organizations did not *“really see how this can be useful for them, because they’re very much focused on the needs of their client”* (Policy Lab Coordinator).

Furthermore, Lab coordinators report that marginalized stakeholder groups (such as specific citizen groups, farmers or NGOs) were often difficult to continuously engage due to various reasons, including (1) the inability to convince those stakeholders that they would benefit from being included, (2) a lack of experience or legitimacy in reaching out to and meaningfully engaging these stakeholders, and (3) a lack of resources (money, time, staff) of these stakeholder groups to participate in events (see also Hendriks, 2008; Turnhout et al., 2020) which could often not be compensated for by the project’s own limited financial resources. With inclusion of marginalized stakeholders also comes the responsibility to empower them:

> *“The relation of trust that has to form [...] you have to be able to show that you have some power to really make a difference for the group.”* (project partner)

Implications for the politics of inclusion

Continuous stakeholder management is required to bring together powerful and marginalized voices both in participatory events and entire transformative processes. This also entails creating spaces for deliberation that to some degree resemble (the political dynamics of) the system but at the same time mitigate reproduction of power relations of that system. However, if this experimentation aims to contribute to transformation of the 'system' outside its protected space, power relations are to be restructured not only temporarily during workshops or the Lab process, but more fundamentally in the system. There lies the political challenge: to equitably include a wide variety of voices in experimenting for system transformation, is to restructure power relations of that system. Doing meaningful inclusion for transformation thus is a political intervention and relies heavily on the authority and legitimacy that process facilitators have to make decisions on how and when to include whose voices in which way.

8.5.2 How do we combine representation with deliberation?

The challenge

A second challenge concerns the issue of speakership and representation. As we strive to classify participants in transdisciplinary processes and assess the degree and diversity of stakeholder representation, we are confronted with the challenge of how to make sense of participants' myriad roles. When does a participant represent themselves, and when do they (also) speak for larger groups? Or more broadly: how can inclusion processes aim for diversity, representational legitimacy, or other normative ends, while accounting for the multifaceted and changing roles that participants inhabit (Maassen and Lieven, 2006), to be useful, consistent, and accommodating of roles that may fluctuate over time?

The balancing act

FIT4FOOD2030 strove for broad and diverse inclusion as an overarching approach to food systems transformation. Trainings and guidelines designed to equip Lab coordinators with tools and approaches to organize events also stressed the importance of including relevant actors and operating with broad definitions of who should constitute the stakeholders to Lab activities, along with the encouragement of also including so-called non-usual suspects or marginalized stakeholders who did not usually have a say in food systems and related policy.

The task of operationalizing these general ambitions into something that could be carried out within the confines of Lab events (with anywhere between a handful to several dozen participants), required interpretation, selection, and prioritization, as well as choices that effectively constituted decisions about who should get to represent and speak for different participant groups. This deeply political task has significant impact on how inclusive processes unfold. It was generally carried out on the Lab-level, by Lab coordinators themselves in consultation with their core team or broader stakeholder network, rather than enacted by the project consortium or through project materials, guidelines and templates. In interviews, coordinators frequently recognized that individual participants could shift between representation roles, at one moment seeming to speak for organizations or larger groups, and at other times expressing more personal or individual views:

> *"Sometimes, people participate in workshops just as themselves, with their personal interest. Sometimes just as their profession."* (City Lab coordinator)

Often, Lab coordinators were eager to engage government authorities, together with those who could speak on behalf of groups of stakeholders as representatives:

> *"We don't think we have a fixed network. We have a core group [...] it is not so important to have a large network. It is good to have the main authorities, and around that have a few associations, from the value chain, with industry, consumers side. And with this group we can go further with different strategies and boost the research agenda."* (Policy Lab coordinator)

Attempts at reaching target groups via associations also proved challenging, and suggested an evolving and dynamic relation between representative and deliberation arguments for including stakeholders:

> *"[I]n past years, we wanted to consult citizens through the citizens associations. But that is not really a representation of the voice of citizens. So that was not a really good way to do it. Now, we are changing our minds to use panels or groups of citizens that can be consulted on specific topics."* (Policy Lab coordinator)

Implications for the politics of inclusion

The choices coordinators described above and in other interviews tended to combine pragmatic choices with normative ambitions for weighing representation and deliberation. In particular, the changing stages and topical needs emerging from Labs' activities seemed to influence the generic ambitions to strive for engagement with large and diverse groups in the form of representation (when impact was aimed for) or deliberation (when inclusion was aimed for). Thus, coordinators reported making pragmatic and practical changes pertaining to inclusion to achieve particular goals or make certain types of progress in Labs, often opportunistically in relation to locally specific opportunities for intervening or enhancing the Labs' impact. In doing so, coordinators had a very powerful position in 'translating' the meaning of deliberation and representation to their local context, and their choices strongly shaped their Lab's direction. The implications of these observations are twofold. First, in line with the work of Hendriks (2009), it suggests that normative interpretations of democratizing participatory processes are constructed differently in different contexts and phases. Second, it suggests an intrinsic tension between inclusion and transformation ambitions in considering when and which stakeholder groups are to be engaged through deliberative or representative efforts. That brings along the political question of who decides, and with what legitimacy and authority, who is to be included in transformative processes and in which way.

8.5.3 How do we balance diversity and directionality?

The challenge

A third challenge refers to the tricky practice of doing inclusion by balancing and fostering both directionality and diversity. As one of the City Lab coordinators illustrates, the tension is integral to complexity:

> *"I think dealing with complexity means dealing with open questions that are not still resolved. Not solving conflicts, but being like an arena where people can discuss and can think about other perspectives."*

The Labs, however, also aimed at contributing to transformation processes, and had the specific goal of experimenting with the actual implementation of one (or more) desired transformation pathways:

> *"To bring people together to make a change; that is the objective. […] We did [the Policy Lab] for a purpose that served policy-making […] and in connection to the FOOD 2030 goals."* (Policy Lab coordinator)

While there was a large degree of flexibility on the Lab level, the project already had a preset notion of creating visions and pathways within the context of transformation toward the FOOD 2030 agenda. Managing this was not straightforward, as one City Lab coordinator illustrates:

> *"The food system is rich […] and sometimes, we were a bit lost in this richness. So at the end we have chosen food waste, one topic […] working on something which is very local, specific […] and on the other side something which is so wide. So, these different dimensions are not easy to manage."*

The balancing act

We observed that in different situations and contexts, as well as at different stages of the Lab process, Lab coordinators (strategically) used different arguments and methods in closing down diversities and legitimized this by invoking different (democratic) values.

Sometimes, decisions were reached within workshop settings through deliberation and collective decisions, as one City Lab coordinator believed that coordinators *"cannot force, because we are nobody, we are a network, we are not the owners of the network".*

In other instances, the coordinators were more direct in steering the process in particular directions, for instance to align with the specific targets of the framework set out by the project, to make Lab outcomes more relevant, legitimate or accountable:

> *"During a workshop when we were identifying clusters [...] we explained that this is the focus of our project and that the transformation needed within food production should be the focus of another multi-stakeholder ecosystem."* (City Lab coordinator)

Directionality toward a specific thematic focus might have excluding consequences for the diversity of stakeholders. According to a City Lab coordinator*, "if we decide that we are not focusing on [food] production, it is normal that we have to ignore some of the stakeholders and incorporate new ones."* Therefore, inclusion for transformation is in fact to balance multiple diversities and directionalities.

Interesting as well were instances where structural and socio-material configurations contributed to dynamics of inclusion and exclusion. For instance, during the Covid-19 pandemic the Labs had to re-invent themselves as virtual spaces. This allowed opening up the process for new stakeholders (for instance particular farmers, who were often not able to attend daytime Lab activities organized in cities), but led to exclusion for others (for instance stakeholders with lack of access to, or acquaintance with, digital tools and platforms).

Implications for the politics of inclusion

The challenge of when to intervene and on what grounds strongly relates to the different role perceptions in transformation processes (Sarkki et al., 2013; Wittmayer and Schäpke, 2014). While some Lab coordinators considered themselves to be topical experts or change agents (strongly intervening in the process), others considered themselves mainly network builders or process facilitators (envisioning a more 'neutral' stance), while again others sought ways to combine directionality and diversity in their role-ambition:

> *"I am a strong advocate for that we need an urgent and radical change in the system, however, I let go of any strong attachment with regards to how we get*

there. I understand now that the complexity of the issue calls for various ways and approaches simultaneously." (City Lab coordinator)

Our observations suggest that balancing diversities and directionalities is challenging, but that a variety of strategies and associated role perceptions can be considered (il) legitimate by Lab coordinators, stakeholders and project management. They also illuminate the deeply political role of Lab coordinators, and the powerful position they have in shaping processes (and, therefore: outcomes) of inclusion. Thus, 'doing inclusion' does not in itself create responsible innovation; a balancing of directionality and diversity is required throughout different phases of co-creation (Van Mierlo et al., 2020).

8.5.4 How are the boundaries of inclusion constructed?

The challenge

In the current complexity of (food) system transformation, where so many projects and experiments are initiated across governance levels, often related or overlapping, an important question arises: who is actually included in what? Consequently, how and by whom are the boundaries of inclusive experiments constructed?

In FIT4FOOD2030, we observed that this boundary-complexity affected the work of the Labs. For instance, one City Lab, contributing to setting the local policy agenda, partnered with existing networks and governments, and facilitated visioning sessions for this new network. The Lab enhanced its impact, but lost some control over who was part of the processes and activities. Another example: a Policy Lab seeking to foster collaborations between stakeholders in research, policy and society, and to co-develop funding programs for transdisciplinary R&I, acted as a catalyst in linking existing networks and stakeholders. To increase their impact, they too partnered with existing (international) initiatives in organizing workshops and agenda-setting activities. Although one could argue that these Labs involved stakeholders from larger networks in their activities, one could also argue that to contribute to transformation, the Labs lost some autonomy over their boundaries. Determining and enacting the boundaries of the Labs leads to confusion on who is included in which process. It raises the question which actor, project or Lab is primarily responsible for which (inclusive) developments, and therefore, accountable for the ways in which they are shaped.

The balancing act

While several Labs opted for the strategy of embedding in larger institutions or partnering with (local) governments, this is not the only possible strategy, as others worried it would affect the autonomy of their Lab. One City Lab Coordinator for instance indicates that

> *“when we work with the [city government] […] we have the sensation that if we were inside them, we would be collapsed by urgencies that come from the top of the [city government] […]: ‘Lab, do that now because there is a fire here!’”*

Navigating this challenge proved a complex endeavor but if coordinators managed to successfully link up to ongoing developments to create (local) impact, while at the same time remaining a degree of autonomy and flexibility to be inclusive as local spaces for experimentation, this could also be rewarding:

> *“It is interesting to find on one side the balance between something which has strong priority, like the municipality, but on the other side challenge these priorities. So, swim in this big sea of policy priorities, but on the other side try to swim in an opposite direction to refresh the discussion.”* (City Lab coordinator)

Being part of a large EU-funded CSA project also brings along a role for Labs in responding and being adaptive not only to local networks and governments, but also to EU and project-level (policy) developments. This embedding of the Lab in larger policy discourses was often considered advantageous and being part of an EU-project provided the Labs with leverage to engage particular stakeholder groups, but also in their efforts to influence (local) governments, as the activities of the Lab were

> *“not something that we have thought of ourselves […] it’s really something that’s framed within a European project, and that’s always something that has more weight”* (Policy Lab coordinator).

Implications for the politics of inclusion

The boundary-challenge seemingly emerges from two paradoxical functions of transdisciplinary Labs. The first function, grounded in the desire to be inclusive, aims to create ‘Habermasian safe spaces’ to foster deliberation and reflection (see Habermas, 1981; Pereira et al., 2018a). To do this, one constructs boundaries to demarcate the Lab from the system, where the Lab can be an environment for co-creation and experimentation in which ‘the collective’ of stakeholders can govern itself in a democratic, inclusive and autonomous way (see also Latour’s work on the *Politics of Nature,* 2004). The second function is grounded in the desire to create systemic transformation, which means that to have impact the Lab needs to open up to its environment and be adaptive to changes in the system. To scale-up its outcomes or bring into practice identified pathways, the Lab also needs to link to, or embed itself in, local governments, institutions, or existing networks that it aims to transform (e.g., Pel et al. (2020); Lam et al. (2020a) on scaling mechanisms and transformative strategies).

The balancing act thus is a tricky one: inclusion requires boundary construction to ensure autonomy and inclusion, while transformation requires boundaries to be deconstructed to engage and transform the complex ‘outer world’, adding an additional layer of complexity to the already highly political nature of boundary work (Brown and Dillard, 2015; Glimmerveen et al., 2020). Navigating these two critical functions simultaneously requires reflexive agency of coordinators to manage and enact multiple but, selectively permeable, boundaries of the Labs.

8.6 DISCUSSION AND REFLECTIONS: NAVIGATING THE POLITICS OF TRANSFORMATION

As we have empirically illustrated, navigating the political dynamics in doing inclusion involves navigating multiple challenges simultaneously. Here, we present reflections relevant in the context of transdisciplinarity for transformation and point to avenues for further research.

First, the identified political challenges illuminate intrinsic tensions between efforts to combine inclusion ambitions with transformation and invigorate the notion that inclusion for transformation is as much about exclusion and ‘closing down’ as it is about ‘opening up’ (Van Mierlo et al., 2020). As such, inclusion of particular stakeholders and perspectives is more relevant and justified in certain contexts and process phases than others (Schneider and Buser, 2018). More in particular, we argue that balancing inclusion efforts with excluding effects they bring along forms an intrinsic political aspect of stakeholder engagement. This also raises questions on how facilitators of inclusion processes can engage in mitigating the trade-offs and dynamics of exclusion that participatory processes inevitably bring along, as well as the need to more explicitly specify which actors or institutions bear which accountabilities for which process in complexity (e.g., Glimmerveen et al., 2020) and how responsibility for and political accountability of transdisciplinary processes and outcomes, can be embedded in transdisciplinary practice and design (see also De Campos et al., 2017; Genus and Stirling, 2018).

Second, we have argued that balancing this ‘opening up’ and ‘closing down’ is actually balancing multiple ‘openings’ and ‘closings’ in a number of related political challenges. Doing inclusion is no moment, but a constant balancing of different arguments and values; a *“political practice which is inevitably imbued with unequal power relations that need to be acknowledged but cannot be managed away”* (Turnhout et al., 2020: 18). This emphasizes the deeply political role of facilitators, as well as the power and responsibilities that come with that role in practice. Our analysis, again, indicates the importance of further exploring how (collective and collaborative) learning and building reflexive agency in practitioners involved can best take shape in transdisciplinary transformation processes (see also Van Mierlo and Beers, 2020; Verwoerd et al., 2020). In particular this could shed light on how the balancing of different (or even conflicting) roles between 'action and reflection' (Bulten et al., 2021, cp. Wittmayer and Schäpke, 2014) relates to navigating the political dynamics and challenges at play in transformative efforts. Important in evaluating the legitimacy of these balancing acts is better understanding how trust building processes between stakeholders (and facilitators) take shape and how they can be further enhanced (Svare et al., 2020b), a question worthy of attention in the context of sustainable transformation (Koole, 2020).

Third, our analysis implies that 'doing inclusion' is not only related to reflexive weighing of arguments, but requires facilitators to navigate (systemic) powering processes that result from unintended or undesirable actions and dynamics. This includes powering instigated by local (non)participants, but also project- or funder-level actions that interfere with Lab-level processes. Furthermore, though the influence of structural or socio-material powering processes is increasingly acknowledged in transition studies (see, e.g., Grin, 2010; Svensson and Nikoleris, 2018; West et al., 2020; Contesse et al., 2021; Kok et al., 2021a), this has not yet been extensively explored in the context of inclusion in transdisciplinarity (Dannecker, 2020). As we have illustrated, such structural and socio-material dynamics do, however, permeate the boundaries of 'inclusive experiments' and influence the dynamics of inclusion and exclusion. Further inquiries into how exactly structural and socio-material configurations interact with, or mediate, inclusivity might further enhance our understanding of why and how inclusive processes can take unexpected or undesirable turns.

Fourth, during the FIT4FOOD2030 project, Lab coordinators operating in different localities, targeting different audiences, and with different intersecting (organizational) needs, norms, and priorities were presented with normative (inclusivity, diversity) and topical (food and R&I system transformation) facilitation content. The project sought to prepare coordinators for (and stimulate learning and exploration around) challenges to inclusion. The specific ways in which coordinators faced and responded to challenges by intervening in group discussions, identifying and inviting stakeholders, or otherwise contribute so that marginalized stakeholders were not only included in formal but also substantive ways, nevertheless varied greatly. As such, it was challenging to support a highly diverse group of Lab coordinators in preparing for all the possible judgment calls and attunement to challenges they may encounter, requiring further exploration of how to best support translocal learning and empowerment processes (see, e.g., Avelino et al., 2020). Moreover, adopting more deliberate and reflexive approaches to the inherent challenges and tensions surrounding inclusion will (and should) also become reflected in the outcomes and impacts of inclusion processes - a topic outside the scope of the current chapter but a highly relevant focus of future research.

Finally, though we were not directly involved in 'doing inclusion' in the Labs, we are aware that in each of our roles (researchers, training team and project management) we were not neutral observers, but actively engaged in those contexts FIT4FOOD2030 aimed to transform. The powerful role of researchers in (agenda-setting and) shaping practice has been well documented (see, e.g., Shdaimah and Stahl, 2012) and in the project, we balanced multiple sometimes conflicting roles (see Bulten et al., 2021). In fact, we were performing our own (political) balancing act: navigating between on the hand the pre-set project ambitions and targets as well as directions implied by the EU policy context and funders, and on the other hand the emergent and diverse needs of the different Labs. This required us to make difficult choices (on deadlines, stakeholder monitoring, workshop formats, etcetera) anticipating and adapting to different needs and contexts, taking both 'project' and 'Lab' perspectives in mind. Our actions too were shaped by the limited time, knowledge and resources that short-term project settings inevitably bring along. Such complexities again point to the need to enhance reflexivity, learning and capacity building not only for those 'doing the inclusion' on the ground, but also for those involved in supporting transformative program ambitions in a variety of different roles (see also Den Boer et al., 2021b).

8.7 CONCLUDING REMARKS

In this chapter, we analyzed stakeholder engagement efforts in 25 transformative Labs of the FIT4FOOD2030 project. Our contribution is threefold: first, we empirically unraveled four key challenges that emerge in the political practice of 'doing inclusion': (1) the challenge to meaningfully bring together powerful and marginalized stakeholders; (2) combining representation and deliberation of different stakeholder groups; (3) balancing diversities of inclusion with directionalities implied by transformative efforts; and (4) navigating the complexities of establishing boundaries of inclusion processes. Second, we explored how facilitators navigated these challenges, and emphasize that there are no blueprints or clear-cut solutions that could immediately resolve the identified challenges, as they are intrinsically embedded in the political practice of doing inclusive and transformative efforts. Third, we presented implications for the politics of inclusion, and argued that intrinsic tensions between 'inclusion' and 'transformation' ambitions pose challenges for managing transdisciplinary efforts aimed at transformation. Navigating multiple political challenges, often simultaneously, requires reflexivity, flexibility as well as rigorous methodologies at the level of facilitators, but also more broadly at the level of inclusive processes and the projects they are part of. Our findings also suggest that while focusing on concrete (transformative) outcomes is an important aspect of transdisciplinary projects, a purely functionalist take does not capture the rich and challenging political nature of doing inclusion efforts, and the potential legitimating and empowering roles that such processes bring along. Moving beyond the functional turn then also requires fostering R&I governance efforts that support transdisciplinarity through providing systemic environments in which truly reflexive transformation processes are to be enacted (Schot and Steinmueller, 2018; Fazey et al., 2018a; 2020; Kok et al., 2019; Klerkx and Begemann, 2020; Den Boer et al., 2021a).

As we have elaborated in our discussion, our contribution also leaves many questions unanswered and requires further research along a variety of avenues. We hope that others see our contribution as an explicit invitation to engage with our findings, to further advance the understanding of how the politics of inclusion takes shape in practice. Finally, we hope that our findings can contribute to re-politicizing inclusion in sustainability science, and thereby to designing, doing and evaluating transdisciplinary processes of inclusion aimed at instigating societal transformation toward sustainable and just futures.

CHAPTER ACKNOWLEDGMENTS

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9

Exploring the practice of Labs for sustainable transformation: The challenge of ‘creating impact’

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ABSTRACT

While scholars have argued that transdisciplinary experimentation processes in multi-stakeholder Labs might help create meaningful societal impact, there is ample room to explore the practice of 'doing' Labs (that is: the micro-politics, strategies and challenges involved) in relation to the impacts that Labs aim to create. Based on a case study of the FIT4FOOD2030 project (2017-2020) that set up 25 Labs, we aimed to gain insight into how transdisciplinary Labs with transformative ambitions try to create impact, and which challenges that brings along. For "capacitating change", Labs built agency by focusing on creating (1) new relations through network mobilization, network consolidation and network navigation; (2) new knowledge through knowledge sharing and social learning; and (3) new competences for Lab coordinators and engaged stakeholders. For "creating change" Labs focused on (1) transforming networks - the Lab as catalyst; (2) transforming practices - the Lab as concretizer; (3) transforming structures - the Lab as construction site; (4) transforming cultures - the Lab as critical mass. We observed complex (reciprocal) relations between processes of capacitating and creating change. Finally, we present intrinsic challenges in the practice of 'doing' Labs regarding the evaluation of single-Lab impacts, and the political dynamics of transformative Labs.

9.1 INTRODUCTION

There is an urgent need to accelerate sustainability transitions toward sustainable, low-carbon societies and tackle systemic injustices in fields like agri-food, energy, water and healthcare. These imply fundamental changes in systemic cultures, structures and practices brought forth through deeply normative, long-term, multi-dimensional processes that are characterized by co-evolutionary and non-linear dynamics (Köhler et al., 2019; Loorbach et al., 2017; Markard et al., 2012; Grin et al., 2010; Geels and Schot, 2007). Transdisciplinary research and innovation (R&I) efforts, which involve societal stakeholders in co-creating knowledge and transformative (social) innovations, are considered as important approaches in the field of transition studies (see Köhler et al., 2019, Luederitz et al., 2017), and sustainability science more broadly (e.g., Lang et al., 2012; Brandt et al., 2013; Nörstrom et al., 2020; Caniglia et al., 2021; Hakkarainen, 2022). Transdisciplinary R&I, it is argued, might lead to more democratic and socially robust outcomes, provide legitimacy to interventions and create relevant action-oriented knowledge that could more effectively catalyze sustainable transformation (e.g., Norström et al., 2020; Caniglia et al., 2020; Fazey et al., 2018a; Lang et al., 2012; Klein et al., 2001).

To facilitate transdisciplinary co-creation of knowledge, innovations and transition (policy) pathways, a wide variety of *transformative spaces*, often referred to as 'Labs', have been conceptualized, designed and implemented. Different types of Labs have emerged, for instance, Transformation Labs (e.g., Carli-Joseph et al., 2018; cf. Pereira et al., 2018a); Real-World Laboratories (e.g., Schäpke et al., 2018; Bergmann et al., 2021); Social Labs (Timmermans et al., 2020); Transformation Rooms (Haindlmaier et al., 2021) and (Urban) Living Labs (Hossain et al., 2019; von Wirth et al., 2019; Voytenko et al., 2016). Despite a vast variety of different conceptualizations, these Labs can be considered as spaces for transdisciplinary experimentation for engaging societal stakeholders around complex real-world problems. In experimentation processes (also see Sengers et al., 2019) there is a key focus on developing common visions of (potential) futures and associated transition (policy) pathways (e.g., Oomen et al., 2021; Hebinck et al., 2018); developing, facilitating, implementing and/or scaling transformative (social) innovations (e.g., Loorbach, 2007; Lam et al., 2020a); and facilitating social learning and reflection between participating actors (e.g., Reed, 2008). Labs can be considered to have a 'dual functionality': on the one hand, Labs are part of, and embedded in, systems they aim to transform (bringing along the complexity of having to work both with and against systemic power relations, see also Van Breda and Swilling, 2019); while at the same time Labs can be considered 'demarcated safe-spaces' that are shielded from (the undesirable political dynamics of) systems (e.g., Pereira et al., 2018a). Hence, Labs have *semi-permeable boundaries* (Kok et al., 2021b).

Recent literature stresses both the variety of mechanisms through which (Lab) co-creation processes could lead to *impact* (e.g., McCrory et al., 2022; Bergmann et al., 2021; Lam et al., 2020a; Chambers et al., 2021) as well as the complexities in evaluating and assessing whether impacts have actually been *achieved* (e.g., Schäfer et al., 2019; Lux et al., 2019). A variety of frameworks has been developed to assess and describe the ways in which transdisciplinary experimentation can contribute to societal transformation or 'have societal effects' (such as by Wiek et al., 2014; Luederitz et al., 2017; Lux et al., 2019; Belcher et al., 2019; Von Wirth et al., 2019; Schneider et al., 2019; Lam et al., 2020a; Williams and Robinson, 2020, cf. Schäfer et al., 2020). Due the highly complex nature of change processes, recent studies suggest that impact assessment of transdisciplinary experimentation should not only focus on explicating 'outcomes' as impact, but also explicate how transdisciplinary processes could foster *potentialities* for impact (Lux et al., 2019). Relatedly, Williams and Robinson (2020: 60) argue that "*literature on societal effects is also vague on how 'transformational societal change' is to be conceptualized".* In addition and more broadly, Wyborn et al. (2019: 337) point to *a "growing need for conceptual and empirical work to examine the assumptions underpinning claims about the societal benefits and impacts of co-production".*

In that light, scholars have also expressed the need to further explore and conceptualize the ways in which experimentation processes in transformative Labs can create transformative impacts (cf. Schäpke et al., 2018). Bronson et al. (2021) for instance indicate that unified or coherent impact measurement tools are lacking precisely because of the diversified contexts in which different Labs generally operate, and McCrory et al. (2020: 13) conclude that *"there are opportunities to explore how labs interact with system dynamics across scales"*. As such, there is a particular need to further investigate how strategies for creating impact and the impact itself are related in Labs, beyond standardized 'tools' or 'outcome measurements'. Furthermore, studies stress that there *"is a politics to labs"* (McCrory et al.; 2020: 12) and suggest understanding the political dynamics of co-creation might help explain how and why transformative dynamics (do not) emerge in practice (Turnhout et al., 2020; Kok et al., 2021b; Fritz and Binder, 2020). Hence, there is also a need for better understanding the practice of 'doing Labs' (that is: the micro-politics, challenges and strategies involved) in relation to the wider societal impacts Labs aim to create.

To address these knowledge gaps, we aim to better understand the practice of 'creating impact' in transformation-oriented Labs, by identifying the strategies that Labs pursue in their efforts to create impact, and by unraveling the (political) challenges this brings along. We specifically ask the questions: "How do transdisciplinary Labs with transformative ambitions aim to create impact, and which challenges does that bring along in practice?" Therefore, we conduct an empirical case study on the FIT4FOOD2030 project, a Horizon-2020 funded Coordination and Support Action (CSA) project that supported the European Commission (EC) in implementing their FOOD 2030 policy framework, and through that effort aimed to contribute to transitions toward sustainable food systems. The project had 25 different Labs across Europe that were embedded in different governance settings and institutional contexts, and engaged a wide variety of (local) societal stakeholders in co-creating and implementing novel educational modules (in City Labs and Food Labs) or R&I policy innovations (in Policy Labs).

After introducing our case and methods, in our analysis we abductively synthesize insights from transition studies, transdisciplinarity and our empirical case to present the different impact strategies at play in transformation-oriented Labs. We argue that there are two overarching levels on which Labs can contribute to transformation processes: they can (1) build agency within the Lab (*capacitating change*); and (2) instigate transformative powering processes to change (elements of) systems beyond the Lab (*creating change*). For each level, we identify several different impacts. We contend that this can contribute to better understanding the political nature of 'doing Labs', and help clarify how Labs aim to create impact in transformation processes. We reflect upon our analysis and present avenues for future research in our discussion.

9.2 CASE AND METHODS

9.2.1 FIT4FOOD2030: Labs for food system transformation

In order to support the transformation of EU food systems, the EC launched the FOOD 2030 policy framework in 2015 (EC, 2017). This framework aims to stimulate the uptake of transdisciplinary R&I efforts across EU Member States, so that R&I systems can more effectively contribute to food system transformation. As part of facilitating the implementation of the FOOD 2030 framework, the FIT4FOOD2030 project was launched in 2017 and funded under Horizon 2020 as a CSA project (see also, EC, 2021).

FIT4FOOD2030 established 25 'Labs' across Europe. Those included 11 Policy Labs[71] that operated on national or regional levels and were mostly embedded in (at least two different) government ministries. Policy Labs sought to engage multi-stakeholder networks in order to contribute to aligning and transforming R&I policies so as to deliver more inclusive and transdisciplinary R&I (project) funding or policy strategies. There

71 Policy Labs were located in Austria, Basque Country, Estonia, Flanders, Hungary, Ireland, Italy, Lithuania, the Netherlands, Norway and Romania.

were also 7 City Labs[72] (later joined by an additional 7 Food Labs[73]) that operated on local (city-region) levels and were run by science centers, science museums, or university Science Shops. These Labs worked on co-creating transformative educational modules, building competences in food system actors, and in some cases on influencing local food policy (agendas). To develop these innovations, Labs typically organized a series of workshops that would each be attended by up to several dozens of stakeholders (see EC, 2021 for an overview). The activities of the Labs were structured in different project phase, see Table 9.1.

Table 9.1 | Overview of phases and activities of FIT4FOOD2030 Labs.

Phase	Description of Lab activities
1. Network building and system understanding	• bring together different types of stakeholders in workshops • ensure all relevant stakeholders are included • build shared understandings of local food and R&I systems
2. Visioning and developing roadmaps	• co-create future visions of food systems and the role of R&I therein • identify barriers and opportunities for (R&I) interventions • develop roadmaps toward future R&I systems
3. Action planning and experimentation	• co-create, pilot and implement educational modules, or R&I (policy) action plans (City Labs) • co-create policy innovations and (plan for) implementation with relevant policy actors (Policy Labs)
4. Sustaining and scaling	• evaluate lessons learned (impacts, challenges) • strategize for scaling, embedding and translating the developed innovations, networks and tools

The Labs and their activities were coordinated by one or more Lab coordinators, who were employed at the host institutions of the Labs and were trained (for instance on food system transformation, public engagement, and co-creation exercises) by the project consortium. The project offered limited financial resources, but in addition to training also supported with tools and methodologies[74] to be used in Lab contexts (adapted for instance from Reflexive Monitoring in Action, see Van Mierlo et al., 2010a; and Transition Management, see Loorbach, 2007).

9.2.2 Research approach: Action-oriented and abductive

As authors we were working within the FIT4FOOD2030 project, contributing to the overall project management (authors 1,4,5,6), methodology development and evaluation efforts, as well as developing and facilitating training and learning sessions for FIT4FOOD2030's Lab coordinators (authors 1,2,3,6). We took on different roles that are

72 City Labs were located in Amsterdam, Athens, Barcelona, Budapest, Milan, Sofia and Tartu.

73 Food Labs were located in Aarhus, Azores, Birmingham, Dublin, Graz, Trentino and Vilnius.

74 See the FIT4FOOD2030 Knowledge Hub.

common to adopt in transition processes, such as those of project manager, researcher, knowledge broker and facilitator (cf. Wittmayer and Schäpke, 2014). These roles were often dynamic and changing, and sometimes conflicting (cf. Bulten et al., 2021). For example, we had to make sure all partners and Labs performed the actions required through the project proposal, with sufficient quality, on time, while at the same time we aimed to provide safe spaces for reflection, in which partners and Lab coordinators were allowed to show their vulnerability, e.g. in not being able to perform the required tasks.

By taking an active role in the project and doing research 'along the way', our efforts were grounded in transdisciplinary and action-oriented research approaches (Lang et al., 2012; Fazey et al., 2018a) that are considered important means to deliver on creating societal impact through research as an intervention (cf. Lux et al., 2019; Schneider et al., 2019). Wyborn et al. (2019: 320) define such action-oriented research as *"processes that iteratively unite ways of knowing and acting [...] leading to mutual reinforcement and reciprocal transformation of societal outcomes."* In particular and concretely, through our engagement with the project, we actively contributed to developing *theories of change* on the level of individual Labs as well as the project as a whole, which *"enhance learning for effectiveness of societal interventions through designing and regularly scrutinizing pathways to impact"* as they *"outline an intervention's working hypotheses about how its activities might trigger changes and continuously refines it through cycles of action and reflection"* (Schneider et al., 2019: 27). As practitioners in the project, together with other project partners and Lab coordinators, we tried to stimulate learning and reflection in project activities (workshops, conferences, training sessions) to eventually contribute to complex societal problem solving (cf. Lang et al., 2012).

By iterating between insights from literature and empirics in our analysis, we follow abductive reasoning which *"yields plausible explanations of puzzling phenomena"* (Shani et al., 2020: 64; cf. Peirce, 1903/1997). This means that we aim to contribute to theory development by synthesizing insights gained from theoretical exploration and our empirical work. Rather than constructing a framework *ex-ante* and testing it (*deductive*), or developing a conceptualization based on empirical findings *ex-post* (*inductive*), in our research we were iterating between theory and data. Abductive reasoning is considered appropriate in transdisciplinary action-research (Stirling, 2015; Shani et al., 2020) that is characterized by a high degree of complexity and requires to adapt insights reflexively during research practice *ex-durante* (cf. Lang and Wiek, 2021). This led us to construct an integrated analysis section where we introduce mechanisms for impact, stressing their relevance or origin in literature, and empirically elaborate on how these mechanisms play out in practice.

9.2.3 Data collection and analysis

The empirical object of our study is the FIT4FOOD2030 project (2017-2020) with its 25 Labs. We consider the project to be an embedded single case study, where the project as a whole serves as the case, and the Labs as *"units of analysis"* within that case (see Baxter and Jack, 2008; Yin, 2003; Scholz and Tietje, 2002). Embedded case studies aim for *"comprehension of the case as a whole in its real-life context"* (Scholz and Tietje, 2002: 2). In particular, we focus on the project's 11 Policy Labs, and 7 City Labs, as these provided most insights regarding the strategies for impact, whereas the work of 7 Food Labs (that joined the project midway and had less transformative ambitions due to their short timeline, limited resources and the effects of the pandemic) in this study served as supportive and contextual information.

During the project, we collected empirical data during project activities and through interviews. Additional supportive data that provided insight in the project context was gathered through observations during project meetings, documents and activities. Informed consent was given during interviews, workshops and project activities. An overview of data sources is presented in Table 9.2. Recorded data was (selectively) transcribed and coded using Atlas.ti. When using quotes, we refer to anonymized respondent numbers R1-R49.

Table 9.2 | Overview of data.

Data source	Data type	Level of analysis	Details
29 (online) interviews	Main	Transcribed and coded	29 online interviews of 45-90 minutes (including some duo-interviews) conducted with in total: 13 consortium partners (R1-13) 19 Lab coordinators (R14-32)
14 (two-day) training, learning or reflection sessions with Lab coordinators	Main	Selectively transcribed and coded Participant observation Informal dialogues	Training (in real-life: two days; online during covid: two half days) with Lab coordinators (R14-49) included lectures, exercises, reflection and learning sessions, and informal engagements such as dinners: 7 trainings with Policy Labs 5 with City Labs 2 with Food Labs
2 surveys	Main	Selectively transcribed and coded	2 comprehensive surveys (including open questions) were sent to Lab coordinators in 2019 and 2020, and inquired into Lab coordinators' experiences and learning needs as well as Lab and project processes, outcomes and impacts
Project documents	Providing context	Not coded	Documents such as project plans, (draft) project deliverables and policy briefs provided context into project dynamics
Project meetings	Providing context	Non-systematic field notes, not coded Participant observation Informal dialogues	During 3 years of FIT4FOOD2030 (2017-2020) authors joined, organized and or facilitated project workshops and conferences; and joined more-than-weekly project meetings

9.3 RESULTS

In this section we present the different mechanisms through which the FIT4FOOD2030 Labs tried to contribute to the project's transformative ambitions. Through abductively synthesizing insights from transition studies, transdisciplinary sustainability science and our empirical exploration, we contend that impact can be seen to be achieved on two levels: (1) capacitating change; and (2) creating change.

First, regarding building agency to capacitate change, we consider impacts as creating new relations, new knowledge and new competences. Second, we highlight four impacts which Labs tried to create by exercising power in their systems: by transforming networks, practices, structures and cultures. For each impact we elaborate the coordinators' perceptions of the impacts at play in relation to the challenges they encountered while implementing the Lab activities.

9.3.1 Capacitating change

Many scholars have illuminated the processes through which transdisciplinary R&I leads to societal impacts (e.g., Lux et al., 2019; Wiek et al., 2014; Schneider et al., 2019) and emphasized how these can serve to strengthen *capacities for change*. In the context of sustainable transformation, the notion 'capacity for change' is strongly related to both individual and collective *agency* (Stirling, 2019; Westley et al., 2013; De Haan and Rotmans, 2018; Wolfram, 2016). Though there are many different conceptions of what agency is, and who or what is able to exercise it (e.g., Giddens, 1984; Emirbayer and Mische, 1998; Archer, 2000), we follow recent conceptualizations by Kok et al. (2021a, building on Giddens, 1984 and Stirling, 2019) on the politics of transitions in considering agency as a *capacity for reorientation* that can be attributed to human agents as well as (socio-material) networks as a whole. In that way, building collective agency in order for Labs to be reflexive, adaptive and transformative could be seen as key to delivering systemic change.

New relations

A first crucial step toward building collective agency in Labs is creating new relations in the Lab (e.g., Schäpke et al., 2018; Nevens et al., 2013). We propose three mechanisms that are crucial in creating new relations:

Network mobilization

Network mobilization entails bringing together different (types of) stakeholders in the activities of the Labs. The composition of involved stakeholders can differ for project phases and goals of the Lab (see e.g., Musch and Von Streit, 2020; Loorbach, 2007).

This poses intrinsic challenges and questions as ‘who is allowed’ to deliberate and be represented in the Lab (e.g., Turnhout et al., 2020; Kok et al., 2021b).

The first strategy the FIT4FOOD2030 Labs pursued to increase their transformative capacities was building multi-stakeholder networks, including also ‘non-usual suspects’, and to consolidate and sustain these networks. Building networks was considered crucial for building transformative capacities, and though

> *“you can’t evaluate in advance how your connections will turn out, and how they will support your Lab”* you can *“use their inertia or their momentum, with their network and what they are doing”* (City Lab coordinator, R21).

The evolution of networks was highly differentiated across Labs and different types of networks emerged, depending strongly on Labs’ local aims and context. In most instances, the network consisted of a small core group and several dozen other interested stakeholders who would join workshops or Lab activities. For instance, one Lab coordinator described the network as follows:

> *“We don’t think we have a fixed network. We have a core group, the most important people. And the other stakeholders from the value chain [...], they are changing sometimes depending on the needs. Depending on the points that we want to discuss”* (R25).

For others, the (ambition for the) network was more fixed and consolidated:

> *“Having all of these stakeholders align, which are more than 50 stakeholders from more than 30 organizations, is an outcome that we would like to highlight”* (City Lab coordinator, R19).

Network consolidation

Where network mobilization can be seen as an impact, it was a highly challenging endeavor. Important in this regard was network consolidation: building meaningful relationships and engagement. Bringing together stakeholders is not enough; Labs should actively seek to support trust building in the networks that emerge (e.g., Svare et al., 2020b; Schäpke et al., 2018) in order to make sure that meaningful relationships emerge. This is challenging as it requires a lot of time and energy investment from participating stakeholders (see e.g., Sahakian et al., 2021), pointing to the need to realize realistic benefits to those participating, for otherwise participation risks becoming tokenism (e.g., Cooke and Kothari, 2001). One City Lab coordinator explained how such a 'vibrant' network became visible:

> *"One outcome that I'm proud of is that to see people, the City Lab members, come back to us. Even in this strange period* [covid pandemic]*. So, toward all the time that we've been working with them we've also seen proposals [for activities] from them. So, it was not just our work as coordinators to get them involved but also see proposals from them"* (R16).

In particular, the inclusion of both powerful and marginalized stakeholders was seen as important as well as a key challenge (see also Kok et al., 2021b):

> "*What was our learning? The importance of establishing trust. So, just to have the connection to the people in the neighborhoods directly, which is very difficult. You also have to establish trust for regular citizens or most of all for socially deprived citizens"* (R41).

When the project was midway, one City Lab coordinator expressed uncertainty on the success of network building:

> *"I really felt that the workshops have started a network formation process, and at some point it seemed that it was growing and that we could say that the City Lab had an impact in starting and supporting this network. But now, actually, I feel that since we stopped creating more workshops and more opportunities, this network kind of died"* (R22).

These challenges and 'ups and downs' illustrate the highly dynamic and political journeys of Lab coordinators in their efforts of network building and consolidation. Yet, toward the end of the project, the Labs had engaged over 1600+ stakeholders in their workshops and activities, and the project's local Labs had delivered educational modules to 1000+ higher education students and school children (EC, 2021).

Network coordination

For building collective agency, there is the need for the Lab to navigate a complex landscape of existing initiatives and organizations and to find common direction within that landscape. This requires adaptive and reflexive management practices of networks within Labs (e.g., Schäpke et al., 2018) in efforts to help create energetic and vibrant networks.

Regarding the coordination of emerging networks, Lab coordinators generally emphasized their changing and dynamic nature. One City Lab coordinator stressed that the relation between the Lab and the network

> *"is very open. Each time we have an activity, each time we are meeting the stakeholders in the City Lab, we have a meeting with them and we ask them, we tell them okay this is what we would like to do"* (R15).

Coordinators also indicate that having flexible network compositions, especially in early stages of experimentation is important. At the same time, having core groups or fixed networks is also seen as an important means to create transformative capacity. We also observe slightly different interpretations of the relation between the 'Lab' and the 'network'. For some coordinators the Lab the Lab was the network:

> *"[the Policy Lab] is a network that we have built with our stakeholders, but I see [...] and it's also a meeting opportunity, a meeting place, a meeting of these different stakeholders and working together, not only in a free network, but really a working group"* (R31).

For others, the network was something that was supported by the Lab (and the FIT-4FOOD2030 project) where the Lab (coordinators) served as facilitators of the network: *"we are nobody, we are a network*, [the Lab coordinators] *are not the owners of the network"* (City Lab coordinator, R19). The 'network' was not only a vehicle for capacitating transformation (as one Policy Lab coordinator stressed: *"the network is the basis for further steps"* (R27)) but was also seen as a concrete impact itself. One Policy Lab coordinator described: *"The impact has been bringing people together, building the network"* (R30).

New knowledge

Second, transdisciplinary research emphasizes the importance of *knowledge co-production* as avenue for creating new knowledge for transformation (Norström et al., 2020; Caniglia et al., 2021; Schneider et al., 2019; Turnhout et al., 2020). In particular, this could lead to the knowledge on systems ("what?"), targets ("where to?") and transformation pathways ("how?) (cf. Hirsch Hadorn et al., 2007).

Knowledge sharing

Knowledge sharing was seen as an important mechanism to capacitating change. Lab coordinators stress that these are multi-directional processes. Not only do the 'Labs' share knowledge to participating actors, for instance through Lab coordinators or invited ‘experts’ during Lab workshops, conferences or activities, Lab coordinators repeatedly stress that knowledge sharing took place more bottom-up between participants. One coordinator explained: *“we didn’t give them knowledge, we shared knowledge together”* (R47). Such processes of knowledge sharing are not straightforward, and require participants to feel safe to express their views, opinions, and insecurities during Lab activities. If such safe spaces were successfully created, knowledge sharing was found valuable and led to meaningful exchanges, as one coordinator reflected upon:

> *“It was a real conversation, and they were more interested in how this knowledge that the other people have, could be put into work in some way, or could be of help in everyday life”* (R21).

In addition, coordinators indicated that knowledge sharing also took place from participants to the ‘Lab coordination’ level:

> *“it was a lot of fun just walking around listening to what the different groups were discussing. And there are a lot of knowledgeable people. So it is very interesting to listen to them. And we see that others who also are knowledgeable, they do kind of get an awakening when you get other experts in front of you and you discuss the same thing. But with different views”* (R24).

Social learning

Second, social learning to foster collective action through multi-stakeholder engagement (cf. Van Mierlo and Beers, 2020; Schneider et al., 2019; Reed et al., 2010) was considered a key mechanism. Reed et al. (2010: 6) define social learning as “*a change in understanding that goes beyond the individual to become situated within wider social units or communities of practice through social interactions between actors within social networks*”. Most coordinators stressed that the interactions between the participants in their workshops often led to new understandings that were co-created during Lab activities. For instance, one coordinator described how they tried to create shared understandings:

> *“We decided to have two different meetings with different [stakeholder] groups, and then to bring them together [...] to create a background and a common knowledge about certain concepts. So the first impact would be exactly this one: to have people from different sectors talking in the same language”* (R28).

In addition, co-creating shared knowledge was seen as important as stakeholders contributed to

> *"the exploration of the complexity of the problems. They also contributed to defining shared visions. They also contributed to giving us examples of actions that could be taken."* (City Lab coordinator, R19)

This again also points to a challenging task for Lab coordinators, as they have to identify (often up-front) which stakeholders and knowledge they wish to engage in order to lead to fruitful knowledge co-creation processes:

> *"to understand where the knowledge is, first of all. Because, once you know the level of knowledge they have, you can build certain pathways [...] How to increase the knowledge that helps a lot to do the transition."* (Policy Lab coordinator, R32)

At the same time, facilitating knowledge sharing required explicit interventions from the Lab coordinators. Here it was challenging to combine multiple role perceptions in both steering toward meaningful exchanges, while also respecting the different views of participants:

> *"the private sector, they were [having] the difficulty to get the researchers to work with them. […] Because they have, of course, a different perspective. [...] From both sides, just to make them both understand, or maybe speak the same language, because of course [this is] not obvious."* (Policy Lab coordinator, R28)

While coordinators in interviews often referred to moments where they felt knowledge sharing and co-creation had been 'conflict-free' or 'constructive', they also pointed to moments where participants with clear agendas (e.g., from industry or particular societal groups) would attend Lab activities in order to share divergent perspectives, leading to differences of opinions or conflict. For instance, in one City Lab this led to discussions on the role of red meat in school diets. The Lab coordinator felt intervention was needed and believed the Lab should be about *"being open, but on the other side, going in a direction which is in line with our education and the kind of contacts we have"* (R15) in order to create 'productive conflicts'.

New competences

Thirdly, literature highlights the importance of developing competences and transformative leadership in transdisciplinarity (Ingram et al., 2020; Schneider et al., 2019) which in addition to knowledge also involve *"skills and attitudes that enable successful task performance and problem solving with respect to real-world sustainability problems, challenges, and opportunities"* (Wiek et al., 2011: 204).

Competence building of coordinators

FIT4FOOD2030 aimed to establish communities of practice where coordinators themselves could learn, reflect and further develop themselves professionally as change agents. One Food Lab coordinator reflected:

> *"I think the specific value of our group is also having this room for reflection, it's all kind of a community of practice I think, where you of course could also meet up with ideas where you would like to work together"* (R34).

Despite highly divergent local contexts (such as different organizational, institutional, socio-cultural and political contexts) and different Lab ambitions and focal points (e.g., food waste, health, agricultural production), coordinators generally valued the training opportunities provided by the project, because

> *"first we talk about challenges each Policy Lab is facing. So then you understand that you are not alone on this road. So that motivates you. It is not always success, you know, sometimes you have challenges and that encourages you, to go further, not to stop. Again, and then again, trying to seek your aim"* (Policy Lab coordinator, R32).

Several Lab coordinators indicated that working in a large EU project with transformative and multi-stakeholder ambitions was a rather new experience for them professionally, and it helped them to develop competences, such as networking building, workshop facilitation and stakeholder management. Participating also supported knowledge development on food systems, transformation processes and R&I, which in turn helped their competence building because they would feel more secure to guide the Lab activities, also content-wise.

Competence building of engaged stakeholders

Additionally, Labs stimulated competence development in their networks. This was especially the case for the City Labs, for which this was an explicit target of the project. One coordinator explained:

> *"Our goal is not only to develop our students' competences but also equip them in order to become the food smart citizens of tomorrow. And there are huge numbers of initiatives, but we have co-developed with the representatives from the different types of stakeholders [...] of course the project FIT4FOOD2030 has given us a context, a framework to work on and allows us also to be flexible in order to adapt"* (R20).

While the City Labs engaged students and professionals through newly developed educational modules (see Section 9.3.2), both City and Policy Labs focused on building competences through their multi-stakeholder workshops. In these workshops stakeholders would together work on analyzing local or national food systems; develop (different scenarios and) visions on future food systems and co-create (policy) pathways toward such futures. In addition, by bringing different perspectives together, stakeholders were invited to reflect upon their own roles, positions and perspectives. One Policy Lab coordinator explicated that this is important for impact:

> *"For policymakers, I think we have to push them a little bit, to come to the meetings and also to impress them about the role they should have in food system change"* (R26).

9.3.2 Creating change

In addition to capacitating change, scholars of sustainable transformation are concerned with where in the system *experimentation* processes can *create change*. In the sustainability transitions literature this involves investigating how *transition experiments* (and transition governance efforts) could aim to create changes in networks of actors, as well as practices, structures and cultures (e.g., Van Raak, 2015; Grin et al., 2010; Rotmans and Loorbach, 2009). We understand practices as 'ways of doing', such as behavior, routines and habits (Rotmans and Loorbach, 2009, cf. Shove and Walker, 2010; Schatzki, 2011). Structures as 'ways of organizing' not only imply material (infra) structures, but also rules, regulations and institutions (e.g., Grin et al., 2010). Finally, cultures we consider 'ways of thinking' and include for instance paradigms, beliefs and systemic intent. Though analytical separate categories, in reality they are strongly interrelated, as Sahakian et al. (2021) show in a study on Living Labs aiming to transform energy practices. Focusing on structures and cultures is important, as Dorninger et al. (2020) see a need for empirical analyses to turn the gaze toward how transdisciplinary projects could address deep *leverage points* such as systemic structures and paradigms (cf. Meadows, 1999; Abson et al., 2017). Transforming incumbent networks, practices, structures and cultures is a deeply political endeavor that requires actors, organizations or initiatives such as Labs to *leverage their agency* in order to exercise power in order to bring along change (see e.g., Stirling, 2019; Grin, 2010; De Haan and Rotmans, 2018). These processes of exercising power to transform systemic elements we call *powering* (as a verb), building on work of Kok et al. (2021a) and Avelino and Rotmans (2009). We observed strategies for creating change by transforming networks, practices, structures and cultures.

Transformed networks - the Lab as catalyst

While creating new relations by building new networks was an important mechanism to build transformative agency within the Lab, transforming (the relations between) existing networks can be seen as an impact that has systemic implications 'outside' of the Lab. From that perspective, the FIT4FOOD2030 Labs can be seen as catalysts that engage already existing networks and initiatives and create synergies in order to strengthen efforts at realizing food system transformation. One Policy Lab coordinator describes this mechanism as follows:

> *"We get in touch with already existing networks, we are making our own network, and we are developing networks of networks. Making networks meet, making people meet [...] there are quite a lot of good forces, with similar or overlapping objectives. So, actually it's really a question of bringing synergies between existing networks together to work"* (R23).

From an 'impact perspective', recognizing the interconnectedness of existing networks and initiatives is important as the complexity of sustainability governance efforts blurs the causality regarding what kind of project or initiative generates what kind of 'change in the system'. This challenge is highlighted by the same Lab coordinator who stated:

> *"It's difficult to say that our Policy Lab has been the only actor, no of course it is a common effort. And it's of course very difficult to measure the impact of our Policy Lab. We know that we contribute and that we do the right thing but it's not that easy to say"* (R23).

Other Lab coordinators too highlighted the leading role that Labs can play in network catalyzation, which might otherwise not have happened: *"It's us [from the R&I department] who are now trying to link these networks. Not really people from the network of food or agriculture"* (R31).

Transformed practices - the Lab as concretizer

Lab coordinators highlighted that 'doing the Labs' provided a basis for changing the *ways of working* within their host organizations. Especially Policy Lab coordinators indicated that multi-stakeholder interactions and cross-ministerial practices were getting more traction. For instance, one Policy Lab coordinator described:

> *"We much more frequently discuss now with the Ministry of Social Affairs about these food issues. The cooperation I would say has improved. […] I think the Policy*

> *Lab has facilitated widening of contact between different ministries on different levels"* (R42).

Similarly, one other coordinator indicated that the Policy Lab likely contributed to institutionalizing new ways of working, especially regarding connecting different sectors that were previously unconnected:

> *"There has always been a distinction between agriculture and all the other parts of the food system. So in the institutions there was no importance to considering all the parts of the food system [...] we started talking about this, and now we have everyone talking about the food system"* (R29).

Important again here is the reflection that coordinators presented on the causalities of 'creating change:

> *"I noticed a small change in this direction [....] I cannot be sure about this result or the part we had in this result but we had probably a small part in this"* (R29).

Considering creating change in practices, the Labs can be seen as "*concretizers*": where novel ways of 'working and doing' might already been looming under the surface as part of systemic wide shifts toward 'multi-stakeholder governance' or 'co-creating education', the FIT4FOOD2030 Labs served as instruments to concretize these broad concepts into workshops and activities. This could help to further institutionalize and normalize the uptake of such practices across the involved organizations, by showing their concrete value in practice.

Transformed structures - the Lab as construction site

More tangible were some of the Lab's outputs in creating novel or adapting existing 'concrete' structures. For instance, 19 educational modules were co-created by the project's City Labs. Topics included reducing food waste, entrepreneurship, building transformative skills; and audiences ranged from primary school children, citizens in science museums to university students and professionals. Modules were implemented for instance in science museums, schools or embedded in university curricula. Implementing such modules was challenging. One City Lab coordinator described how the 'university system' was not flexible enough to accommodate implementation of new courses within project timelines, as it would require confronting incumbent regulations. Therefore, adaptation of existing courses to include the project's ambitions and 'transformative approach' proved a more impactful pathway than developing new structures.

Policy Labs focused mainly on aligning or developing R&I agendas or vision documents, as well as developing new funding programs that fund transdisciplinary and transformative R&I projects. These can be considered key outputs of the project. Interesting as well were the ways in which they were developed as they interacted with the second mechanism on transforming practices. Adopting new practices were an integral part of developing new structures. For instance, one Policy Lab organized a 'sand-pit workshop' bringing together dozens of scientists and practitioners for three days to co-develop a consortium proposal in collaboration, rather than in competition (see EC, 2021: 26) which helped to *"inspire, to involve, to work together, to share a common responsibility"*.

Labs can then be considered a 'construction site' where food system actors build and experiment with new structures, as well as a place where existing systemic structures driving or hindering food system transformation are identified, and potentially adapted (such as Policy Labs adapting national or regional R&I strategies). There is, again, a relation to other impact mechanisms. For instance, one Policy Lab secured continuity of activities by establishing a permanent working group to continue the work of the Policy Lab. Hence, formalized structures are seen as means to 'consolidate' the transformed networks, practices and cultures.

Transformed cultures - the Lab as critical mass

Regarding contributing to transforming cultures – or: intents and discourses – related to food system transformation, several Lab coordinators indicated that they observed notable changes in their local contexts. An explicit strategy (and objective of the project) was to 'raise the awareness' on food systems thinking and multi-stakeholder engagement in R&I. One coordinator described:

> *"Basically we are working on raising the awareness and raising the consciousness about food, health and sustainability and the need for system change, when we speak about the food system"* (R23).

Another coordinator added that they felt their Policy Lab was successful in this regard:

> *"When we speak about our Policy Lab impact, first of all we observe that awareness about sustainable food systems in our network is obviously raised"* (R33).

Contributing to changed mindsets and ways of thinking often goes hand in hand with other impact mechanisms, such as changed ways of working. One coordinator explicitly linked the change in mindset to changed ways of multi-stakeholder working:

> *"One of the big impacts [...] is that we have been able to put a different amount of people within a group, with different eyes, having a really important element of social groups within that and the food industries etcetera. […] And the impact here is that after FIT4FOOD2030, the result is that these people can work together [...] for this social paradigm change that has to come. Within [Farm to Fork], but within other strategies and projects as well"* (R47).

Interesting and notable about this coordinator's observations is that not only it is believed that various impact mechanisms can (and should) reinforce each other, but also that this happens across projects and initiatives. This, again, points to the difficulty to assess the impact of individual projects, or Labs, and in particular singular activities as there are cross-fertilizations and interactions within the larger networks that work toward sustainable food systems. Such a perspective also points to Labs as 'critical mass', that play a part in broader collective efforts in changing mind-sets across (localized) systems.

9.3.4 Impact mechanisms for transdisciplinary Labs

We considered strategies to generate impact through Labs to be two-fold: both creating capacities for change within the context of the Lab, as well as contributing to transformation processes by creating change in the systems and networks in which the (stakeholders of) the Labs are embedded. An overview of our take on impacts and mechanisms is presented in Table 9.3.

Table 9.3 | Creating impact through transdisciplinary Labs.

Type of impact	Place of impact	Impacts & mechanisms
Capacitating change *impact = capacity*	Lab (building agency)	*New relations* • Network mobilization • Network consolidation • Network coordination *New knowledge* • Knowledge sharing • Social learning *New competences* • Competence building of Lab coordinators • Competence building of engaged actors
Creating change *impact = transformation*	System (exercising power)	*Transformed networks* • Linking & catalyzing new and existing networks *Transformed practices* • Showcasing multi-actor and system approaches through concrete activities *Transformed structures* • Constructing new innovations (such as policy programs, educational modules, funding schemes) *Transformed cultures* • Raising awareness and changing mindsets on food systems transformation

9.4 DISCUSSION

9.4.1 Causality, complexity and impact

One fundamental set of challenges in both 'doing a Lab' as well as evaluating its potential impacts is related to the difficulties of pointing to 'causality' of impact pathways: what causes what and how do we know that? As we illustrated, Lab coordinators felt that their strategies and activities definitely contributed to some kind of change and impact. They could 'see it', 'feel it', and to a certain degree they could also 'show it'; but pinpointing exact causal pathways remains challenging. This challenge encompasses three issues.

First, we observed a reciprocal relation between building agency in, and powering by, Labs. Building capacities helps creating change, and creating changes helps building (or obstructing) the environment in which capacities can be built. Similarly, different impact mechanisms were seen to reinforce each other, or even as critical to combine in particular order (suggesting pathways for impact). This reciprocity mirrors work by for instance Schneider et al. (2019) who point to multi-directional relations between processes and societal effects of transdisciplinary research. It also echoes the agency-structure dialectic (Giddens, 1984), where actors' (or: Labs') agency shapes as well as is shaped by structural environments. Second, our work too points to the need to move beyond evaluating 'outputs and outcomes' of (transdisciplinary) experiments, a development brought forward by the turn toward effectiveness-orientation and projectification of sustainability science and policy (e.g., Musch and Von Streit, 2020; Torrens and Von Wirth, 2021). As our study suggests, capacitating change is also considered an important *impact* of Labs (cf. Lux et al., 2019), suggesting experimentation processes as mode of governance (cf. Bulkeley and Broto, 2013) could be considered impacts themselves. Third, though in-depth long-term systemic analyses and cross-case Lab comparisons could be valuable in future research to shed light on the dynamics of Labs in relation to systemic change (see McCrory et al., 2020), there is still an intrinsic 'impact measurement problem'. In highly complex systems with nonlinear dynamics, an *output-orientation* becomes untenable precisely because the linear causal pathways that warrant justification of outputs as the indicators for realizing transformation can no longer be precisely determined. This notion is also reinforced by our empirical observations where Lab coordinators stressed that the vast variety of other initiatives (that can reinforce, compete with, or obstruct each other) makes attributing the cause of 'transformative change' to one Lab, project or intervention challenging. This requires rethinking 'impact evaluation' of individual Labs, projects and experiments toward considering broader collectivities and portfolios of actions and initiatives.

Our work suggests it could be valuable to further develop instruments for assessing impact not only beyond output-orientation, but also beyond individual initiatives toward understanding how entire innovation landscapes can support transformation. Here lie opportunities for design and implementation of mission-oriented innovation systems (cf. Hekkert et al., 2020; Klerkx and Begemann, 2020) and transformative innovation policies (Haddad et al., 2022; cf. Schot and Steinmueller, 2018).

9.4.2 Navigating political dynamics of 'doing Labs'

Though the Lab coordinators in FIT4FOOD2030 emphasized their strategies for impact and highlight positive outcomes of their journeys, they also indicated that both capacitating change and creating change are notoriously difficult processes due to the political dynamics involved. Synthesizing insights from their experiences, we identified four overarching challenges in navigating the political dynamics of Labs.

First, in short-term contexts such as the 3 years of FIT4FOOD2030, it is extremely difficult to build enough transformative capacity to actually create meaningful changes in incumbent regimes. Strategies to create impact through experimentation often fail at first (cf. Woltering et al., 2019), requiring Labs to adapt their strategies and reconfigure toward new goals and activities through flexible *theories of change* (Deutsch et al., 2021). Additionally, if resources are limited (such as in FIT4FOOD2030) and within short-term projects, the question remains how impactful small droplets are in a big sea of incumbency that is tightly held together by a web of vested power relations. Second, due to short-term project orientation, there is a risk that systems will jump back to their 'original configuration' due to their undesirable resilience (Oliver et al., 2018) after temporary structures such as Labs cease to exert their powering processes. It can be considered a limitation of this present study that we were not able to investigate this due to the short-term orientation of our own work as well. Third, Lab coordinators indicated that many of their strategies were dependent on 'windows of opportunity' that emerged in the systems they were operating in. This is understandable, as trying to create impact also means having to work *with* power relations in the system (Van Breda and Swilling, 2019), but it also makes Labs dependent on the systemic configurations at play. Especially for the Policy Labs operating in deeply institutionalized regimes (cf. Grin, 2020), incumbent political administrations, political climates, locked-in institutions and macro-scale policy developments (as landscape effects, see Grin et al., 2010; Jørgensen, 2012) were major contributors to how 'doing the Lab' unfolded in practice. It relates, fourth, to the political question of who or what drives the (transformative) dynamics of systems. Though Labs and their networks had a large degree of autonomy in deciding on priorities and activities, there were also pre-set directionalities implied by project management, as well as urgent *ex-durante* suggestions, for instance to focus more on including consumers in Policy Labs or focusing on topics the project thought relevant for the EC in City Labs. In addition, the funding context (an EC H2020 call) strongly shaped the direction of the project (both *ex-ante* as well as *ex-durante*), when for instance new policy developments around the EU Farm to Fork Strategy emerged. While it is acknowledged that funding contexts strongly drive within-project dynamics, the political dynamics and implications deserve further attention in future research (Fritz and Binder, 2020).

These political challenges raise the questions of who or what is actually ‘steering’ the Labs as well as the dynamics of the systems the Labs are part of. Our case illustrates a more complex relationship than simply ‘experiments’ such as Labs setting in motion transformative change (bottom-up) or policy instruments setting top-down directionalities. Rather, transformative practice is highly political and multi-directional, requiring further investigating the democratic legitimacy of transition-oriented interventions in the context of blurred accountabilities and complex multi-level governance settings (De Geus et al., 2022; Tschersich and Kok, 2022).

9.5. CONCLUDING REMARKS

In this chapter we addressed the question of how we can better understand the practice and challenges of ‘doing Labs’ for sustainable transformation, in relation to the impacts that Labs aim to create. To that end, we synthesized insights from transdisciplinary research and transition studies to conceptualize how Labs can create societal impact. We argued that impact could be created by building agency within the Lab (*capacitating change*) as well as by powering processes instigated by Labs aimed at transforming the systems they are part of (*creating change*). Empirically, we explored the FIT4FOOD2030 project that set up 25 Labs across Europe to contribute to sustainable and healthy food systems. We illustrated that Labs aimed to build agency by focusing on creating *new relations*, *new knowledge* and *new competences.* Then, we analyzed how Labs tried to exercise power to create systemic change, by focusing on transforming *networks, practices, structures* and *cultures*. Our work suggests complex (reciprocal) relations between processes and outcomes of capacitating change and creating change.

We believe our work could help understand the functions that Labs can fulfill in transformation processes and the challenges this brings along in the practice of ‘doing Labs’. In particular, our analysis suggests *intrinsic* challenges in assessing Lab impacts, requiring evaluation to move beyond output-orientation as main measures for ‘transformative societal impact’, as well as to move beyond single Lab or project evaluation to capture transformative capacities of portfolios of interventions. Secondly, 'doing Labs' is a highly political practice, where issues such as 'who is steering' the Lab dynamics in which direction beg consideration of the democratic legitimacy of Lab interventions. While our work has its limitations, we hope it can contribute to better understanding and facilitating the different roles Labs can play in 'creating impact' for urgently needed transformations toward sustainable futures, in ways that do justice to the wide variety of voices and perspectives in our societies.

CHAPTER ACKNOWLEDGEMENTS

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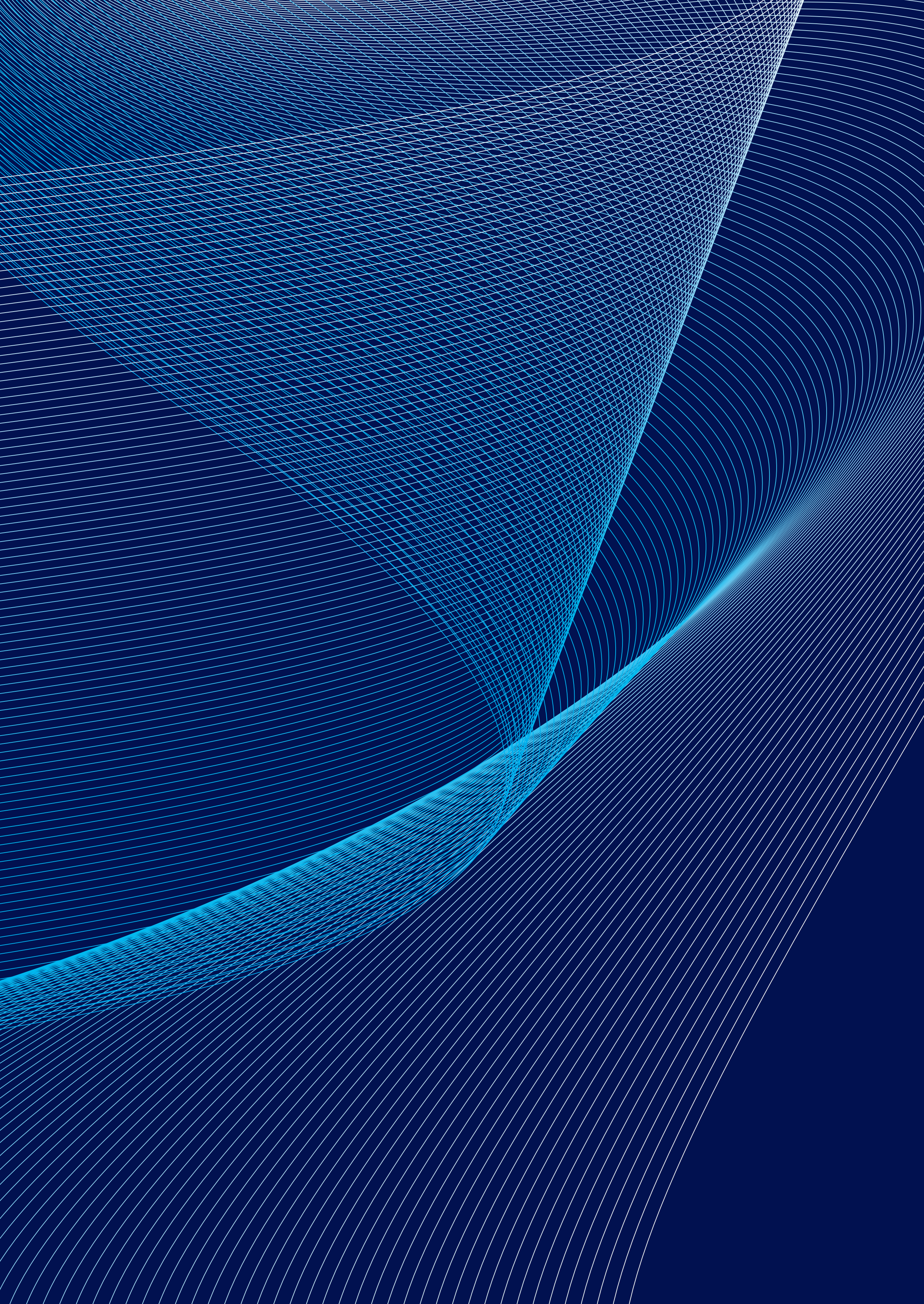

10

Governing translocal experimentation in multi-sited transition programs: Dynamics and challenges

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ABSTRACT

Transition experiments are important instruments to foster sustainability transitions. Transition scholars increasingly suggest investigating how multiple local experiments can become connected across spatial scales, and how transformative dynamics of multiple connected experiments can be facilitated and governed. In this chapter we analyze the different types of translocal dynamics involved in simultaneously governing multiple experiments in multi-sited transition programs, by empirically exploring the FIT4FOOD2030 program (2017-2020) that supported 25 transition experiments. Then, we present four overarching challenges in governing translocal experimentation: (1) finding synergies between diverging local needs and program ambitions; (2) navigating the cross-scale political dynamics in multi-sited transition programs; (3) moving beyond output-oriented evaluation frameworks in order to capture transformative efforts of short-term programs; and (4) expanding the boundaries of programs by linking to ongoing policy developments in highly complex multi-level governance settings. We hope our work can inform transition governance efforts in fostering transformative translocal dynamics toward sustainability.

10.1 INTRODUCTION

In order to tackle persistent, interlinked and highly unequally distributed global challenges such as climate change, biodiversity loss, unhealthy consumption patterns, environmental pollution and water scarcity, there is an urgent need to foster sustainable and just transitions in a wide range of socio-technical systems (Grin et al., 2010; Markard et al., 2012; Loorbach et al., 2017; Köhler et al., 2019). In transition literature, significant attention has been given to the role of transition experiments as spaces for stimulating and co-creating the development of novel pathways and transformative innovations to tackle (context-specific) sustainability challenges (see Sengers et al., 2019 for an overview of experimentation in transitions, cf. Smith and Raven, 2012; Rotmans and Loorbach, 2009; Kemp et al., 1998).

While insights on single, local experiments are manifold and valuable, for societal transformation a move beyond one-off, isolated experimentation is imperative (e.g., Van Den Bosch, 2010; Loorbach, 2007; Geels and Raven, 2006; Williams, 2016; Sengers et al., 2021). Work on the subject shows that transformative (social) innovation processes diffuse and interact translocally across space and between various governance levels (see Wieczorek et al., 2015; Avelino et al., 2019; Pel et al., 2020; Loorbach et al., 2020, cf. Coenen et al., 2012), implying the need to further explore *the "ways in which experiments become connected across different spatial scales"* (Sengers et al., 2019: 162). This stresses the importance of giving *"attention to the interdependency between local configurations, multiple interactive scales and social networks"* (Köhler et al., 2021: 206). At the same time, scholars have elaborated the many ways in which sustainability initiatives can be amplified, linked or scaled beyond their local context in order to contribute to systemic impact and transformation (see e.g., Lam et al., 2020a, cf. Loorbach et al., 2017), drawing attention to the issue of how to support and govern portfolios of transition experiments (cf. van den Bosch, 2010; Loorbach, 2007). That issue is especially relevant as transition-oriented projects and programs are increasingly implemented across the globe in order to govern the development and scaling of transformative (social and policy) experiments in multiple localities, that is, across (spatial) scales, simultaneously (see for instance EC, 2021). This in turn then requires further *"analyz[ing] the ways in which experimental governance approaches support transitions"* (Köhler et al., 2019: 9-10, drawing upon Bernstein and Hoffmann, 2018; Matschoss and Repo, 2018), while taking into account the complex interplay between spatial scales and governance levels involved in enacting transitions (e.g., Coenen et al., 2012; Truffer et al., 2015; Hansen and Coenen, 2015; Wieczorek et al., 2015; Hebinck et al., 2021a).

In this chapter, we address those needs by conceptualizing and unraveling the translocal dynamics involved in simultaneously governing multiple experiments in multi-sited transition programs. Surely, multi-sited transition programs are only one way to intervene in transition processes across scales. In addition, experimentation is only one part of the broad range of means involved in transition governance.[75] However, it is a pertinent one. For instance, in EU Horizon 2020 and Horizon Europe funding schemes, increasing attention is given to large-scale (mission-oriented) research, innovation and policy programs that are expected to engage a wide variety of societal stakeholders in co-creating and scaling innovations at multiple sites (across different countries) simultaneously directed at the attainment of the global Sustainable Development Goals (SDGs).

We seek to contribute to unraveling the dynamics and challenges in place by empirically exploring the EU-funded FIT4FOOD2030 program (2017-2020) that set up 25 transition experiments (in the form of transformative Labs) across Europe in an effort to contribute to EU food system transformation. Each Lab brought together a wide variety of (societal) stakeholders to co-design and experiment with novel (social and policy) innovations that aimed to contribute to (local) transformations while interacting with, being embedded in and supported by, the overarching FIT4FOOD2030 program.

In that way, this multi-sited transition program also aimed to stimulate translocal dynamics between different transition experiments. We thus address the research question: How can multi-sited transition programs such as FIT4FOOD2030 influence translocal dynamics of experimentation, and what challenges do they encounter in those efforts? In order to contribute to a better understanding of governing translocal experimentation in multi-sited transition programs, we first identify and empirically unravel the different types of interactions that constitute the translocal dynamics of FIT4FOOD2030. We then reflect and elaborate on four overarching challenges for enacting such multi-sited transition programs in practice. In this way, we hope our contribution sheds light on the mechanisms through which transition programs can set in motion (transformative) translocal dynamics beyond the mere sum of (multiple) localized experiments.

Before presenting our empirical analysis and explicating implications for transitions research and governance, we now first set out to construct an operationalization of the governance of translocal experimentation in multi-sited transition programs.

75 Scholars for instance increasingly stress the importance of (sectoral) policy mixes in supporting transitions (e.g., Kivimaa and Kern, 2016).

10.2 GOVERNING TRANSLOCAL EXPERIMENTATION IN MULTI-SITED TRANSITION PROGRAMS

10.2.1 Experimentation for sustainability transitions

Sustainability transitions in complex socio-ecological and socio-technical systems are described as long-term processes of structural change that involve significant reconfigurations of systemic structures, cultures and practices, across their socio-political, economic, material and ecological components (see Grin et al., 2010; Markard et al., 2012; Köhler et al., 2019 for overviews of the field). Governing transitions is challenging, as highly complex systems are characterized by non-linear dynamics contributing to persistent locked-in system states (see e.g., Rotmans and Loorbach, 2009; Geels and Schot, 2007). As such, traditional governance interventions might not be suitable to work toward transformation, which instead arguably requires adaptive, reflexive, pluriform and anticipative forms of governance (see e.g., Folke et al., 2005; Loorbach, 2007; Grin et al., 2010).

Key to such approaches are processes of experimentation. Experimentation processes for transformation take place in a wide variety of settings and contexts, including socio-technical niches (Strategic Niche Management (SNM), see Kemp et al., 1998); transition arenas (Transition Management (TM), see Loorbach, 2007; Rotmans and Loorbach, 2009); transformative spaces (Pereira et al., 2018); (Urban) Transition Labs (Nevens et al., 2013); (Urban) Living Labs (Hossain et al., 2019, Bulkeley et al., 2016); Reflexive Arrangements (Loeber and Vermeulen, 2016); and Real-World Laboratories (Schäpke et al., 2018; McCrory et al., 2020), as well as across a wide range of governance levels and geographies (see Köhler et al., 2019; Grin, 2020; Pereira et al., 2020). Despite their many manifestations, experiments in transition literature share multiple commonalities, leading Sengers et al., (2019: 161) to define such experiments as *"inclusive, practice-based and challenge-led initiative[s] designed to promote system innovation through social learning under conditions of uncertainty and ambiguity."* As to further concretize this conceptualization, we explicate some key elements of transition experiments by synthesizing insights from the broader literature on experimentation (e.g., Loorbach, 2007; Schot and Geels, 2008; Bergek et al., 2008a; Van den Bosch, 2010; Sengers et al., 2019). We distinguish five important elements of transition experiments: (1) mobilizing networks and resources; (2) visioning and directionality; (3) developing and scaling innovations; (4) learning and reflection; and (5) creating legitimacy. Though they suggest a certain sequentiality, in practice they overlap and require iteration in transition experiments. An overview of this operationalization is presented in Table 10.1.

Table 10.1 | Overview of different elements of transition experiments.

Element	Description	References
Mobilizing networks and resources	Mobilizing networks and resources is an important and continuous effort in transition experiments. Consolidating transformative networks of both powerful and marginalized actors could lead to better outcomes while serving normative democratic ambitions of multi-stakeholder experimentation. To avoid an anthropocentric take on network mobilization, we understand the concept of resources as broad and non-hierarchical (following Avelino and Rotmans, 2009) meaning it includes material artefacts, finances, social capital and ideational resources (knowledge, inspiration). In that way, processes of resource mobilization entail many different ways of increasing the transformative capacity of emerging networks (cf. Kok et al., 2021a).	Loorbach, 2007; Schot and Geels, 2008; Schmidt et al., 2020; Kok et al., 2021b Bergek et al., 2008a; Avelino and Rotmans, 2009; Grin et al., 2010; Avelino et al., 2020; Kok et al., 2021a
Visioning and directionality	Developing visions toward (different) futures is a key element of 'doing' transitions, as it helps to set directionalities and can concretize objectives of transition processes. Visioning could help foster commitment of stakeholders to long-term transition ambitions. Recent literature conceptualizes performative efforts of futuring as "the identification, creation and dissemination of images of the future shaping the possibility space for action, thus enacting relationships between past, present and future" (Oomen et al., 2021: 2-3).	Loorbach, 2007; Schot and Geels, 2008; Grin et al., 2010; Oomen et al., 2021
Developing and scaling innovations	Transition experiments can facilitate the co-development and scaling of novel technical, social or policy innovations. After their development, transformative innovations are implemented within the context of transition experiments. Ideally, innovations then scale (out, up) as to ensure consolidation and embedding within institutional contexts, organizations and policy domains, or diffuse to (dis)similar contexts. In this way, transformative innovations contribute to 'real-world' transition dynamics.	Geels and Schot, 2007; Coenen et al., 2012; Loorbach et al., 2020; Gorissen et al., 2018; Lam et al., 2020a
Learning and reflection	Processes of learning and reflection as well as the potential for creativity and inspiration these bring along are key ingredients for sustainable transformation processes. There are many different ways in which (social) learning takes place in experimentation: for instance between actors in experiments, different experiments or experiments in their context.	Loeber et al., 2007; Grin, 2010; Hoffman and Loeber, 2016; Regeer et al., 2016; Avelino et al., 2019; Van Mierlo and Beers, 2020; Van Poeck et al., 2020
Creating legitimacy	Novel transformative networks need to acquire legitimacy which entails building *"social acceptance and compliance with relevant institutions"* (Bergek et al., 2008b: 581). This is not straightforward as (democratic) legitimacy in transitions is socially constructed rather than a fait accompli. While it is often considered that deliberative co-creation processes can enhance legitimacy it is not automatically clear for whom or what they should be legitimate (or responsible; cf. Maasen and Lieven, 2006).	Bergek et al., 2008b; Hendriks, 2009; Hendriks and Grin, 2007; Grin, 2010; De Geus et al., 2022

10.2.2 Translocality and transition experiments

In efforts to better grasp the (local to global) scales involved in sustainability transitions, scholars have turned to problematizing the dynamics of 'translocal networks' (Coenen et al., 2012; Avelino et al., 2020; Santo and Moragues-Faus, 2019; Moragues-Faus and Sonnino, 2019; Loorbach et al., 2020). Deeply rooted in (critical) studies of geography, history and cultural anthropology, translocality has been conceptualized by a *"multitude of terms, revolving around notions of mobility, connectedness, networks, place, locality and locals, flows, travel, transfer and circulatory knowledge"* in an effort to *"capture complex social–spatial interactions in a holistic, actor-oriented and multi-dimensional understanding"* (Greiner and Sakdapolrak, 2013: 375-6).

If the concept is so dense and muddled, why bother with it in the first place? We argue with Avelino et al. (2020: 956) that a focus on translocal dynamics is relevant to counterbalance the numerous studies that merely *"focus on isolated local cases".* In such an 'isolated' view, crucial interactions between an experiment and wider cross-scale dynamics are bracketed out of the equation while for instance transnational linkages can be crucial in transformative innovation processes (Wieczorek et al., 2015; Loorbach et al., 2020). Gottowik (2010) argues that translocal dynamics can occur both across real and perceived spatial scales (or spatial-administrative borders)[76], implying that a broad understanding of translocality could help identify dynamics 'beyond the local', both with regard to local-transnational interactions; as well as for instance dynamics between transition experiments across governance levels and spatial scales within the same country.

Considering translocality thus implies emphasizing the interactions between different spatial scales involved in transformative dynamics. McFarlane (2009: 562), for instance, interprets translocal networks as *"composites of place-based social movements which exchange ideas, knowledge, practices, materials and resources across sites"*, but points out that translocality implies something more than *"just the connections between [multiple] sites"*. The understanding that 'translocal' implies deep relations and mechanisms, beyond 'multi-local' dynamics, is echoed in recent transition studies research exploring how translocal linkages could foster empowerment of different localities and help build transformative capacities (Avelino et al., 2020). Pel et al. (2020: 8) propose that *"translocal networks are a key source of empowerment for local [social innovation] initiatives"*. In addition, recent transitions research has described not only how translocal networks can empower sustainability initiatives, but also highlighted different (translocal)

76 Meaning that *"transnationality is considered to be nothing else but a special case of translocality"* (Gottowik, 2010: 181, building on Freitag, 2005: 3).

mechanisms through which transformative innovations can diffuse (e.g., Loorbach et al.,2020; building on Gorissen et al., 2018; Frantzeskaki et al., 2017; Ehnert et al., 2018). This relates to ongoing work on institutionalization, amplification, embedding, scaling or broadening of sustainability initiatives in efforts to move 'beyond experiments' (Sengers et al., 2021; Lam et al., 2020a; Woltering et al., 2019; Gorissen et al., 2018).

Prior efforts in transition studies to analyze the relations between the local and transnational scales involved in transformative dynamics provide important insights into how transition experiments can become connected across space and scale, and help unravel how 'beyond the local' dynamics emerge (cf. Raven et al., 2012). However, they also suggest further exploring how translocal networks can actively be empowered in relation to incumbent institutions and dynamics (cf. Avelino et al., 2020). This leaves ample room to explicate the role of governance efforts in facilitating transformative translocal dynamics. Loorbach et al. (2020: 258) indicate that governing translocal networks requires to *"strategically empower transformative innovations to engage with incumbent regimes as well as to strategize across different transformative innovations to build transformative movements"*. As such, we see a need to further conceptualize and explore how translocal networks can be enacted and governed (cf. Santo and Moragues-Faus, 2019), i.e. how transition programs can set in motion empowering and transformative translocal dynamics beyond the mere sum of (multiple) localized experiments.

10.2.3 Operationalizing the governance of translocal experimentation in multi-sited programs

In order to help understand and support the governance of multi-sited transition programs that aim to facilitate the translocal dynamics of experimentation, we here propose an operationalization of the different interactions that can take place in multi-sited programs and together constitute their translocal dynamics.

First, to conceptualize transition programs[77] in relation to the multiple localities they comprise, we build on Castells' (1996; 1997) elaboration of the notion of the "network society". According to Castells, social practices (e.g. those involved in governing) are organized in (socio-material) networks pertaining to a space of flows that links them up around the world, while fragmenting concrete actions and actors in the (physical) space of places, made of localities among which power is diffused and resources (e.g., financial resources, human resources, information, discourses) circulate. In line with this conceptualization and the geography of transitions literature (e.g., Coenen et al., 2012;

77 The question whether programs managed in a consortium of partners with a variety of (disciplinary) backgrounds and interests, which are elaborated in very disparate countries, is a proper or useful way of addressing transition challenges is outside the scope of our analysis.

Raven et al., 2012) we consider multi-sited transition programs as transition governance arrangements[78] that are entangled with localities in three ways: (1) they are overarching (suggesting higher levels of aggregations across a particular scale, for instance: national programs covering several sub-national regions); (2) they are interwoven with the localities (meaning that they become manifest through the experiments they support, for instance: through the activities and processes within an urban transformative Lab part of a European project) and (3) they too are geographically grounded (emphasizing that they are rooted in some particular spatial contexts more than in others, for instance: an EU-program can be related to the spatial context of Brussels).

In order to better grasp the different types of dynamics at play in multi-sited transition programs, we operationalize three types of interactions that together constitute their translocal dynamics of experimentation: (i) local interactions; (ii) local-to-local interactions; (iii) local-program interactions.

(i) Local interactions we understand to be the interactions within a specific space of place: the local actors, institutions and materialities within transition experiments, and where the space of flows (for instance through flows of discourses, such as the notion of sustainable food systems), 'hits the ground'. These local dynamics are crucial to take into account as Avelino et al., (2020: 959, building on Greiner and Sakdapolrak, 2013) argue that *"local connections between actors in local initiatives are (at least) as important as transnational connections across actors and initiatives."*

(ii) Local-to-local interactions we consider to be the interactions between experiments or initiatives in different places within the overarching context of the program at issue. These interactions can include flows and mobilities between localities across spatial scales (two transition experiments in different countries both dealing with energy justice); or for instance between experiments at different governance levels (for instance between experiments at municipal and national government levels) or different societal domains (for instance between two Living Labs in the same city, one focusing on sustainable transportation and the other on local food systems).

(iii) Finally, local-program interactions we consider as interactions between one or multiple localized experiments (e.g., a Lab or another initiative) and the program it is part of. These interactions are common in the context of transition governance and are challenging to navigate as programs are often localized in terms of institutional or governance scales, where experiments within a program are often (also) localized in geographical or spatial scales. This perspective highlights the complex and multi-scalar nature of transition processes (Coenen et al., 2012; Miörner and Binz, 2021).

78 Cognizant of different conceptualizations of governance (Kooiman, 1999) we follow Termeer et al., (2011: 161) in considering governance arrangements the *"ensemble of rules, processes, and instruments that structure the interactions between public and/or private entities to realise collective goals".*

Our take on the relation between programs, experiments, local system elements (actors, institutions, materialities) and the types of interactions that together constitute translocal dynamics is schematically visualized in Figure 10.1. We contend that a multi-scalar networked understanding of translocality allows for explicating and emphasizing different sets of interactions, depending on the program, experiment or local actors, institutions and materialities at focus in the analysis. We believe that this operationalization helps to explicate the complex interactions in multi-sited transition programs, and we set out to unravel how these translocal dynamics emerge in the case of FIT4FOOD2030.

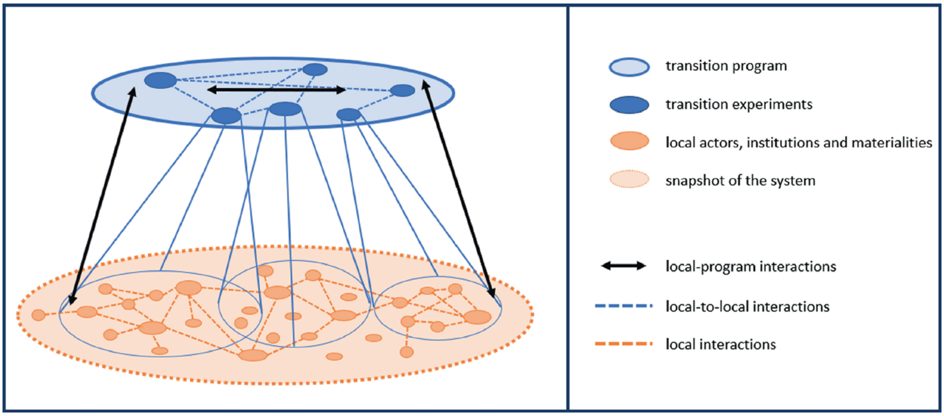

Figure 10.1 | Schematic visualization of the different socio-spatial levels, networks and interactions involved in governing translocal experimentation for sustainability transitions.

10.3 CASE AND METHODOLOGY

10.3.1 Case description

Our empirical case is the FIT4FOOD2030 program (2017-2020). As a Coordination and Support Action (CSA), the program had 16 partner institutions (e.g., from academia, industry, science communication) and supported the Directorate-General for Research and Innovation (DG RTD) of the European Commission (EC) in implementing their FOOD2030 policy framework (EC, 2017; 2021). This framework in turn responds to calls to accelerate food system transformation and aims to leverage research and innovation (R&I) to contribute to food systems that are *"sustainable, resilient, diverse, inclusive and competitive for the benefit of society"* (EC, 2017: 4). Being a R&I policy framework, FOOD2030 seeks to stimulate the uptake of transformative and transdisciplinary R&I approaches in the EU that are considered promising instruments to catalyze sustainable transformation (e.g., Caniglia et al., 2021; Norström et al., 2020). In the vision of FOOD2030, R&I could contribute to food system transformation by focusing on four FOOD2030 priorities: (1) nutrition for sustainable and healthy diets; (2) climate smart and environmentally sustainable food systems; (3) circularity and resource efficiency of food systems; and (4) innovation and empowerment of communities.

In order to contribute to this ambition, the FIT4FOOD2030 program established 25 multi-stakeholder Labs across the EU, building on the concept of Living Labs (Hossain et al., 2019) and Real-World Laboratories (Schäpke et al., 2018; McCrory et al., 2020). Labs can be conceived of as transition experiments that bring together a wide variety of stakeholders in multi-stakeholder workshops in an effort to co-create and/or pilot various social innovations. These innovations were transformative educational modules on the city-region level (in 7 City Labs and 7 Food Labs) or policy innovations (e.g. new R&I strategies, practices, funding programs) through cross-sectoral collaboration at national policy levels (in 11 Policy Labs). The program initially set up 7 Policy Labs and 7 City Labs and expanded horizontally mid-program by adding an additional 4 Policy Labs and 7 Food Labs.[79] The program's Labs followed context-sensitive but rigorous methodologies (based on TM, Loorbach, 2007) to support the Labs across four program phases. As such, the Labs aimed to (1) mobilize stakeholder networks and develop shared system understanding; (2) develop visions for future food systems R&I; (3) experiment with co-developing novel innovations; and (4) strategize for sustaining activities beyond the program's lifetime.

Each Lab was managed and facilitated by one or more 'coordinators' that were employed by ministries related to food systems or R&I in the case of Policy Labs, or by universities, science museums or science centers in the case of City and Food Labs. The Labs received very modest program funding but had a large degree of autonomy in designing their own activities. The program supported the Lab coordinators by offering tools and methods[80], a number of two-day training sessions, interactive webinars and bi-monthly learning and reflection sessions. For an overview of the different types of Labs and some of their activities and outcomes, see Table 10.2 and for a more detailed elaboration see EC (2021). For an overview of the Labs' locations, see Figure 2.2.

79 FIT4FOOD2030 labeled the second batch of city-region Labs 'Food Labs' instead of City Labs to avoid a too urban focus. Due to their short time span within the program, Food Labs followed a different trajectory than the City Labs as well, and they focused on implementing multi-stakeholder workshops.

80 See the FIT4FOOD2030 Knowledge Hub containing different Tools for Transformation (http://www.knowledgehub.fit4food2030.eu).

Table 10.2 | Overview of the different types of FIT4FOOD2030 Labs, and some of their characteristics. Adopted from Kok et al., (2021b).

Lab Type	Focus	Locations	Examples of activities and outcomes
City Labs and Food Labs	Educational module co-creation (City Labs) and implementation (City Labs and Food Labs) Transformative network building	City Labs: Amsterdam, Athens, Barcelona, Budapest, Milan, Sofia, Tartu Food Labs: Aarhus, Azores, Birmingham, Dublin, Graz, Trentino, Vilnius	• Local policy agenda setting, co-developing policy strategies • 19 educational modules (implemented in schools, science museums, universities) engaging 1400+ students and school children • Modules for instance focused on food waste reduction, systems thinking or healthy diets • 1000+ stakeholders engaged in the Labs
Policy Labs	Policy innovations Transformative network building	Austria, Basque Country, Estonia, Flanders, Hungary, Ireland, Italy, Lithuania, the Netherlands, Norway, Romania	• Co-developed R&I strategies and visions • Established new transdisciplinary funding programs • Cross-sectoral collaborations between governance sectors and levels • 600+ stakeholders engaged in the Labs

10.3.2 Research approach and case design

We conducted an embedded single case study (Baxter and Jack, 2008; Yin, 2003) where we considered different subunits (the 25 Labs as experiments) within the same overarching context (FIT4FOOD2030 as transition program). Such a case study design can help answer the ‘why and how’ questions in our analysis (Section 10.4) as well as help synthesize case findings to construct more generalized conceptualizations in our discussion.

Our research approach is grounded in interventionist, action-oriented R&I approaches (e.g., Fazey et al., 2018a; Caniglia et al., 2021) that are *“process- and future-oriented”* (Wittmayer et al., 2014: 481). These approaches are *“more likely to view action, learning and the generation of new knowledge as being more closely intertwined”* (Fazey et al., 2018a: 58). Thus, they are considered valuable as they help not only to understand complex dynamics from within the system, but can also actively contribute to system transformation (Luederitz et al., 2017; Schneider et al., 2019; Den Boer et al., 2021a).

Authors 1, 4 and 5 were actively involved in FIT4FOOD2030 program management, co-designing and co-facilitating training and learning sessions for Lab coordinators, co-developing multi-stakeholder methodologies to be used in the Lab experiments, as well as monitoring and evaluation efforts. This meant that we adopted multiple, dynamic, and sometimes conflicting roles during different activities and program phases, such as the role of researcher, program manager, process facilitator, knowledge broker, reflexive monitor and change agent (cf. Wittmayer and Schäpke, 2014; Bulten et al., 2021).

We are aware that through our multiple roles during the program we had powerful positions (cf. Fazey et al., 2018a) in steering program dynamics and opening or closing down directions and pathways for experiments. As we will illustrate in our analysis and discussion we needed to navigate deeply political challenges, limited by our knowledge and fallibility, as well as modest time and resources that short-term programs bring along. In our efforts, we tried to be reflexive and receptive to the different needs and ambitions across different localities in order to contribute to the urgently needed transformations of the systems we were working in.

10.3.3 Data collection and analysis

In our research, we adopted an abductive approach to empirical data by iterating between existing literature and our empirical data in efforts to contribute to theory development (cf. Dubois and Gadde, 2002) which is considered appropriate in action-oriented research (Stirling, 2015). We draw on a wide variety of data collection methods, including semi-structured interviews, surveys, workshops, field notes and desk study. Data was transcribed verbatim and coded with Atlas.ti. An overview of data sources and their level of analysis is presented in Table 10.3. Supportive data is not used explicitly in the analysis, but provided the authors with insights in the context of FIT4FOOD2030.

10.4 ANALYSIS: TRANSLOCAL DYNAMICS OF MULTI-SITED EXPERIMENTATION

In this section, we aim to identify the different manifestations of translocal dynamics that we empirically observed, in order to analyze the different ways in which they contribute to or detract from transformative ambitions of multi-sited experimentation processes. We illustrate how entangled local interactions, local-to-local interactions and local-program interactions together constitute the translocal dynamics of experimentation in multi-sited transition programs. We structure our findings around the experimentation elements (1) mobilizing networks and resources; (2) visioning and setting directionality; (3) developing and scaling innovations; (4) learning and reflection; and (5) creating legitimacy. Our analysis helps us to explicate our theoretical contribution in Section 10.5, where we present four overarching challenges in the governance of translocal experimentation.

Table 10.3 | Overview of the data used in the analysis.

Data source	Level of analysis	Function	Details
29 (online) interviews	Transcribed and coded	Main data source	16 interviews with Lab coordinators 13 interviews with core program partners involved in program coordination or Lab training
2 surveys	Coded	Main data source	Lab coordinator surveys as part of program monitoring and evaluation
Training sessions for City Lab (5 sessions), Food Lab (2) and Policy Lab (7) coordinators	Selectively transcribed and coded Non-systematic field notes Participant observation	Main data source	Multiple two-day workshops, designed in consultation with coordinators to support the Labs in addressing challenges. They took place either in Brussels (where the EC and many FIT4FOOD2030 partners were located), in Amsterdam (where program management was located) or online (during the covid-19 pandemic)
3 reflection sessions	Systematic field notes, coded	Main data source	3-hour online focus groups were organized with Policy Lab coordinators to reflect on their learnings and the impact of their Labs
Program meetings	Non-systematic field notes, not coded Participant observation	Supportive	Numerous meetings, workshops, conferences and bilateral conversations during three years of FIT4FOOD2030 (2017-2020).
Written materials	Not coded	Supportive	Deliverables, publications, reports

10.4.1 Mobilizing networks and resources

Local interactions: Much of network mobilizing endeavors took place in the localized context of experiments. That is not surprising, as the network-building tasks were explicitly embedded at these levels in program design. This meant that Lab coordinators (often in consultation with the emerging networks) would strategize which actors should be involved at what stage of the process as a means to ensure that mobilized networks were relevant to local ambitions and contexts. Lab coordinators and program partners observed that their efforts led to the establishment of vibrant networks and the involvement of a wide variety of actors across the Labs (such as students when co-creating educational modules, and high-level policy makers when co-creating policy innovations, see also Table 10.2, and EC, 2021).

We observed evident spatial dynamics involved in local network mobilization. For instance, Lab coordinators explained that getting the ‘local’ stakeholders to join the Lab activities was difficult, as sometimes local meant rather far away. For instance, due to logistical challenges, in large countries it could be challenging to get all the regional authorities involved in setting R&I policies together in the capital, where the relevant national ministry was located. Similarly, some City Lab coordinators indicated that getting the relevant farmers or other rural actors to join (especially) day-time activities in their Labs located in cities was also a challenging endeavor. This points to a complex and contextualized understanding of the relation between spatial proximities and network mobilization (see Hansen and Coenen, 2015). In addition, finding the right local network was challenging according to a City Lab coordinator:

> *"You can't evaluate in advance how your connections will turn out, and how they will support your Lab."*

Despite significant reflection and adaptation, ensuring the equal inclusion of different actors remained an intrinsically challenging endeavor as it was difficult to meaningfully bring together powerful and marginalized stakeholders for the purpose of system transformation (cf. Kok et al., 2021b).

Local-to-local interactions: To a modest degree there were mobilities of actors and resources across experiments, mostly when for instance 'local actors' attended activities of both a Policy Lab and a City Lab located in the same country which could help to bring local perspectives to national policy processes. However, local-to-local interactions in network mobilization were hindered by language barriers (as activities of Labs took place in native languages), and by physical distances between localities. These interactions thus mainly manifested in the exchange and mobilization of ideational resources (knowledge, inspiration) between the different coordinators of the Labs in shared trainings and workshops (also see Section 10.4.4 on "Learning and reflection"). In addition, this manifested (though to a limited degree) when partnering to collaborate in novel projects or initiatives (thus securing financial resources) in efforts to sustaining their activities and networks (see e.g., Gorissen et al., 2018 on scaling mechanisms).

Local-program interactions: Though the localities had a high degree of autonomy in network mobilization, the program did have pre-set ambitions in terms of stakeholder inclusion targets (an emphasis was put on including unusual suspects) which meant that the program influenced (and requested through monitoring and evaluation efforts or funder suggestions) the inclusion of specific groups of local stakeholders (e.g. small businesses or citizens), adding to the translocal character of network mobilization.

In terms of resources, we observed two distinct local-program dynamics. First, the program provided different types of resources to the Lab experiments, resulting in (transnational) flows across localities and governance levels. Financial resources provided to the Labs were very limited but FIT4FOOD2030 provided training programs, tools and methodologies for guiding transformative processes as well as established ‘actor flows’ by organizing conferences and providing coordinators of local Labs an entry point to EU policy networks to showcase their work. That, second, also relates to how local experiments in turn provided resources such as actors and knowledge (local lessons, best practices) to national policy contexts and the EU policy level (see EC, 2021).

10.4.2 Visioning and directionality

Local interactions: To a large degree visioning processes were embedded at the Lab-level. For instance, the Labs organized multi-stakeholder events to develop visions for (local) future food systems. Of particular interest in this regard were the different role perceptions of the coordinators of the FIT4FOOD2030 Labs in these processes:

> *“I think it is about finding a balance between your own vision and your ideas, and about what’s happening and recognizing opportunities in your environment”* (City Lab coordinator).

Local-to-local interactions: We observed that, to a modest degree, there were interactions between Labs regarding processes of visioning and setting directionality, facilitated by FIT4FOOD2030. As the different experiments were connected through the program and coordinators regularly met during training sessions and program activities, there were flows of knowledge, inspiration, best practices as well as ‘lessons learned’. These interactions mostly led to cross-fertilization on how to organize and facilitate processes of visioning, rather than influencing the content of directionalities, as the Labs had large degrees of autonomy on selecting the topical focus for their work (for more details see EC, 2021). This was not an easy task for the program management, not only because it is challenging to facilitate and support a wide range of (context-specific) needs and ambitions of the Labs, but also because the program management team was based in Amsterdam and most activities were organized in local contexts in local languages, adding to the socio-spatial distance between program and local levels involved.

Local-program interactions: While localities were encouraged to determine their own objectives and directions, however, the Labs were part of a larger program that followed the EC’s FOOD2030 priorities. That set the boundaries in which localities could navigate their own visions, with FIT4FOOD2030 supporting localities with the tools (e.g. workshop formats, training) to do so. One Lab coordinator illustrates: *“We use the [program’s] methodologies, but the objectives are mainly locally determined, they all align with the FOOD2030 [priorities].”* The translocal dynamics of FIT4FOOD2030 regarding directionalities was explicated by one program partner, who indicates that *"we are bringing a particular EU policy level to the ground, to the level of the citizens".* Yet, a key challenge related to setting directionalities we observed, finds its origin in the program's ambitions to support the EC in the implementation of the FOOD2030 policy framework. For instance, one program partner stressed that FIT4FOOD2030 was focused on *"getting more support within the countries [on FOOD2030]"*, while another one added that *"it is part of the mission to feed [the Lab work] back to the European Commission"*. This led to ongoing discussions – and a variety of co-existing perceptions – on whether the primary focus of the program should be setting directionalities in local contexts through the Labs (instigating local transformation through experimentation) or that the work of the Labs should influence directionalities at the program-level, that is, in EU R&I policy. While trying to accommodate both ambitions simultaneously, program partners indicated that this led to challenges in determining how the program (and the EU policy context) was related to the work of the Labs, and how flows of knowledge, ambitions, and directionalities should be organized in practice. These examples point to the transnational nature of transition programs where local, national and EU-level visions and directionalities emerge and interact within experimentation contexts; and the challenges this brings along in accommodating multiple ambitions simultaneously.

10.4.3 Developing and scaling innovations

Local interactions: The FIT4FOOD2030 Labs aimed to engage local stakeholders to co-create innovations (novel educational modules, novel R&I funding programs) to be implemented and scaled within specific contexts (e.g. school canteens, or departments at ministries). The autonomy of Labs in relying on these local networks for innovation development was crucial

> *"as not everything can work in the different contexts. There are many differences across the different contexts and different cultures. So, to have some flexibility and autonomy in the way you can go around things is necessary"* (City Lab coordinator).

It was in these local contexts that experiments encountered strong driving forces (such as very engaged stakeholders and their networks) and barriers (such as institutional, financial, structural barriers, incumbent power dynamics and resistance from policy and industry actors) to implementing innovations. Despite these challenges, implementing innovations was rewarding for a City Lab coordinator:

> *"The piloting of the first module we prepared, with the various students in primary school [...] for me, as a coordinator, and I think for all of our team, it was the first time we saw in practice that the project works."*

Local-to-local interactions: While co-creating innovations took place in the localized context of experiments, the translocal dynamics was reflected in different ways in which transformative innovations diffused across localities (Loorbach et al., 2020). One Lab coordinator points for instance to the importance of local-to-local exchanges as replicating dynamics:

> *"We are now using the educational module developed by [another City Lab] on food waste. We had the first webinar last Friday, and I'm really proud because the implementation of the educational module is giving the strong feeling of success."*

Closely related of course is the observation that such dynamics were instigated by the program actively coordinating the diffusion of innovations across experiments and setting up the infrastructures, such as workshops to facilitate exchanging educational modules (for City Labs) through which diffusion could take place.

Local-program interactions: In addition, the program actively sought to stimulate experiments to implement new transformative practices on the local level *("If we are not part of this project, would we start working like this? I don't know."*, Policy Lab coordinator) and sometimes guided Lab coordinators beyond their comfort zone in efforts to stimulate novel ways of working within their own organizations (for instance: deploying co-creation formats to foster cross-sectoral collaborations between different ministries in Policy Labs). As such, innovative practices finding their origin in specific spatial contexts and EC discourses (e.g., those on food systems thinking) diffused through the program activities and materialized as concrete manifestations in localities and organizational contexts across the EU. Finally, and conversely, FIT4FOOD2030 also helped to showcase local innovations at aggregate policy levels, facilitating the translocal diffusion across governance levels. For instance, Labs (both their novel approach and concrete innovations) were featured at EU-level conferences, and fed in to the EU policy discourses, briefs and reports (such as in EC, 2021). This contributed to anchoring local best practices in EU-level policy structures and discourses. Thus, FIT4FOOD2030 aimed both to catalyze the uptake of social innovations across experiments beyond the local levels toward high-level policy domains as well as support implementation and scaling of practices within local experiments. This highlights the complex multi-directional interactions at play in translocal experimentation efforts.

10.4.4 Learning and reflection

Local interactions: We observed that processes of learning and reflection took place across a variety of (spatial) scales. First, both the coordinators and participants of the Labs indicated that much of their learning emerged in the local context through interactions with stakeholders during workshops, as well as 'learning by doing' the transition experiments. One coordinator indicated that

> *"this activity made me to think broader, to have a larger overview regarding the food system because until now I used to have a look only on the food industry"* (Policy Lab coordinator).

This 'local' learning depended very much on the interactions between stakeholders:

> *"My learning is very social. So discussing with [the stakeholders] is also to take something, to rethink something that I heard […] in a new way and learning properly"* (City Lab coordinator).

Local-to-local interactions: Second, a key ambition of FIT4FOOD2030 was to facilitate and instigate learning between the Lab coordinators (and through that: between the experiments) in multiple structured learning sessions. We observed that learning between the Labs formed a key element of empowering the local experimentation processes (cf. Avelino et al., 2019). As one City Lab coordinator indicated, learning across different local contexts helped to reflect upon one's own socio-cultural and geographical contexts and the implications that that particular context has for transformative innovations that could emerge:

> *"Realizing all of us faced relevant struggles and you are not the only one [...] And also because local context is really important, not everything can work in your context. You also need to critically think and select and decide if you want to follow an approach that has worked in another context."*

Fundamental contextual differences between localities could hamper mutual learning, but even though it was sometimes *"difficult to learn from each other because the situation is so different, it can also inspire"* (program partner). Interestingly, in some cases the program seemed more successful in fostering reflexive collaborations across transnational scales but within similar initiatives (for instance: Policy Lab to Policy Lab) than it was in connecting initiatives and diffusing innovations across governance levels but within the same country. Sharing learnings between a City and a Policy Lab could be challenging as different institutional contexts, organizational routines and types of envisioned innovations created barriers to translocal diffusion and empowerment. This suggests that non-spatial proximities (organizational, socio-cultural) too play an important role in translocal learning processes (cf. Hansen and Coenen, 2015).

Local-program interactions: From a program coordination perspective, it was challenging to take into account the diverse learning needs of different Labs. Yet, the coordinators often appreciated the learning activities that FIT4FOOD2030 designed: *"I don't think that we could do this without these trainings and without materials"* (Lab Coordinator). We also observed reflexivity on the program-level itself on how FIT4FOOD2030 was fostering learning in and between the different experiments. One partner stressed:

> *"I think we constantly tried to observe: is this successful? Are we doing the right things? Are we doing things in the right way? And we made a lot of changes to the way [the learning sessions] were organized."*

10.4.5 Creating legitimacy

Local interactions: Important in the program's efforts to engage stakeholders for transformation ambitions were (translocal) processes of building legitimacy for the ambitions of the FOOD2030 framework, the approach of the FIT4FOOD2030 program as well as the processes and outcomes of the Lab activities. These took place within localized contexts of the Labs, with and for local actors and institutions. Among other things, Lab coordinators were leveraging their (institutions') historically grown authority and credibility in reaching out to specific groups of (marginalized) stakeholders to be engaged in the activities of their experiments. This local dimension is important as

> *"it is [local coordinators] who are working locally with the stakeholders, and how that is happening […] is because of their reputation and because of the track record that they have working locally"* (program partner).

Local-to-local interactions: Indirectly, local-to-local connectivity helped foster legitimization, as being part of a connected set of experiments across different localities helped to empower local experiments by providing credibility to local experimentation processes. As one City Lab coordinator described:

> *"I guess it's good that we are doing this all over Europe [...] that there is this international work going on, many organizations working for the same goals. This kind of gives more credentials, making it more important to any stakeholder that I would invite and engage with."*

Local-program interactions: Relatedly, we observed that the multi-sited program architecture and the multi-level policy contexts in which Labs were embedded gave rise to translocal dynamics of (de)legitimization. One particular dynamic involves FIT4FOOD2030 providing legitimacy to the local policy contexts, and thus empowering local transition actors to mobilize 'high-level' program support in their own transformative efforts. As one Policy Lab coordinator illustrated, this was largely due to being part of an 'EU-level' program, which helped to strategically engage high-level actors:

> *"It helps to convince also our hierarchy, our secretary generals, our cabinet, our ministers, that it is important what we do. [...] It is really something that is framed within a European project, and that is always something that has more weight."*

At the same time, Lab coordinators indicated that there was also a risk of delegitimizing dynamics, if the local stakeholders attending their workshops would feel that they were merely joining the activities to 'test' or 'implement' ideas for the EC, without clear benefits for the local transformation processes. This required Lab coordinators to carefully navigate the different types of (de)legitimizing dynamics involved, while being attentive to the implications (of Lab activities) for both 'local' and 'program' levels.

10.5 DISCUSSION

By synthesizing the findings from the FIT4FOOD2030 program, we here illustrate how translocal dynamics of experimentation can lead to four cross-cutting sets of challenges in the practice of governing multi-sited transition programs. For each challenge, we highlight the implications for the governance of translocal experimentation and we suggest avenues for future research.

10.5.1 Local needs and program ambitions

First, based on our empirical analysis, we see a challenge in balancing experiments' needs with program ambitions. There is a tension between (1) the need to support overarching policy domains in setting in motion system-wide transitions by providing common directionalities, and (2) the need to create space for experiments that are autonomous in developing context-specific transformation pathways. In FIT4FOOD2030 this balancing act involved providing structured methodologies and fostering the development of common visions while also being attentive to the needs of the different experiments. Still, it was challenging to facilitate these diverging needs. The 25 Labs were stimulated to set in motion diverse journeys based on their local stakeholders' needs, ambitions and tailored to their embedding in specific political, geographical, or institutional contexts. At the same time, funders and policy makers to whose needs the program was responding, often requested "policy-relevant" and concrete generalized lessons. This required flexibility, anticipation and adaptivity from the program, for instance by changing the topics discussed in trainings depending on Lab needs on the spot, or by requesting Labs to collect different types of stakeholder data based on needs of the funder midway in the program. Similar dynamics took place within experiments, where local coordinators needed to balance ambitions of the experiment as a whole with the diverse needs of their local stakeholders while taking into account the overarching program ambitions.

Such dynamics, we contend, are to a certain degree manifestations of the broader political dilemma on combining diversities of inclusion with directionalities implied by transformative efforts (Kok et al., 2021b), raising the question how inclusivity and urgency can be combined in efforts of responsible scaling in transition governance (Skjølsvold and Coenen, 2021). This requires finding novel ways of combining pluralities of different local needs and perspectives with overarching transformative ambitions of translocal transition governance. Importantly, it draws into question how much diversity in terms of topical focus, organizations, countries, governance levels (EU) programs can effectively accommodate while accelerating transformative dynamics through coordinated intervention. That in turn urges reflection on, and further inquiries into whose interests, ambitions or needs are emphasized and prioritized in (democratized) transition governance efforts and to whom or what transition-oriented programs are accountable (cf. Hendriks, 2009).

10.5.2 Navigating the politics of translocal experimentation

The challenge described above strongly relates to a broader set of challenges regarding the role of politics and power in transitions. The politics of transitions has received ample attention in the field (e.g., Avelino and Rotmans, 2009; Grin, 2010; Meadowcroft, 2011; Avelino, 2021; Kok et al., 2021a) also in the context of experimentation processes (e.g., Hoffman and Loeber, 2016) and increasingly with regard to the empowering (or disempowering) dynamics that translocal innovation processes bring along (Avelino et al., 2019; 2020). Governing the politics of translocal experimentation was challenging as it required FITF4FOOD2030 to be attentive to, and respond to, empowering and disempowering dynamics not only in different ‘localities’ but also across (governance) scales. Transformative programs thus both need to draw upon as well as redirect systemic power relations (Avelino and Rotmans, 2009; Van Breda and Swilling, 2019). It brings along a responsibility for programs (through their ‘local experiments’) to serve as empowering instruments that include marginalized stakeholders and ensure meaningful deliberation. However, this is not straightforward precisely due to the translocal dynamics of multi-sited programs, which embeds ‘program management’ efforts at different localities, diffusing responsibilities and accountabilities across spatial scales.

Another political challenge for policy-oriented programs emerges because they are often deeply embedded in regimes. This brings along the additional complexity that actors find themselves in deeply institutionalized contexts firmly held in place by a web of vested interests and power relations, while ‘doing innovation from within the regime’ also offers the opportunities to enhance the transformative impacts of experiments (Grin, 2020). These challenges point to the need to rapidly advance transformative capacity building not only on the level of those ‘doing the experiments’, but also on policy (program) levels to support transformative agency building across experiments and governance domains (cf. Wiek et al., 2011). That might support practitioners and researchers to reflexively navigate the translocal power dynamics involved in multi-sited transition programs.

10.5.3 Short-term programs and long-term transformations

Third, we see a challenge in balancing here-and-now program dynamics with long-term processes of social change. This tension emerged due to the (relatively) short-term nature of FIT4FOOD2030, while both the experiments and the program were bound to specific concrete outputs ‘during the program’ (as written down in the proposal phase) that ought to contribute to longer-term impacts ‘after the program’ (cf. Musch and von Streit, 2020; Torrens and von Wirth, 2021). The tension at hand is explicated by a Lab coordinator: *“You won’t see the direct results yourself, so I think it is just really important to believe in the activity itself, the process itself”.* This highlights the program’s efforts in re-thinking the role of measurable and quantitative output indicators, toward more plural and transformative evaluation of the contributions of transformative programs (see EC, 2021). It also stresses the potential of the concept of ‘small wins’ (see Termeer and Dewulf, 2019) that – being distinctly different from low hanging fruit – emphasizes fostering the seeds for change that lie underneath the surface and illuminate the potentialities for transformation. Yet, this challenge is particularly manifest in multi-sited transition programs, as the impacts of localized interventions and transition pathways are highly context-specific and spatially distributed, and they don’t necessarily ‘add up’ to overarching, system-wide change indicators.

Importantly, this challenge calls into question the capacity of incumbent innovation systems to be cognizant and supportive of long-term transformative innovation processes (Kok et al., 2019; Fazey et al., 2020) and it requires exploring (1) how to best design and evaluate the impacts of short-term programs with transformative ambitions (cf. Schneider et al., 2019) and (2) how to best support translocal experimentation by further reorienting incumbent innovation systems toward Transformative Innovation Policies (see Schot and Steinmueller, 2018; Diercks et al., 2019) or Mission-Oriented Innovation Systems (see Hekkert et al., 2020; Klerkx and Begemann, 2020).

10.5.4 Flexible boundaries of multi-sited transition programs

Finally and relatedly, our work in the FIT4FOOD2030 program highlighted the difficulty to establish who and what are actually part of the experiments and the program, and who or what are influencing its dynamics, but are not included. In other words: there is a boundary-challenge (Kok et al., 2021b). Considering translocality, the complexity increases as the scales involved are manifold and the diffusion and mobility of actors, ideas and resources across localities at different scales is acknowledged. This further blurs and entangles responsibilities and accountabilities of actors and organizations involved, even more so as actors are not only 'included in' the program at focus, but in a wide range of different networks, initiatives and platforms engaging with other (transformative) ambitions. Related is the question of who or what is actually 'governing' the dynamics of programs. Our observations in FIT4FOOD2030 suggest that not only do programs drive dynamics in experiments, actors involved in experiments in turn strategically use programs to achieve their own (transformative) 'local' ambitions. This suggests a nuanced and dynamic understanding of hierarchies and steering mechanisms, pointing to the importance (and complexity) of the multi-scalar, multi-level dynamics at play in transition governance.

In our case, this boundary-challenge led the program management team (within the scope of their resources and abilities) to govern transition dynamics by (1) being anticipative and adaptive to developments in policy contexts, as well as local needs, and either align or seek collaboration with these initiatives, requiring (2) working with flexible Theories of Change (ToC) as well as with reflexive reorientation of program goals and ambitions (cf. Deutsch et al., 2021), while (3) embracing evaluative impact narratives that abandoned linear causalities but focused on non-linear impacts and seeds for change (or: small wins, Termeer and Dewulf, 2019) and acknowledged that programs merely navigate the complex landscape of transformation initiatives (see also Voß and Bornemann, 2011; Schneider et al., 2019). Further investigating how transformative ambitions can be facilitated by and translated to program design and evaluation, while seeking to generate both tangible outcomes as well as build transformative capacities, might help funders in better designing multi-sited transition programs containing portfolios of transition experiments.

10.6 CONCLUDING REMARKS

In this chapter, we turned our gaze toward the translocal dynamics of experimentation in sustainability transitions. Focusing on translocal dynamics, we argued, might help to better understand the different ways in which transition experiments can become connected across space and scale, and the role of multi-sited transition programs in fostering transformative dynamics. Throughout our analysis and discussion, we described how the translocal dynamics of multi-sited transition programs comprised a complex interplay between local, and local-to-local and local-program interactions. We empirically analyzed these dynamics for different elements of experimentation processes: (1) mobilizing networks and resources; (2) visioning and directionality; (3) developing and scaling innovations; (4) learning and reflection; and (5) creating legitimacy. Our work suggests that the translocal dynamics of multi-sited transition programs can have an empowering effect for the 'local' experiments, as well as for the overarching program, as it triggers dynamics across spatial scales and governance levels beyond the mere sum of (multiple) localized experiments.

At the same time, the highly political and complex nature of such programs leads to many challenges in the practice of 'doing translocal experimentation'. If these challenges are not addressed properly, transition programs risk bringing along disempowering dynamics that reinforce status-quo configurations. Addressing these challenges, we have argued, requires reflexive, adaptive and iterative governance efforts that can (1) find synergies between diverging local needs and program ambitions; (2) navigate the cross-scale political dynamics in multi-sited transition programs; (3) move beyond output-oriented evaluation frameworks in order to capture transformative efforts of short-term programs; and (4) expand the boundaries of programs by linking to ongoing policy developments in highly complex multi-level governance settings.

Finally, we are aware that our work leaves many questions unanswered. As we have argued above, there is ample room for further investigating how the translocal dynamics of multi-sited transition programs can support or hinder urgently needed sustainability transitions. We hope that others see this work as an explicit invitation to engage with our findings and to continue working on unraveling the complex dynamics at play in delivering transitions toward sustainable and just futures.

CHAPTER ACKNOWLEDGEMENTS

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PART V

REFLECTIONS AND RECONSIDERATIONS

"Waar visie ontbreekt, komt het volk om."[81]

Joop den Uyl, 1973

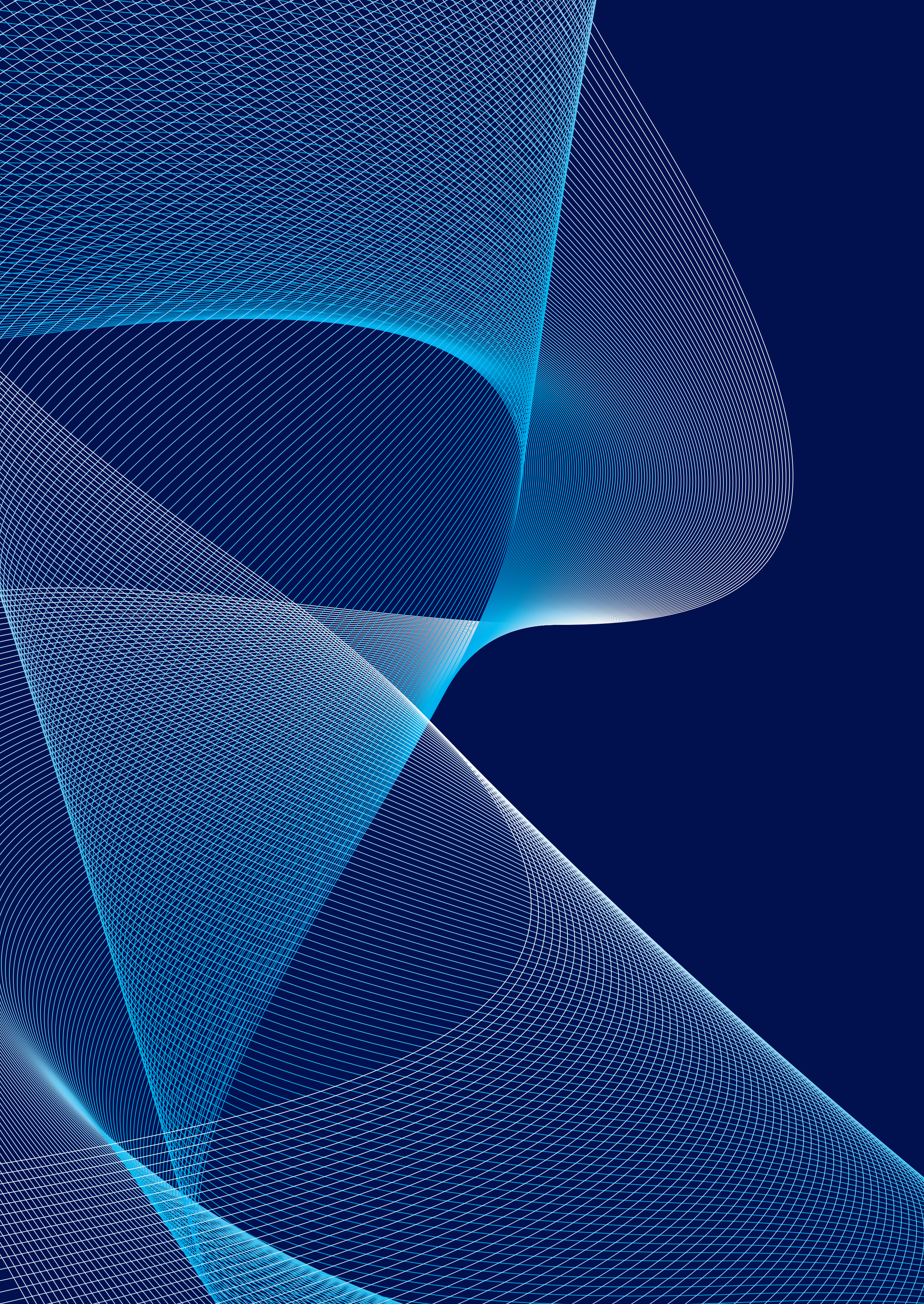
"De Onderzoeker deed zijn ogen dicht. Hij ging van wit naar zwart. Zo bleef hij lange tijd zitten, met zijn oogleden gesloten om te ontsnappen aan de witheid rondom hem waarvan hij voorvoelde dat hij er, als hij niet oppaste, in zou kunnen verdwijnen of oplossen. Hij dwong zichzelf er niet te veel aan te denken. Hij moest zich niet laten gaan, daar kwam het op neer. Hij moest blijven wie hij was, niet vergeten dat hij de Onderzoeker was. De Onderzoeker blijven. Koste wat kost de Onderzoeker blijven."

Het Onderzoek
Philippe Claudel, 2010

81 This can be translated as: "Where vision is lacking, the people perish."

The work presented in this thesis aimed to contribute to better understanding the governance and politics of sustainability transitions, with a particular conceptual orientation toward transdisciplinary experimentation as a mode of governance, and an empirical orientation toward food systems and their relation to R&I systems. To that end, the different studies aimed to contribute to answering the overarching research question: *"How may we understand the politics and governance of transdisciplinary experimentation in sustainability transitions?"* The thesis presented three different parts with a different perspective on these issues, each addressing a particular sub-question raised in Chapter 2.

In the general discussion (Chapter 11) I will first zoom in and summarize the main findings and conclusions for each of the three sub-questions posed in this thesis. Then, I will zoom out and elaborate on several cross-cutting considerations that stem from integrating insights across the different parts of this thesis in interaction with the broader literature on transitions and transdisciplinarity. Here I will also present directions for future research. Subsequently, I will reflect upon some methodological and conceptual choices made, confusions that have arisen, and the roles I played during my (empirical) work for the thesis. Then, in Chapter 12, I will present some concrete recommendations for transdisciplinary R&I projects aimed at societal transformation, as well as for R&I funding and policy making. I will provide some concluding remarks in Chapter 13.



11

General discussion

11.1 KEY FINDINGS AND CONCLUSIONS

In this section, I present key findings and conclusions of the work presented in this thesis. These findings are clustered around the three sub-questions of the thesis that were posed in Parts II, III and IV.

11.1.1 Politics, complexity and transitions

In Part II of this thesis, I asked the question: *"How may we understand the politics of sustainability transition governance from a theoretical perspective?".* In relation to this question, co-authors and I presented two different yet related answers to the abovementioned question. One answer (Chapter 3) emphasized the *causal* orientation ("why is it this way?") of the politics and governance of transitions, by focusing on ontological and epistemological issues and considering how politics (as agency, power, and processes of powering) drive or hinder processes of transformative change. Our contribution here is a further clarification of the relational nature of power, and the role of non-humans in transitional dynamics of complex adaptive systems. A second answer (Chapter 4) focused more on the *normative* orientation ("where do we want to go?") of the politics of transition governance with an emphasis on epistemological and axiological considerations. Our main contributions are a further clarification of how democratization of transition governance might pave the way for enacting just transitions in agri-food systems, and an elaboration on several key challenges democratization brings along for *institutionalizing* just transition governance efforts.

How do these answers help us understand stasis and transformative change? In our work we argued that a more symmetrical, relational and 'force-field' understanding of power (which structures agency of components) enables the observation of different types of power relations. Including non-human components in political analyses of transitions might help to understand why incumbencies are so deeply rooted (beyond the intention of human agents) and systemic change is notoriously difficult to realize (Chapter 3). This provides ample room to understand how systemic injustices are reinforced and reproduced through complex networks of incumbent structures and agents (Chapter 4). More specifically, in Chapter 4 we argued that underlying unsustainability and dynamics of injustice in agri-food systems are further locked-in through governance paradigms that structure our capacities to turn the tide toward more just and democratic transition governance (cf. Sievers-Glotzbach and Tschersich, 2019).

At the same time, our work also provides insights into how we can capitalize the transformative potential of 'politics' that supports the governance toward just and sustainable transitions. We stressed the importance of considering multiple dimensions of justice and making transition governance more ‘democratic’ (Chapter 4). Though this is challenging, at the same time we stress that building agency in complex heterogeneous networks (such as governments, socio-ecological systems, or societal constellations) can help to enhance *capacities for reorientation* (related to Giddens’ *capacity to do otherwise*, 1984, cf. Stirling, 2019). Developing these capacities are crucial for instigating transformative action and for countering incumbent powering processes that reinforce incumbent governance paradigms (Chapter 3).

Regarding transdisciplinary experimentation, we argued that overcoming the incumbent governance paradigm that favors technical expertise above other forms of knowledge (Chapter 4) and supporting agency building in emergent networks (Chapter 3) are highly important. It are these considerations that also set the stage for Chapters 5 and 6, where we discuss the transformative potential of transdisciplinary R&I approaches. At the same time, we stressed that ‘democratization’ alone is not the panacea for ensuring just or sustainable transformation (Chapter 4, cf. Pickering et al., 2022), and we pointed out the importance of instigating powering processes that radically restructure incumbent resource dynamics (Chapter 3). In that light, our work could help to explicate and navigate challenges in democratically and experimentally governing just and sustainable transitions. This provides entry points for considering the interrelations between different structural, systemic and enabling approaches in transition governance (Scoones et al., 2020).

11.1.2 Transforming research and innovation

In the third part of this thesis, we explored a tale of two systems. Or more precisely: we explored the relation between R&I systems and (transformative change in) food systems. This part focused on the question: *“How may we govern transformative change through transdisciplinary R&I?”*

The assumption underpinning this tale of two systems is the realization that R&I efforts that are transdisciplinary in nature might be able to contribute more effectively, with more legitimacy, and in more democratic ways, to urgently needed sustainability transitions (e.g., Caniglia et al., 2021; Lang et al., 2012; Fazey et al., 2018a). Yet, scholars have pointed out that there are many challenges to doing transdisciplinary R&I in practice (e.g., Brandt et al., 2013; Lang et al., 2012; Fazey et al., 2018a). Though literature stresses the importance of addressing these challenges, it often omits to consider to view these challenges as strongly related and systemic in nature. Through the contributions in this part, co-authors and I identified challenges to doing transformative and transdisciplinarity R&I in food systems, and we argued that these challenges are strongly intertwined and have a systemic nature: *incumbent R&I systems* are not up to the task of delivering food system transformation. In other words: if we want to govern transformative change through R&I, we need different R&I systems that are more supportive of transdisciplinary and transformative approaches. The contribution of this part is two-fold. First, we further explored the role of transdisciplinary R&I in catalyzing food system transformation (Chapter 5). Second, we highlighted how a coupled-systems perspective considering the entanglement of R&I systems and food systems might help designing interventions that aim for a double systems transformation. These boundary interventions can aim to act upon systemic leverage points (cf. Raven and Verbong, 2009; Meadows, 1999), so that their multisystem interactions can better support food system transformations (Chapter 6). To be able to govern transformative change through R&I, we also stressed the importance of R&I governance interventions that (1) stimulate systems approaches in R&I; (2) foster transdisciplinary and transformative research agendas; (3) stimulate portfolios of experiments and projects that reinforce each other; and (4) stimulate innovative experiments that shape conditions for change. Exactly such interventions we empirically unraveled in Part IV of this thesis.

A thorough rethinking of the role of R&I as well as how it is funded is a crucial step toward the development of the integrative policies that are necessary to engender systemic change – in the food system and beyond. These considerations also add to the importance of considering rapidly institutionalizing transformative innovation policies (Schot and Steinmueller, 2018), and the establishment of mission-oriented (agricultural) innovation systems (e.g., Klerkx and Begemann, 2020; Hekkert et al., 2020) that are supportive of transdisciplinary efforts, as part of the transformation of R&I systems more broadly. In short: to govern transformative change through transdisciplinary R&I, we need to transform R&I systems themselves.

11.1.3 Governance and politics of transdisciplinary experimentation

In Part IV, we presented several empirical elaborations on the governance and politics of transdisciplinary experimentation. All these explorations[82] revolved around the FIT4FOOD2030 project, in which I was involved and on which we conducted an in-depth single (embedded) case study. We explored the overarching question: *"How may we understand the politics, and facilitate the governance, of transdisciplinary experimentation in transition-oriented projects?".*

The empirical elaborations each present a different answer to this question, by zooming in on a different facet, or level, of experimentation in a *project-context*. The first empirical

82 In addition, in an *intermezzo* (Chapter 7), we presented a co-publication with project partners about FIT4FOOD2030 and the role of the developed tools and network.

study (Chapter 8) zoomed in all the way down to the Lab coordinators and their practice of 'doing stakeholder inclusion'. The second perspective (Chapter 9) highlighted the Labs in their contexts and investigated how 'doing Labs' relates to 'creating impact'. The final perspective (Chapter 10) considered FIT4FOOD2030 as a transition program with different experiments across space and scale, and investigated the governance of translocal dynamics of experimentation. Our answer to this sub-question is both multi-level, as well as multi-faceted. The politics and governance of transdisciplinary experimentation concerns (interactions between) different levels: the level of Lab coordinators; the level of Labs as entities; the level of translocal dynamics of experimentation; the level of projects and programs that contain a set of different experiments; and interactions between Labs or projects and the wider policy contexts and systems they are part of. It is also a multi-faceted answer: considering the politics and governance of experimentation is to take into account issues such as democratization and power dynamics of the inclusion of stakeholders; building agency in (Lab) experiments that might help to instigate transformative power dynamics; and considering accountability and legitimacy of translocal dynamics in multi-sited transition programs.

The project-orientation of transdisciplinary experimentation that is grounded in the abovementioned multi-level and multi-faceted politics, has several implications for facilitating the governance of FIT4FOOD2030-like projects. Facilitating the governance of transdisciplinary experimentation requires enabling and empowering those involved in these projects to navigate three challenges. Before providing concrete recommendations for projects and R&I funding in Chapter 12, I here elaborate on these challenges and strategies for mitigating these.

The first challenge involves *balancing here-and-now-project dynamics with long-term transformative ambitions*. In our empirical analyses, we observed that the short-term orientation of FIT4FOOD2030 led to trade-offs with its long-term transformative ambitions. In addition, our findings in Chapter 9 indicate that in the practice of 'doing Labs' there are divergent views on what 'creating impact' through projects constitutes, and that impacts can be created at levels of creating capacities for change (agency, cf. Chapter 3) or creating changes (powering, cf. Chapter 3). This also led us to conclude in Chapters 9 and 10, that there is a need to move beyond output-oriented evaluation frameworks in order to capture transformative efforts of short-term programs. While this consideration is taken up in the broader literature on experimentation (e.g., Luederitz et al., 2017) or small-wins (Termeer and Dewulf, 2019), multi-sited programs reinforce the challenge due to the large variety of pathways and experiment journeys that are set in place, which makes uniform 'output evaluation' even more difficult (Chapter 10).

A second challenge refers to the political practice of *governing diversities of inclusion with directionalities implied by transformative efforts*. The FIT4FOOD2030 Labs displayed a large diversity in terms of locations, contexts, topical focus points, and stakeholder publics. This brought along political challenges for Lab coordinators in governing the opening and closing of transdisciplinary processes (Chapter 8, cf. Van Mierlo et al., 2020; Stirling, 2008). On another level, for project management to support this diversity of needs and orientations, this required *ex-durante* exploring how to best support translocal learning and empowerment processes, while adhering to overarching project ambitions and funder requirements (Chapter 10). Navigating the boundaries of inclusion also required FIT4OOD2030 to adapt to, and anticipate, ongoing (policy) developments as to further the program ambitions. At the same time, our studies into the fuzzy reality of a multi-level, multi-actor and multi-sited project, also suggested a nuanced and dynamic understanding of hierarchies and steering mechanisms within these types of transition-oriented projects (Chapters 8, 9 and 10, informed by Chapters 3 and 4). Hence, our findings suggest that flexible project designs, building capacities to adapt to, and anticipate, (policy) developments, and acknowledging the deeply political nature of inclusion (cf. Turnhout et al., 2020) might benefit the governance of transdisciplinary experimentation.

Finally, our findings indicate that Lab coordinators, project partners and project management (including myself and co-authors) struggled with determining whether their practices of doing the project actually contributed to the projects inclusive and long-term transformative ambitions. This challenge involved *knowing how and whether project activities contributed to transformative change*. Are we including the right stakeholders and how do we know (Chapter 8)? Are we creating real impact, and how can we make that tangible (Chapter 9)? Are we really supporting the transformative ambitions of the project and fostering translocal dynamics (Chapter 10)? Our findings also suggest that this inherent challenge may be (partly) overcome by (1) focusing on stimulating learning and reflexivity at different levels of the project through structured activities (stakeholders in the Labs, Lab coordinators, project management and the project as a whole (cf. Svare et al., 2020a, Loeber et al., 2007; Van Mierlo and Beers, 2020); (2) supporting the deployment of creative tools and methodologies that can be used in different empirical contexts that help structure transformation processes (see also Chapter 7); and (3) by adhering to flexible project designs that can help to re-align project activities and ambitions during project implementation (through flexible *Theories of Change*, cf. Schneider et al., 2019; Deutsch et al., 2021).

Despite the challenges involved, I conclude that these types of projects are promising instruments to consider as part of wider portfolios of governance instruments for sustainability transitions, as long as the deeply political nature of these types of interventions (regarding democratization, power dynamics, empowerment, and legitimacy of interventions) is acknowledged, and accounted for.

11.2 CROSS-CUTTING THEMES AND FUTURE RESEARCH DIRECTIONS

After presenting the main findings of this thesis in the previous section, I now take a slightly broader perspective by zooming out, and by elaborating on several cross-cutting themes that have emerged. These provide additional insights in answering the main question of this thesis: *“How may we understand the governance and politics of transdisciplinary experimentation for sustainability transitions?”* I will link insights from the different parts of the thesis to the wider literature, and point to directions for future research.

11.2.1 On impact: Droplets in a sea of incumbency?

A first cross-cutting theme is the notion of ‘impact’. Empirically, we explored this issue elaborately with regard to the impacts that Labs tried to create, and the challenges they encountered in these endeavors, in Chapter 9. We also reflected upon the broader ‘impact’ perspective of FIT4FOOD2030 through its translocal dynamics of experimentation and the interactions between local experimentation and wider program and policy contexts in Chapter 10. One could even state that in Chapter 8 we zoomed in on the impact that transdisciplinary Labs can make on, or for, stakeholders that are included in transformative projects. We highlighted the impact-ambitions of the project in Chapter 6, potential catalytic impacts of transdisciplinarity in Chapter 5, and we already set the scene for understanding the systemic change (as impact) and built agency in networks (as impact) as well as systemic incumbencies in Chapters 3 and 4. From our findings it is clear that the ambition of changing the R&I and food systems was (of course) not realized after a three-year project period. However, despite its modest resources and relatively small-scale orientation (as just one of the many interventions at play in the EU policy context) the project was successful in *contributing to several changes* in the system.

The impacts of FIT4FOOD2030 were often rather intangible or on the undercurrent levels of systemic networks and practices (Chapters 8, 9 and 10). In Chapter 9, we stressed that impact could be seen as both capacities for change as well as creating change. Capacitating or creating (meaningful, but perhaps rather small) changes based on transformative ambitions is creating impact. But it is not the same as *“changing the sys-*

tem". As we argued in Chapter 3 (cf. Stirling, 2019; Grin et al., 2010), changing the system more widely through experimentation is notoriously difficult, because complex societal systems comprise a strong web of vested interests tightly held together by incumbent power relations. This links to our arguments in Chapter 4, that stress that such dynamics are further reinforced (or perhaps even driven) by underlying systemic paradigms, such as the focus on scientific expertise as (the only) source of legitimate knowledge, a strong systemic reliance on perpetual economic growth and an anthropocentric understanding of human-nature relations. Relatedly, our findings in Chapter 9 suggest that impact created through localized and small-scale interventions such as Lab experiments can be seen as droplets of impact in a sea of incumbency. And while these droplets by themselves do not change a system, they do two other things:

First, as we explicated in Chapter 10, many individual experiments can reinforce each other leading to 'larger than the sum of parts dynamics', especially as they are governed in the context of multi-sited programs which aim to stimulate translocal dynamics. This understanding is theoretically rooted in the complexity of systems that we elaborated in Chapter 3, whereby one hopes to invoke non-linear dynamics of change (cf. Grin et al., 2010). This also points to the importance of connecting different policy programs, initiatives, projects, experiments and Labs aiming at food system transformation so that they can counter deeply institutionalized incumbencies (Chapters 4, 5 and 10). In that way, governance efforts can be conducted at stimulating transformative translocal dynamics that help empower local interventions and help diffuse (social) innovations (cf. Avelino et al., 2020; Loorbach et al., 2020). However, as we illustrated in Chapter 10, such translocal experimentation can actively be governed as this helps to anchor elements of experimentation at program levels. Further investigating whether and how these translocal dynamics can also lead to significant changes at policy levels is crucial. Furthermore, the relation between translocal experimentation and their interactions with regime actors (both enabling and constraining their efforts at creating impacts) deserves further scrutiny (cf. Avelino et al., 2020). In this regard, a promising example that is to be implemented in the European context is the *Partnership on Safe and Sustainable Food Systems,* that is to serve as an explicit instrument (or platform) of the European Commission for connecting the different initiatives, projects and food system actors on food systems R&I for a longer period of time, and by linking their efforts explicitly to the implementation of the Farm to Fork Strategy as part of the EU Green Deal.

Second, as we have illustrated another important type of 'impact' refers to the capacities for change that are built through experimentation (Chapters 8, 9 and 10). This also reflects back on earlier considerations that emphasize that employing different strategies for building *agency as a capacity for reorientation* in broader networks, experiments or Labs is a crucial element of systemic transformation. This relates of course, to the broader literatures on agency building (e.g., Westley et al., 2013); developing transformative capacities (e.g., Wolfram, 2016; Schneider et al., 2019); supporting undercurrent changes (e.g., Rotmans and Loorbach, 2010); and enhancing small wins (e.g., Termeer and Dewulf, 2019). It might be especially relevant to make efforts of agency building more 'tangible', as well as to explore pathways through which agency building as process relates to, or results in specific, structural systemic changes[83] (e.g., Deutsch et al., 2021; Lux et al., 2019). This is important as transdisciplinary efforts that (only) emphasize the "process-side" of things might forget about the urgent need to realize concrete changes across systems.[84]

There are also some challenges and dilemmas that can be identified. First, when one considers the discourses in the context of EU R&I projects, it almost seems as if every single project is expected to change the whole food system, with only several million euros to spend, and within three or four years![85] Hence, not properly acknowledging the differences in types of outcomes and impact (creating change, capacitating change, as well as 'systemic change'), may lead to an overpromise of transformative ambitions in projects that aim to 'change the system'. This is problematic because it means that projects can hardly live up to their (and the funders) expectations. It is also problematic because one might start *overpromising* in order to acquire project funding, in line with the effectiveness-orientation of sustainability science (cf. Musch and Von Streit, 2020) and broader "impact sensationalism", which leads to overpromising the societal impacts that can (realistically) be delivered (Gjefsen et al., *forthcoming*; Chubb et al., 2017). Another challenge involves the question of how long the "created changes" last, after the incentives that created them (e.g., the FIT4FOOD2030 Labs or other projects with short-term orientations) cease to exist. Do the changes last, are they further diffused, scaled, or amplified (e.g., Loorbach et al., 2020; Lam et al., 2020), i.e. has enough transformative agency been created? Or do systemic configurations jump back to original system states due to undesirable resilience (Oliver et al., 2018) or backlash trajectories (cf. Pel, 2021)? It can be considered a limitation of this thesis that we were not able to empirically investigate post-project how these dynamics unfolded. At the same time, I think these questions are highly relevant in the context of the projectification, effectiveness-orientation

83 Useful to this end is further considering the role of *Theories of Change* in projects, and portfolios of transdisciplinary and transformative interventions (cf. Deutsch et al., 2021; Schneider et al., 2019).

84 Even though these risks might only be *perceived*, for instance by policy contexts and funders who favor a focus on effectiveness in evaluation (e.g., Musch and von Streit, 2020), there is still a problem for the field as it might affect the societal support, and legitimacy, of transdisciplinary interventions if they are considered 'merely talking'.

85 This observation is slightly provocative, and based on my own experiences rather than extensive discourse analysis.

and short-term nature of sustainability projects (cf. Torrens and von Wirth, 2021; Musch and von Streit, 2020).

Finally, let me briefly consider the relationship between justice, systemic incumbencies and the impacts of experimentation. In Chapter 4, we explicated that just and democratic transition governance entails overcoming a number of deeply rooted governance paradigms. Importantly, we stressed that connecting the three paradigm shifts for ensuring just and democratic transition governance necessitates reaching beyond governance through single interventions or experiments toward more integrated efforts that fundamentally rethink and overcome underlying structures, power relations, as well as R&I systems that perpetuate incumbent injustices. Though we did not elaborately draw upon conceptualizations of justice in the empirical explorations in Part IV of this thesis, this points to the very idea behind these multi-sited and transdisciplinary interventions: through trying to act upon belief systems and systemic cultures and practices (e.g., Chapter 9) these aimed to address potentialities for more structural change. This is important, also given the points raised in Part II on how translocal and historical dynamics of injustice and unsustainable system dynamics have brought forward an intricate web of stasis regarding particular powering processes; while the power-relations themselves as *force-fields* tightly bind incumbent configurations together. That makes it equally important and challenging to bring on board those relatively unheard voices in processes of decision making (Chapter 8). In this way, the theoretical notions presented in Part II might help further explicate why transformation is so challenging, while also pointing out some of the (normative) advantages of governing through transdisciplinary experimentation, as was aimed for in the FIT4FOOD2030 project. This helps building agency in emergent networks, and could help further democratization of transition processes, in particular by considering procedural and recognition dimensions of justice by including a wide variety of voices and perspectives in 'governing' R&I systems in Europe. At the same time, in Part IV we stressed that transdisciplinarity aimed at sustainable transformation is inherently challenging, deeply political, its impacts often intangible, and its coordination across space and scales notoriously difficult.

Future research directions:

1. Endeavors could further explore the potential paradox between democratization and the urgency to create impact and enhance responsible scaling *now* (e.g., Skjølsvold and Coenen, 2021), especially in light of recent work that stresses that democratizing sustainability governance could enhance (environmentally) sustainable outcomes (Pickering et al., 2022).
2. A second line of inquiry could explore in more detail the relationship between processes of capacitating change, and the actual changes that (short-term) projects bring along. Of particular interest would be inquiries into long-term effects of (finite) interventions, and unraveling in more detail the different impact pathways that link project activities to societal impacts through transdisciplinary projects aimed at transformative change (cf. Schneider et al., 2019; Lux et al., 2019). This may also provide entry points for engaging with recent work on for instance small wins and transformative capacities (Termeer and Dewulf, 2019; Wolfram, 2016). More insights could be gathered on the questions: through which pathways do built capacities (not) lead to tangible societal effects? How can processes of capacitating change and creating change be designed to keep momentum after projects or interventions end?
3. In addition, if we want to understand how Labs as instruments might (or might not) contribute to transitional dynamics, it can be insightful to further advance research on dynamics of (non)change in different empirical and geographical contexts, as well as help identify critical supporting or hindering factors that translocal dynamics, and embedding in larger projects and programs might bring along. This relates to calls for more (long-term) beyond-case and cross-case comparative analyses of Labs (e.g. McCrory et al., 2020) and transition experiments more broadly, for instance *"by zooming out to engage with very large numbers of projects over multiple empirical domains, perhaps with the help of more quantitative tools"* (Sengers et al., 2019: 162). The latter consideration might also help to support cross-fertilization between multiple case studies, modeling approaches (cf. Köhler et al., 2018) and formal operationalizations of transitional dynamics (e.g., De Haan, 2010), which is considered an important endeavor in the field (Köhler et al., 2019).

11.2.2 On governing: Overcomplexity and a return to Maakbaarheid?

A recurring theme in this thesis is the notion of *complexity*. Or rather: complexities! We discussed ontological and epistemological complexities[86] (Chapter 2) the complexity of food systems (Chapter 5), the complexity of R&I systems (Chapter 6), the complexity of politics (Chapter 3), the complexity of governing transitions (Chapter 4), the complexity of running multi-sited, inclusive and transformative projects and experiments (Chapter 10), the complexity of creating impact (Chapter 9), and the complexities involved in stakeholder inclusion in emerging networks (Chapter 8). One might start to wonder, where do we even start?! Clearly, so far our multi-stakeholder efforts and network governance approaches have not led to mankind tackling the sustainability crises.[87] If we are all part of complex networks (suggesting that this makes us only partly responsible, partly capable of steering, partly accountable due to complexity), is our tendency to *complexify* things perhaps a key barrier for powerful intervention? Let me therefore elaborate on some findings of this thesis regarding governance of (EU food) system transformation and (over)complexity.

First, given the complexities that I have just explicated, I too am to blame for making things complex. So for the purpose of transparency and accountability, let me reflect upon the question: should we not abandon complexity and return to *Maakbaarheid* [loosely translated as "makeability"]? The idea of *Maakbaarheid* emerged in Dutch social-democratic political circles in the 1970s and suggests that strong and capable government interventions can lead to realizing just and equitable societies.[88] As I already pointed out in Chapter 1, the failures of governments to do so led to the emergence of experimental network governance approaches, that might more effectively be able to tackle wicked problems (cf. Rittel and Webber, 1973).[89] At the same time, because of a variety of reasons (as elaborated on in this thesis: deeply rooted incumbencies, prob-

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86 Here, I will discuss complexity in light of government interventions, but I have often wondered whether scholars' efforts at pluralizing and *complexifying* ontologies and the subsequent abandonment of Modernist orientations (most prominently by Latour, 1987; 1993) has perhaps given rise to, or at least further weaponized, the deeply problematic rise of (climate) science denialism (evident for instance in the Republican "war on science", cf. Mooney, 2007). Have we dug our own grave? Perhaps unsurprisingly, in response to these dynamics, constructivist scholars have rushed to construct new boundaries between science and non-science (e.g. Latour, 2004; 2017) in order to restore trust, authority, and build legitimacy for climate action. As Bruno Latour himself argued: *"We are indeed at war. This war is run by a mix of big corporations and some scientists who deny climate change. [...] You need to present science as science in action. I agree that's risky, because we make the uncertainties and controversies explicit"* (De Vrieze quoting Latour, 2017: 159).

87 Nor have other strategies, such as the SDGs, unfortunately (see Biermann et al., 2022).

88 In this school of thought with its *"yes we can!" philosophy,* there was often not much reflection on the complexity of both societal challenges and intervention strategies.

89 In policy sciences, this came with the turn from the "makeable society" toward a governance philosophy embracing the "energetic society", which is a *"society of articulate citizens, with an unprecedented reaction speed, learning ability and creativity"* (PBL, 2011: 9).

lematic power relations, constraints on time and resources, *etcetera*) transdisciplinary experimentation has also not yet led to system-wide changes toward sustainability. In that light, it is important to realize that experimentation is only one mode of governance (with particular aims and strengths) in sustainability transitions. The field of transition studies points to the need to combine deliberative experimental approaches with broader (public) policy mixes (Kivimaa and Kern, 2016; Rogge and Reichardt, 2016); phase-out policies and deliberate destabilization (Rogge and Johnstone, 2017; Van Oers et al., 2021; Hebinck et al., 2022); and government interventions in setting directionalities for R&I on societal missions (Hekkert et al., 2020; Klerkx and Begemann, 2020) in efforts to combine enabling, systemic and structural approaches to transformation (Scoones et al., 2020).

However, there is room to better connect these experimental governance approaches (that embrace complexities) with strong government interventions that directly affect the political economy and deeper systemic structures. In this way, there might be opportunities for *Maakbaarheid 2.0*! One promising example is the EU Green Deal, which can be seen as an effort to strongarm incumbent fossil fuel regimes across Europe. At the same time, the challenges regarding its implementation stress why considering complexity, and its connection to experimental approaches remains crucial. Scholars have emphasized that the Green Deal is currently formulated rather 'top-down' from within incumbent neoliberal discourses, which might actually lead the Green Deal to "*only serve as a justification for EU Member States to delay implementing transformative climate policies and therefore perpetuate socioeconomic behaviors and institutional arrangements that are overly responsible for the climate crisis*" (Samper et al., 2017: 17). In addition, considering the implementation of the Farm to Fork and Biodiversity Strategies as part of the Green Deal, Candel (2022) argues that current policy impact assessment instruments are also still rooted in 'old ways' of (linear) economic thinking, meaning that they cannot accurately capture the transformative effects of complex policy implementation, which in turn gives rise to unjustified criticisms and political conflicts. Candel (2022: 298) concludes that *"for European society to accept and set in motion a genuine transition there may actually be a need for higher degrees of politicization, channeled through democratic institutions."* These considerations reinvigorate some of the notions presented in Chapter 4 on moving beyond the bottom-up and top-down dichotomies in governance efforts for agri-food transitions, as well as the need to rethink incumbent economic-growth oriented policy paradigms, and in Chapters 4 and 8 on further democratization and inclusion of stakeholders in locally implementing policy frameworks. As such, I would argue that there is a need for concentrated translocal interventions that have both an experimental character, as well as enough 'brute force' coupled to them as to structurally reconfigure incumbent power relations.

That requires new types of governance strategies that link innovation policies and experimentation through R&I projects to sectoral policy mixes; as well as link bottom-up democratization with institutionalizing efforts at aggregate governance levels, across the timespan of project lifetimes. Here lie opportunities for the implementation of the EU Green Deal, as well as for implementation of Mission-Oriented Innovation Systems (Hekkert et al., 2020) or Transformative Innovation Policies (Schot and Steinmueller, 2018: 1565) that urgently require *"not only a new framing but also begin[ning] to experiment with new policy practices"* (exactly something the FIT4FOOD2030 Policy Labs started working on, see e.g., Chapters 6-10). In short, there is no need for returning to the old *Maakbaarheid*. But we should be wary of considering experimentation as mode of governance as the *panacea*, for it might not always yield concrete results in complexity. Experimentation is needed to pave the way for building capacities (cf. Chapter 9) and legitimization (cf. Chapter 10) of large-scale policy interventions and policy instruments that more radically transform systemic structures.

Based on these considerations, let me briefly address the different transition patterns as identified within the complexity approach to transition studies (e.g., De Haan, 2010, van Raak, 2015; cf. Grin et al., 2010) as outlined in the introductory chapter. As we stressed in Chapter 3, mere *empowerment* of niches might not be sufficient because it fails to lead to required transformative powering processes due to deep systemic incumbencies in complexity. However, our arguments indicate that only formulating solutions from within regimes to *adapt* to emerging needs in niches is equally insufficient as it fails to radically alter the deeper systemic structures that perpetuate unsustainable and unjust dynamics (Chapter 4).[90] Similarly, while the transformative power of the *reconstellation* pattern might be considered promising, top-down interventions to trigger regime reconfigurations might not automatically lead to legitimate and deeply democratic implementation strategies, for which involvement of both niche and regime actors is considered key (Chapter 8). Therefore, perhaps a prudent *transition pathway* (as a combination of *transition patterns*) to aim for in the context of EU food system transformation would be creatively combining the opportunities different transition patterns bring along. Under landscape pressures and general directionalities set by the Green Deal, niche-regime

90 A brief reflection on the radicality of transitions in relation to Food and Nutrition Security (FNS): due to the central societal function of food systems and the dependence of (vulnerable) communities on its relative stable functioning, aiming to simply overthrow incumbent systems risking a state of functional collapse is of course undesirable. But do note that this is a completely different consideration than the false distinction that currently emerges in current EU debates, which suggests we face a stark choice between either sustainable food systems or (meat-based) FNS and which suggests environmental measures regarding agricultural production (such as the Farm to Fork Strategy) should be dismantled for the sake of FNS (see Pe'er et al., 2022). This false dichotomy is especially harmful as scholarship has stressed that we *need* radical transformation toward sustainable food systems precisely to ensure the (long-term) security delivery of healthy and nutritious foods (e.g., IPCC, 2019; Willett et al., 2019).

interactions can lead to regimes incorporating sustainable innovations developed in experimental contexts (such as in multi-stakeholder Labs) and tailored to local conditions and contexts. This requires reconfiguring underlying systemic structures and intent to ensure broader upscaling and implementation of inclusive social and policy innovations (cf. Geels and Schot, 2007). Further accelerating such transitional dynamics also requires the political will and support to implement the Green Deal on both Member State and EU levels, something which is often still lacking, suggesting signs of emerging backlash dynamics.

Future research directions:

1. Transition scholarship could further investigate the role of complexity thinking in policy implementation: does complex network governance lead to better (environmental, justice) outcomes of transition processes? Considering the urgency for sustainability transitions, does that mean that democratization of transition governance also leads to better outcomes (cf. Pickering et al., 2022)?
2. Further engagement from transition scholars with the EU Green Deal and the Farm to Fork strategy might help understand and guide questions regarding their implementation: how can urgency, democratic legitimacy and accountability be combined in implementation in ways that do justice to the complex interplay of actors, institutions and policy processes at play in different localities and administrative jurisdictions?
3. Both in-depth single case and cross-case analyses (historical or *ex-durante*) might provide insights into how transformative innovation policy practices can take shape, how they can be stimulated through for instance Policy Lab methodologies, and how they can support the development and implementation of Mission-oriented Innovation Systems (cf. Hekkert et al., 2020; Schot and Steinmueller, 2018).

11.2.3 Bridging gaps: Connecting systems, policies and scales

To govern complexity in light of urgency, Scoones et al. (2020) stress that there is a need to combine *structural approaches* (targeting systemic fundamental structures); *enabling approaches* (enhancing agency and developing capacities for change); as well as *systemic approaches* (targeting interconnections between institutions and networks). In the previous subsections, I have mostly framed the findings of this thesis in light of structural approaches (regarding the need to fundamentally confront structural incumbencies), enabling approaches (in light of the need to build agency and capacities for change) and to a limited degree, in light of systemic approaches (regarding governance directionalities and interactions between niches and regimes). Thus, let me further explicate some implications of the work of this thesis for implementation of *systemic ap-*

proaches, especially regarding the multi-system, multi-level and multi-scalar dynamics at play. In light of the need to further systemic approaches to governing transitions (in alignment with structural and enabling approaches), I believe that the work presented in this thesis illuminates several domains where *interconnections* of food systems could be better acknowledged, understood and fostered during (implementation of) governance interventions.

First, there is a need for better connecting multi-system interactions to foster food system transformation. Whereas this thesis explicitly considered the interactions between R&I systems and food systems (e.g., Chapters 5 and 6), food systems are strongly connected to a variety of other societal systems, such as energy systems, health systems and the bioeconomy (Hebinck et al., 2021a; Hassink et al., 2018). The observation that societal systems are coupled is emphasized in the literature on multi-regime interactions (e.g., Raven, 2007; Papachristos et al., 2013) as well as in emergent conceptualizations of Deep Transitions (Schot and Kanger, 2018). In Deep Transitions literature, it is argued that there are several meta-rules (such as globalization and a linear economy) that drive the dynamics of multiple (coupled) socio-technical systems, pointing to the need to address these deeply institutionalized rules (for instance, toward more localization and circular economies) in order to catalyze large-scale transformations. As we argued in Chapter 6, acting upon these multi-system interactions requires the development of boundary innovations that could spur cross-system transformative dynamics (cf. Raven and Verbong, 2009). In Chapter 5, we stressed that this also requires integrated policy efforts that move beyond sectoral silos such as agriculture, health and environment (cf. Hebinck et al., 2021b).

Second, and related, this begs the rapid implementation of integrated food policies in both national contexts as well as at local government levels (cf. Candel and Pereira, 2017). Here lie opportunities for learning, legitimizing and scaling through translocal networks, as our findings in Chapter 10 indicate that it is valuable (and challenging) to catalyze translocal dynamics across governance levels, and between national contexts. At the same time, our suggestions in Chapter 4 to move beyond growth-oriented and anthropocentric governance paradigms, also imply significantly rethinking the current EU Common Agricultural Policy (CAP), as scholars have suggested that precisely the interrelations within food systems, as well as couplings to other systems, necessitate developing a Common Food Policy (De Schutter et al., 2020) that moves beyond the sole focus on agricultural production.[91] As such, there is an urgent need to more effectively link policies not only between different sectors, but also between multiple governance levels, for instance in connecting local government interventions to national policies and international strategies (such as the EU Farm to Fork Strategy). Regarding the institutional interplay in multi-level governance settings (such as within the EU), this also entails aligning expectations and responsibilities on which governments (local, national, EU) are to design and implement specific types of policy instruments so that they align rather than conflict.

Third, governance interventions could more actively acknowledge and address interconnections between space and scale. There are (at least) two reasons why this focus is prudent. As we stressed in Chapter 10, embracing the multi-scalar nature of governance interventions could support the emergence of transformative translocal dynamics in multiple spatial contexts simultaneously, for instance by stimulating deep connections between (policy) experimentation processes in different countries or regions. It also begs reflection on how they relate to other existing policies already in place in different localities (e.g., Moragues-Faus et al., 2017). Governance interventions could actively connect different governance levels, as localized (spatial) contexts are often also dispersed across governance levels (for instance, two cities having different local governments, different socio-ecological contexts, and being spatially separated, but with national government programs on food 'hitting the ground' simultaneously in both cities). As we argued in Chapters 8 and 10, that requires, arguably, overarching programs that have capacities to connect across scales by being sensitive to contextual differences in localities, but, paradoxically, being uniform and coherent enough to effectively catalyze common and *desirable* directionalities toward sustainability. This relates, second, to considering the (unintended) undesirable effects that governance efforts might bring along across scales. In Chapter 4 we explicated that the global interconnectedness of food systems, and the food system dynamics across scales, beg considerations of how (the absence of) governance interventions reinforce(s) translocal dynamics of injustice across space and scale. This presents policy makers with the challenging task of implementing policies that mitigate injustices that find their origin at scales or spatial contexts beyond their span of control. It also requires governance interventions to be cognizant of their effects and impacts across their own political-administrative borders, and thus seemingly

91 Regarding policy integration beyond sectoral silos, it is surprising that the EC has organized most of its budget regarding food-oriented policies in the CAP (embedded in DG AGRI) while the sustainability targets regarding food are embedded within the Farm to Fork Strategy that is coordinated through the DG SANTE. Especially as the Horizon Europe R&I funding calls through the DG RTD aim for multi-stakeholder engagement and cross-sectoral collaborations to support the implementation of Farm to Fork, and considering the historical tensions between the different Directorate-Generals, surely, there might be more effective ways for coordination? For reflections see also Schebesta and Candel (2020).

beyond their (localized) span of accountability. Therefore, taking a *systemic* approach to food system transitions also means acknowledging the different interconnections that governance efforts have beyond the jurisdiction of the interventions themselves.

Taking these notion together with our empirical work in Chapters 8, 9 and 10, I believe this illustrates why interventions through large-scale multi-sited transition projects such as FIT4FOOD2030 can both work as 'the way forward' and, paradoxically, why they struggle. They work, because these governance instruments are key in connecting actors, networks and institutions across space, scale and governance levels, enabling the emergence of (some degrees of) translocal, cross-system and multi-level dynamics that could be transformative in nature. They struggle, because due to the *fragmentation of focus* (or: a diminished *span of control*) these interventions bring along, their actions, accountabilities and responsibilities become dispersed across different levels, scales and systems. This could affect the ability of these projects to create structural localized impacts. Hence, due to their ambitions for catalyzing translocal dynamics, these programs would require significantly more resources than localized projects as they require iterative and intensified coordination efforts. In addition, in order for such systemic approaches to be successful in connecting systems, scales and levels, it might indeed be pertinent to combine them with structural and enabling approaches (Scoones et al., 2020), in order to build capacities for engaging in *connective* activities across space and scale, and to make sure they can lead to tangible outcomes that address underlying structures (leading to a enhanced *span of connectivity*).

Future research directions:

1. These considerations provide entry points for transition scholarship to further interrogate the effectiveness and legitimacy of (future) multi-level policy mixes aimed at destabilizing incumbent food regimes, and fostering transitional dynamics toward healthier and sustainable system states (e.g., Kaljonen et al., 2021; Van Oers et al., 2021, cf. Rogge and Reichardt, 2016; Kivimaa and Kern, 2016).
2. Future research could learn from cross-case successes and failures regarding translocal experimentation, which might help clarify local system dynamics through comparison with other contexts, as well as help diffuse transformative innovations (cf. Avelino et al., 2020; Loorbach et al., 2020). This might open up pathways to engage with importantly needed inquiries into agri-food dynamics and transition pathways in low- and middle income countries (Hebinck et al., 2021a).
3. Regarding food systems, further inquiries are needed not only to understand how diversified food systems themselves are interconnected across space and scale (Hebinck et al., 2021a; Boillat et al., 2020), but also to understand how the effects of interventions across scale and space can be 'measured', 'known' or otherwise made tangible, and how accountabilities for (absence of) interventions beyond direct spatial jurisdictions can be understood and acted upon. Promising in this regard could be for transition scholarship to more thoroughly engage with literature on global earth system governance (with an important role for international treaties and multi-stakeholder partnerships, see e.g., Pattberg and Widerberg, 2016; Biermann et al., 2012), especially in relation to how accountability and legitimacy can be strengthened (Biermann and Gupta, 2011).
4. Further inquiries into how cross-scale, multi-sited and multi-level interventions can be designed, implemented and supported, as well as investigating when and how the '*span of connectivity*' starts to impede the '*span of control*', might help catalyze transformative governance. Importantly, the democratic legitimacy of multi-sited interventions that cross political-administrative borders deserves further attention, in line with calls to further challenge the democratic legitimacy of transition governance strategies (De Geus et al., 2022; Hendriks, 2009).

11.2.4 A promise in tatters? Re-tracing the non-humans

Let me turn the gaze toward a completely different topic. A critical reader might wonder where the non-humans and their so-called 'politics' have gone in the empirical elaboration (Part IV) of the thesis, after receiving such laudable attention in the theoretical exploration (Part II)? Well, I believe they were in fact among us! Let me therefore articulate the ways in which the non-humans have been present in our inquiries into the governance and politics of transdisciplinary experimentation, and elaborate some implications for future research and governance.

Adopting a non-hierarchical understanding of resources and a more symmetrical understanding of structural and agentic components in complexity regarding their ontology, has influenced conceptualizations throughout the empirical work. For instance, in Chapter 8 we have highlighted the role of structural contexts (e.g., project targets) and technologies (e.g. digital workshops during the pandemic) in contributing to powering effects that drive exclusion and inclusion dynamics in transdisciplinary Labs. In addition, by advancing an understanding of non-humans and humans as being entangled in complex networks (or: configurations) that could have *collective agency*, beyond the mere sum of agencies of individual humans part of those networks, allowed us to confidently conceptualize the agency of Labs as 'units of analysis' in Chapter 9. This is important given the heterogeneous nature of 'being a Lab', that comprises not only the human stakeholders joining Labs, but also their socio-cultural and organizational contexts in which they are embedded, the (socio-material) tools and methods they use in their activities, their material-geographical contexts that shaped the types of activities they deployed, but also their visions and experimentation processes. As such, the collective agency of such a Lab (as their capacity to create change) can perhaps better be grasped by a broader consideration of agency. Then, and in line with these notions and by drawing on socio-material scholarship and studies on the geography of transitions, in Chapter 10 we considered the role of local geographical and socio-political contexts as shaping pathways for experimentation processes (exerting structural powering dynamics) such as providing enabling or constraining pathways for particular directionalities or legitimacy building, giving rise to the variety of experimentation pathways in translocal programs. In addition, we framed an important element of experimentation regarding mobilizing actor networks as well as resources in a rather symmetrical way, pointing again to the importance of non-human factors in building capacities for change. At the same time, as we also stressed in Chapters 5 and 6, it is precisely the socio-material structures of incumbent R&I systems that hinder the further uptake and institutionalization of transdisciplinary R&I. The FIT4FOOD2030 project can, from that perspective, be seen as an attempt to reorient (socio-material) constitutive powering processes of incumbent systems.

At the same time, I acknowledge, the non-humans were often absent in our empirical explorations, which I believe does not stand in contrast with the arguments provided in Part II. Let me try to explain that. First, it is worth emphasizing that in Chapter 3, in addition to clarifying the relational nature of power, the relation between power and agency in complexity, and by further conceptualizing processes of powering in relation to transformative change, we advocated for a more symmetrical consideration of humans and non-humans in complex networks. This has implications for how they can (or cannot) have agency and engage in power relations. What we *did not argue* is that non-humans automatically have agency by themselves.[92] We also *did not propose* that non-humans are necessarily the protagonists in stories of the politics of transformation.[93] Therefore, our empirical explorations in the context of EU projects (containing a large number of human protagonists) do not solely focus on the role of non-human components in the dynamics of transdisciplinary experimentation. Rather, as I have stressed above, we emphasized instances where they did contribute crucially. In Chapter 4, which was written after the FIT4FOOD2030 project ended and for which thoughts on the EU R&I context served as inspiration for my contributions, we argued that one of the core problems in governance (including policy making contexts) is that non-human interests (mostly those of nature and ecologies) are not properly taken into account due to the deeply rooted anthropocentric governance paradigms. As such, the lack of engagement with the natural world in transition governance and transdisciplinary experimentation (and thus: the absence of the non-humans therein) formed a key rationale for developing that chapter. In addition, an interesting dynamic relates to the structuring nature of socio-material networks such as project configurations (i.a., project proposals and funding structures) as well as the role of geographical scales in driving (that is: exercising power over) the empirical case. To be frank: for my empirical work I was trapped in the project case. Of course, I did choose where to focus my work on within that confinement. Yet, there is a path dependence in how project planning influences the degrees of freedom in project practice[94] (see also Gjefsen et al., *forthcoming*; or Fritz and Binder, 2020 on structural power in transdisciplinary projects). This is one reason why we still had to deal with the empirical case that was 'given' to us, with its focus on building stakeholder networks of actors in EU food systems, rather than for instance exploring lines of research where a particular non-human (material artifact, ecology or otherwise) was the protagonist. So again, their absence seems to emphasize their presence after all.

Yet, of course there lie challenges, as well as opportunities for future research endeavors ahead. As we also reflected upon in Chapter 4, involving non-humans in democratization efforts for food system transformation is not only something that could enhance representation of the interests of nature, it is also notoriously difficult. It would put forth an extra responsibility for those designing and implementing transdisciplinary R&I or transition governance. Yet, we also pointed to several promising examples, for instance

92 In fact, we criticized ANT for deploying too flat ontologies regarding politics.

93 Though sometimes they can be! See for instance Contesse et al. (2021).

94 In the jargon of Chapter 3: once established socio-material project configurations structure the agency of actors involved. That is: they exercise power!

including representatives of nature, institutionalizing rights of nature, connecting policy silos on environment, health, agriculture and economy through integrated food policies, or by explicitly considering nature's (and other non-humans') perspectives during experimentation in Labs.

Future research directions:

1. Future research could more explicitly and empirically engage with the theoretical notions presented in Chapters 3 and 4. This might help falsify or support the takes we presented on the politics of transitions, most notably regarding the role of non-humans in the politics of transitions, their (projected) agency or engagement in power dynamics, across different empirical contexts and systems.
2. The challenges in moving beyond anthropocentrism in transdisciplinarity and transition governance beg us to find *creative* ways to involve the non-humans. Here lie opportunities for future experimentation endeavors, especially in light of the increasing focus on nature-based solutions in academic and (EU) policy circles (Faivre et al., 2017; Maes and Jacobs, 2017; Anderson et al., 2019). Transition scholarship could more thoroughly consider how to actively engage non-humans in transition experiments, and how to account for their representation in transition governance in practice.
3. Western transition scholars may benefit from engaging (empowering, respectfully and transparently) with important insights from non-Western and Indigenous communities and scholarship (Ghosh et al., 2021), also regarding the role of non-humans in transformative change, the entanglement of the human and natural worlds (cf. De la Cadena, 2010), and emerging insights on topics such as multi-species justice (Celermajer et al., 2021).

11.2.5 Transforming ourselves: Ideality, transdisciplinarity and universities

As a final cross-cutting theme, let me draw attention to ourselves as transdisciplinary researchers: how does the way we conduct transdisciplinarity in practice relate to ideal-type interpretations? And how can we build supportive and empathic academic systems that embrace the uncertain, fuzzy and intense practice of transdisciplinary?

As we argued, transdisciplinary practice is inherently fuzzy and there is a variety of interlinked barriers to doing transdisciplinary research aimed at transformation (see Chapters 5 and 6). At the same time, scholars often emphasize ideal-theoretical and aspirational dimensions, priorities, guidelines, frameworks and principles of transdisciplinarity (for reflections see Regeer et al., *forthcoming*). As I have stressed multiple times in this thesis, developing guidelines, frameworks and theorizing transdisciplinarity is an important and valuable endeavor. However, taking aspirational perspectives emphasizing ‘ideal transdisciplinarity’ might risk the invoking of platitudes (of which, occasionally throughout this thesis, I myself am equally guilty) such as stressing the need for ‘involving all stakeholders’, ‘continuous reflection’, ‘considering all (relevant)[95] perspectives’, ‘taking into account all elements of the system’, ‘adopting different roles’. This is problematic, because in practice we simply cannot do all these things, let alone at the same time. In Chapter 8 we emphasized that transdisciplinary processes with their highly uncertain and unpredictable dynamics, often in projects with (too) limited time and resources, beg us to make stark choices to simplify the diversities of reality and in order to steer toward particular directionalities, and not toward others.

Another related consideration concerns the ambitions that we put forward in transdisciplinarity, taking into account the fuzzy practice. How ‘well’ do we need to do? How transformative, how empowering, how inclusive? In Chapter 4, for instance, we problematize the question of whether it is enough if our endeavors make transition processes a little bit more just? As we illustrated in empirical chapters, these challenges were prevalent in FIT4FOOD2030. Though justice considerations were only implicitly addressed in the project, ensuring procedural and recognition justice through participation of a wide variety of stakeholders, and by opening up appraisal in R&I processes (cf. Stirling, 2008) were key rationales underpinning the project.

Given the many diversities and choices presented to us during transdisciplinary processes, I argue it is not surprising, and at the same time perfectly okay, to be overwhelmed as a transdisciplinary researcher (such as myself). The question then emerges: how can we foster transdisciplinary capacities that help us navigate this overwhelming practice while still doing justice to our ideas about ideality? Here, there lie responsibilities beyond individual researchers, in order to take pressure (and responsibility) away from individual researchers or (underfunded) projects to ‘change the whole world’ for the better of ‘everyone’. I contend it is valuable to support efforts to develop the required *phronèsis* (cf. Loeber, 2003) on the know-how of transdisciplinarity, and to ensure that the competence building that is required to navigate transdisciplinary work (cf. Wiek et al., 2011) becomes more structurally embedded in (education and broader training within) universities (e.g., Tijsma et al., 2020; Baker-Shelley et al., 2017). Such ambitions run parallel with the further mainstreaming of transdisciplinary R&I (cf. Jahn et al., 2012). To accommodate transdisciplinary ways of working throughout R&I systems, and universities within them, there is work to be done on transforming universities themselves in order for them to more effectively contribute to sustainable transformation

95 But, who is to decide what is considered relevant? This challenge is also discussed in Chapter 8.

(e.g., Baker-Shelley et al., 2017, Chapter 6). This also requires enabling and building new institutions at global scales to facilitate the advancement of transdisciplinary and transformative sustainability science (Van der Hel, 2020).

Taking a slight turn and narrowing our focus from R&I systems to universities, there is a related set of arguments that call for transforming universities that I do not wish to leave undiscussed. This set is strongly related to justice considerations and values such as inclusion and empathy and revolves around the question: How well are our universities functioning in general? Of course, they have been highly successful in providing societies with relevant knowledge and innovations, and surely, there are greater injustices to be found around the world than the potential malfunctioning of (elements of) universities. But are we really to take it for granted that extreme publication pressures and competition for funding overshadow important academic qualities such as community engagement, science communication and mentorship (Davies et al., 2021) and provide incentives for research misconduct and predatory publishing (Hall and Martin, 2019; Bagues et al., 2019)? And how *socially just* are universities that are structurally biased against women and minorities (e.g., Malish et al., 2020) and where scholars and perspectives from the Global South are strongly underrepresented (e.g., Demeter, 2020; Ghosh et al., 2021)? How healthy is working at a university, if 47% of PhD students experiences psychological distress and 39% of PhD students show *severe symptoms of burn-out* (in the Netherlands, according to Mattijssen et al., 2020)? It is not surprising that the importance of collective self-care in (sustainability) science is emphasized (Sellberg et al., 2021) and that academics increasingly call for fundamentally different reward and recognition systems (see e.g., Dijstelbloem et al., 2013[96]; Swider-Cios et al., 2021).

Reflexively re-evaluating our own roles as academics (see Wittmayer and Schäpke, 2014), particularly in relation to the systems we are part of could advance debates on the future of our universities. As transdisciplinary transition scholars we are well positioned to further explore challenges our academies face, and take the lead in enacting transitions toward sustainable universities. Sometimes clichés hold some truth: a better world might in fact start with ourselves.

96 Dijstelbloem and colleagues are founders of the Dutch movement “Science in Transition” which aims to radically transform Dutch academic systems.

Future research directions:

1. Future research could conduct cross-case and in-depth analyses of how transdisciplinary design and evaluation frameworks, guidelines and principles shape project practice (cf. Fritz and Binder, 2020). This might help to design 'designs' that provide just enough structure to transdisciplinary processes, as well as help capacity building programs that foster transdisciplinary competencies as well as 'know-how'. This can also help to identify experiences of transdisciplinary researchers and the different tensions they experience in doing their 'transdisciplinary practice' (cf. Felt et al., 2016).
2. Transition scholarship could further explore the (context-specific) challenges that universities face as well as unravel how material, economic, socio-cultural and political factors drive co-evolutionary and multi-level dynamics that stabilize incumbencies (see e.g., Schneidewind and Augenstein, 2012). Both single-case and comparative analyses (at different scales; including institutions, research fields and countries) can help explain how power relations reinforce locked-in configurations that hinder the uptake of transformative sustainability science (see Lahsen & Turnhout, 2021), identify promising examples that counter '*publish or perish*' regimes, provide insights on how such initiatives could be scaled, and help understand which policy instruments can effectively catalyze transformation of universities.
3. In addition, scholars could initiate transformative action by developing visions of and pathways toward future universities that are (environmental and social) sustainable (e.g., Baker-Shelley et al., 2017; Fazey et al., 2020), designing transition (policy) experiments (cf. Sengers et al., 2019) and developing transition arenas at universities (see Evans et al. (2015) on University Living Labs). These multi-stakeholder initiatives could experiment with new forms of (deliberative) academic governance, reward systems and funding mechanisms. Such self-reflective engagement also relates to recent scholarship on creating transformative change from *within regimes* (Grin, 2020). This might help institutionalize responsible and inclusive academic practices across disciplines and institutions and help favor transdisciplinary practices.

11.3 CLARIFYING CONCEPTUAL CHOICES

In this section, I identify several conceptual challenges, and I reflect on the different choices that were made to confront these challenges, in adhering to particular concepts, and not others, in particular places in the thesis.

First, the thesis is article based, which means that the concepts used in the thesis are the ones used in the particular article that thesis chapters build on. Hence, the choices made in a chapter were mostly made wearing ‘journal’-glasses, not necessarily ‘thesis’-glasses. This gaze might prioritize within-chapter coherence in alignment with framing within specific scientific debates for the sake of contributing to specific academic debates in scientific journals, rather than the between-chapter coherence for the sake of publishing a thesis. Second, many concepts are rather fuzzy, have many different meanings and are often used interchangeably in literature. An interesting example of this (on which I already reflected in the introduction chapter, due to its centrality in the rationale behind the thesis) is the difference, or the absence of difference between, the concepts *transformation* and *transition*. For a comprehensive and insightful discussion on that matter, I kindly refer to Hölscher et al. (2018). However, as sustainability science is an evolving domain, in particular also regarding transdisciplinarity and transition studies as emerging research fields, coherent sets of methodological and conceptual considerations are yet to be further developed (see e.g., Brandt et al., 2013; Köhler et al., 2019). Third, and though perhaps not as solid an argument as one would want it to be, as I indicated in the very beginning (in Part I already), this thesis is not only a collection of articles, but also represents a learning journey, in the context of a rapidly advancing field. Therefore, in more recent work I might have used slightly different terms, placed different emphases, or have engaged more with particular streams of thought than with others.

As a result, though I have used different concepts coherently within chapters, I have sometimes used them interchangeably between chapters. This might suggest an air of nonchalance, which I contend is not the case! Rather, for each separate chapter (or: contribution) and in consultation with co-authors, we have adopted terminologies we felt fitted best with, and did justice to (1) the empirical context at hand; (2) the other (theoretical) concepts invoked in the contribution; (3) the particular (scientific) discourses or debates we aimed to contribute to, also in relation to; (4) the common ways of phrasing and reasoning in the journal we were submitting the specific paper to; and importantly (5) optimizing the clarity, coherence, conciseness and elegance of the arguments we aimed to bring across. In other words: weighing the different arguments above led to different outcomes in used ‘concepts’ in different chapters. Below, I sketch the choices we made regarding concepts, in response to some of the confusions that emerged.

11.3.1 Lost in initiatives

In this thesis, we have used concepts referring to particular sustainability initiatives that share some similarities and can be connected to each other in particular ways, yet can also be used and connected rather differently. This refers, i.a., to the terms ‘Lab’, ‘experiment', 'project' and 'program'. For instance, in most chapters we refer to FIT4FOOD2030 as a *project*. This does justice to the empirical context as it fits with the classification that was used by the funder (the EC through H2020 funding schemes), hence it was the term used by project partners. However, readers might have noticed that in Chapter 10, we refer to FIT4FOOD2030 as a 'multi-sited transition *program*'. As we stress in that chapter, we believe that when considering FIT4FOOD2030 as an effort to govern multiple connected, yet distinct, experiments (in the form of Labs) that at the same time need to be coherently brought together under one umbrella, this might actually be considered a program. Hence, in empirical reality the governance instruments such as FIT4FOOD2030 might not perfectly fit existing conceptual categories (e.g., project, program, network), and with the proper argumentation, can often be considered from multiple perspectives. Another example: note that we consider Labs and experiments to be of similar substance in this regard, whereas in other instances we have argued that it is also valid to consider that Labs *conduct* experiments. Both can be seen as different perspectives on the same type of dynamics, again depending on the weighing of the different arguments for deploying specific terminologies as presented above. Hence, throughout the thesis these slightly different demarcations were based on weighing the different arguments as sketched above for each individual contributing chapter.

11.3.2 Lost in Labs

Another challenging demarcation we often encountered was classifying the FIT-4FOOD2030 Labs. Were they Living Labs? Or rather, Real-World Labs, Transition Labs, Transformation Labs, or something else? Were they perhaps 'simply' Policy Labs, City Labs and Food Labs, the labels the project had invented for them?

While literature argues that there are many different types of Labs (McCrory et al., 2020; 2022; Hossain et al. 2019), it was difficult to pinpoint a common typology regarding the nature of the FIT4FOOD2030 Labs, as their diversity was incredibly large: they had different objectives, different journeys, different types of stakeholder engagement, and were all embedded in different organizations at different governance levels. In one of the (policy) publications authored jointly with the European Commission (EC, 2021) we refer to them as Living Labs, after weighing the rationales as outlined above, where the rationale for contributing to specific discourses (the one on Living Labs as instruments to catalyze change, which is surging in EU discourses and funding schemes) was given significant weight in this instance. At the same time, not all Lab coordinators and partners felt comfortable with the term Living Lab, as it would push their activities into a rather particular frame, and as it might have suggested that they were merely 'testing innovations'. The latter concern potentially originates from early understandings on Living Labs as spaces for 'user engagement' for prototyping and assessing the social desirability of technological innovations as 'solutions' (Almirall et al., 2008). Other labels however, also do not automatically fit. The label Transition Lab, for example, might suggest that the Labs had the (rather challenging) task of bringing about large-scale systemic transitions, while the project only lasted for three years and resources were limited, which required thinking carefully about the 'impacts' Labs could bring along (as we analyzed in Chapter 9). Therefore, as to avoid restricting or pushing Labs, in other work and chapters in this thesis, we usually indicate that the FIT4FOOD2030 Labs build on, or relate to, conceptualizations of Lab approaches *such as* Living Labs or other types of Labs. We also often mention that they were multi-stakeholder Labs (a label which is descriptive and non-restrictive); or transition- or transformation-oriented (a label which is ambitious, but also rather realistic). Again, a tricky balancing act.

11.4 TRAPPED IN LOGICS?: ACTION-RESEARCH IN ACTION!

Finally, let me offer some reflections on my own roles and experiences in the research presented in this thesis. Though I already presented some reflections regarding these issues in Chapter 2, there is another perspective I believe is worthy of some more elaboration. My discovery of this perspective finds its origin in considering this thesis, and in particular the project-oriented research that forms its empirical core, as science in action (Latour, 1987). Or rather, as *action-research in action*! Researchers in transdisciplinary efforts take on many different roles in their work: facilitating interactions, building capacities, performing more traditional research, managing projects, monitoring project work, trying to integrate knowledge, aspiring to be 'change agents', *etcetera*. These roles are manifold and can often be conflicting in practice (see e.g., Wittmayer and Schäpke, 2014; Bulten et al., 2021; Schuijer et al., 2021; Verwoerd et al., 2020). An overview containing a typology of different roles is presented in Table 11.1.

Bulten et al. (2021: 1269) indicate that these challenges arise due to a variety of reasons, such as *"(1) researchers' self-perception and expectations; (2) expectations from transdisciplinary partners, funders and researchers' home institutions; and (3) societal convictions about what scientific knowledge is and how it should be developed."* These are important considerations, and they suggest something more fundamental about why combining different transdisciplinary *action-science* roles might be difficult: there seem to be different sets of structuring elements at play that guide actors' ability to perform particular roles in specific contexts. As a researcher working on the crossroad between academic and societal realms, in trying to contribute to food system transformation by engaging with different stakeholders, I was often confronted with different and conflicting *logics* (including associated cultures, practices, (incentive) structures) that differed greatly between the academic and societal realms. As transdisciplinary researcher, I had to find ways to reconcile these realms, in a way that did justice to the different *logics* at work at the boundaries between academic systems and the societal systems I was engaged in.

Table 11.1 | A brief overview of the different roles and description of examples of role-related activities. This demarcation was developed by synthesizing insights from Wittmayer and Schäpke (2014), Bulten et al. (2021), Schuijer et al. (2021), Verwoerd et al. (2020) as well as our own insights from the FIT4FOOD2030 project.

Role	Description of examples of role-related activities
researcher	conducting research activities (such as data analysis and writing scientific articles or reports); providing scientific advice to policy makers; reflecting upon own role(s) and positionality (cf. the *reflexive scientist*)
monitor (or *evaluator*)	monitoring and evaluating project progress and activities; reporting and reflecting on project progress based on project targets; reflexively intervening based on (*ex-durante* or learning) evaluation processes
change agent	actively intervening and participating in processes of transformation; advocating strongly for creating radical change
facilitator	enhancing, facilitating and supporting learning, reflection and dialogue; aiding the integration of different values and perspectives
capacity builder	building networks and supporting competence development, empowerment and learning as part of capacity building, for instance through training sessions, workshops or other engagements
knowledge broker	linking, integrating and synthesizing different types of scientific and societal knowledge, together with different project partners and stakeholders
project worker	designing, implementing and executing project tasks, such as writing documents; organizing workshops and meetings; delivering project targets
project leader	leading project design and implementation; aligning and coordinating project partners and activities; managing potential conflicts and crises; leading engagements with the world 'outside of the project'

The literature on (institutional) logics is gaining more prominence in the field of transition studies (see e.g., Fuenfschilling and Truffer, 2014). Fuenfschilling and Truffer connect the multi-level perspective, notably the concept of regimes, to institutional logics as the *"deep-structural rules that coordinate and guide actor's perceptions and actions"* (Geels, 2012). They state adopting an (institutional) logic perspective might help to understand *"that institutions regularize behavior, but at the same time enable agency and change"* (Fuenfschilling and Truffer, 2014: 775). In this view, it provides an embedded interpretation of agency, whereby *"actors are constrained, but also enabled by institutional structures, which, in return, are socially constructed by them" (*Fuenfschilling and Truffer, 2014: 776). Such a take aligns with a take on embedded agency as a capacity of actors to be engaged in processes of reorientation, and structures as those conditions structuring that agency (Chapter 3). The concept of "logic" can then also be reconsidered as a set of structuring elements in which agents are embedded that forms conditions for agency. In boundary work, such as is the case for transdisciplinary action-science (for instance at the boundaries of R&I systems and food systems) this means that actors engaged across the boundaries experience different logics (Chapter 6). In other words, logics might give rise to multiple roles being performed in and across different systems, with different challenges associated with performing them. A schematic illustration of how logics can structure agency (the capacity for reorientation) of agents who are encapsulated by the logics is presented in Figure 11.1.

When reconsidering and reflecting upon my work in the FIT4FOOD2030 project, I have identified five different "logics" at play. This sometimes led to tensions as the logics involved different value systems, incentive structures, institutional routines and (normative) assessments of when one does things "good". To a certain degree, these logics structured thus my agency (and actions) throughout the project. They often overlapped and led to confusion on what roles to adopt in which situations. Let me briefly introduce these logics and the specific roles I found them to stimulate:

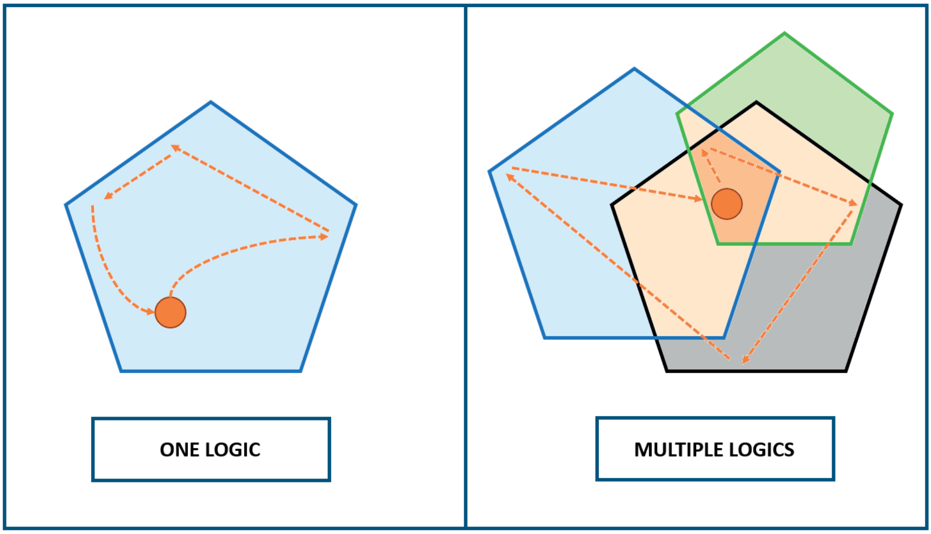


Figure 11.1 | Schematic depiction of how logics (*depicted as pentagons*) can structure the pathways for reorientation (*orange dotted lines*) of agents (*orange circle*), and what this might entail for the amount of *capacity* for reorientation pathways it brings along (reflecting agency, *colored planes*). When agents are engaged in multiple logics (as is often the case in transdisciplinarity) this could bring along a dynamic of multi-logic structuration, where agents need to strategically combine and draw upon different logics.

1. Societal impact logic – the "change agent" and the "facilitator"

Crucial in transdisciplinarity is the 'societal impact' logic. FIT4FOOD2030 was a CSA project, which meant that the project *implemented* the FOOD 2030 policy framework of the EC. Through the 25 Labs and the project activities, we tried to create impact and transform R&I systems in Europe. This required the project to be sensitive to not only needs of the project and funders, but also the needs of the stakeholders that were engaging in the project. It requires breaking open formalized project plans based on emerging needs, trying to move beyond ‘key performance indicators’ to do what is ‘right’ or ‘impactful’, and adapting project activities to different (local) contexts, which stands in stark contrast to the project execution logic (see below). This logic stresses values such as ‘learning’, ‘reflection’, ‘adaptation’, ‘emergent design’ and ‘impact’. In this light, the societal impact logic stimulates roles such as the change agent, but also roles that enhance and support experimentation processes, such as the facilitator.

One could argue that in transdisciplinary research, the societal impact logic should be the most important logic. At the same time, however, I observed that other ‘logics’ were interfering with this societal impact logic, and which each other. These logics are described below.

2. Academic logic – the “researcher”

The academic logic building on notions of “traditional research” means that as a junior researcher I engaged in processes of doing research: engaging with theory, plan data collection, collect data (interviews, focus groups), analyze data, write up and publish in peer-reviewed journals. This logic values *academic* and traditional scientific values such as ‘thorough investigation’, ‘emphasizing uncertainty’ and ‘contemplating findings’, but also stimulates getting scientific work published, meaning core activities in this logic are directed at doing exactly that. This logic thus values to more traditional as well as rather reflective researcher roles.

3. Project logic – the “project worker” and the “monitor”

Third, the project logic involves executing the project tasks according to the project proposal that has been formulated in the beginning, and based on what the funders as “clients” wish to get out of the project. It includes tasks like sending emails, organizing meetings, getting non-scientific deliverables done, and executing tasks in the project proposal of the project. The (quantifiable) results of the project needed to be relevant to the European Commission. Values include ‘efficiency’, ‘ticking the boxes’, ‘accountability’, ‘policy relevance’. This logic stimulated us to stay *in sync* with the policy and project cycles of the EC, which could require quick delivery of policy relevant results. Time is scarce, and in-depth scientific rigor and emphasis on uncertainty are not desired, which conflicts with the academic logic. At the same time, this project logic also valued our (project-oriented) monitoring and evaluation efforts as they might help to enforce accountability and were explicitly embedded in project design. Therefore, roles such as project worker and monitor fitted well with this logic.

4. Coordination logic – the "project leader"

Another logic I experienced, finds its origin in the fact that I was working at the coordinating institution of a complex project. This coordination logic manifested itself due to the complex coordination challenges involved, which meant that we were often working as a crisis manager, hopping from project-crisis to project-crisis. Solving each crisis required a considerable amount of time, energy and resources, which meant that the other logics temporarily moved to the background (causing delays in other places, that in turn might grow out to new crises…). Values involved here are 'flexibility', 'authority', 'getting things done' and a certain degree of 'toughness'. The coordination logic brings along different responsibilities than in the role of project worker. Therefore, this logic required our team to adopt a project leader role.

5. Polis logic – the "(knowledge) broker" and the "capacity builder"

Being one of the 'spiders in the web' of the coordinating institution of a large consortium with 16 partner organizations and 25 Labs (meaning: dozens of actors with different backgrounds and interests) another logic refers to managing this "*polis*". This logic is built on our capacity to understand and address (political) conflicts, balancing different interests in the consortium and being highly sensitive to (developing) personal relations. The act of "doing such a consortium" could be considered a *praxis* in which a plurality of perspectives, interests and experiences and power relations shape the outcomes of the interactions (cf. Turnhout et al., 2020; De Vries, 2007). This also acknowledges that actors in the process also represent, or experience, different logics rooted in their own institutions, organizations or contexts that they bring along when they 'enter' the political life of the project (cf. Regeer, 2009). Building on De Vries' (2007) considerations of an Aristotelian conception of (Greek) political life, we might refer to this logic as the logic of the "polis". In this logic, the project was a mini-society, and we had to invest in personal relations and efforts to keep morale and motivation high. This logic then emphasizes and values 'pluralities of perspectives', 'inclusion', 'politics', 'empathy', 'conflict resolution', 'sensitivity' and 'shared understanding'. Such a logic fitted well with for instance the role of knowledge broker (and actually, brokerage activities more broadly, perhaps also a power broker role?) and roles that stimulate capacity building among participating actors.

Dealing with multiple logics, and multiple roles

As I briefly mentioned, in practice these logics overlap, because if you are doing action-research in action you can find yourself trapped in multiple of these logics simultaneously. Logics are not static. They change over time, and how I experienced them also changed over time, depending on project or research phases, the people you work with, and the degrees in which one manages to deal with the logics at play.

I clearly remember one particular workpackage meeting in Brussels. As a team of about 10-15 people from different countries and types of organizations (academia, industry, innovation networks, science communication) we were trying to figure out what was 'expected from us' with regard to identifying drivers and barriers to potential R&I breakthroughs. In other words: we were trying to figure out what the project proposal had in mind for us. This was not entirely clear because the proposal had been written ages ago, and the situation had changed by then. During the meeting, everyone's face was deeply buried in the *Description of Action (DoA*), also referred to as *The Bible*, and they were all pondering how to interpret this mysterious scripture. Because I was working at the coordinating institution, I also felt that all eyes were directed at me whenever this scripture was not immediately clear on what to do, as if I would be able to provide guidance! Here of course, is where the different logics emerged. We were trying to follow the *project logic*, which meant we needed the DoA to tell us which boxes the project wanted us to tick. This stood in contrast with our need to engage with the *societal impact logic*, through which we hoped to see 'space' in the DoA to interpret it in such a way that we could re-design activities for the needs of our associated networks, the EC and (Lab) stakeholders. At the same time, conflicting interpretations of the DoA found their origin in the different logics and associated interests of the organizations that we were all working in. That also required me, as a representative of the coordinating institution, to live by the *polis* logic and to mitigate any conflicts that emerged to make sure that at the end of the day, we were all on board in our shared political life; as well as to live by the *coordination logic*, which meant that if a crisis emerged on the meaning of the DoA, I had to manage it (within my mandate of course) as well as I could.

One way of dealing with these multiple logics is through stimulating capacity building that allows researchers and other stakeholders engaged in transdisciplinary projects to better navigate different logics, to find synergies between them, and to mitigate potential trade-offs. This might help to perform different roles in transdisciplinary research more easily. However, given these considerations regarding logics' structuring working, it also becomes evident why there is a need to construct (and collectively build) new logics and broaden incumbent logics in scientific systems that support, rather than hinder, the uptake of transdisciplinary action-science. Looking back at Figure 11.1, ideally, not only would the orange dots (us!) then be able to 'hop' across logics more easily (*through capacity building*), the logics would also have semi-permeable boundaries, they would be more elastic, and the societal impact logic would be more aligned with the other logics that emerge in transdisciplinary practice (*through transformed R&I systems*). This relates back to the work we presented in Chapters 5 and 6, where we called for transforming R&I systems so that they can better support transdisciplinary endeavors that combine research with ambitions regarding creating transformative impacts in projects that include many different stakeholders and face complex coordination challenges.

12

Recommendations

Based on the research presented in this thesis, as well as our experiences in the FIT4FOOD2030 project within the European R&I policy context, I will present several recommendations. These are tailored to (1) transdisciplinary R&I projects and (2) R&I policy makers. In addition to drawing upon the articles that are presented as chapters in this thesis, they are also based on, or related to, the broader FIT4FOOD2030 work I have been involved in. Some of these considerations have therefore been, or will be, (partly) elaborated in other work, such as in policy briefs of the project's EU Think Tank (e.g., Gill et al., 2018; 2019; 2020; Sonnino et al., 2020)[97]; a joint publication with the EC (EC, 2021); and other co-authored publications that are 'in progress' (e.g., Gjefsen et al., *forthcoming*).

12.1 RECOMMENDATIONS FOR TRANSDISCIPLINARY R&I PROJECTS

1. **Consider the politics of inclusion:** The rapid uptake of transdisciplinary terminologies by researchers, facilitated by the increasing focus on societal engagement in (public) funding schemes, begs projects to seriously consider the politics of stakeholder inclusion in (transdisciplinary) R&I projects. This requires considering thoroughly the 'why' of inclusion of specific stakeholders, especially of vulnerable communities. Participating stakeholders should see realistic and concrete benefits from being included. In that light it is worth considering allocating a budget to compensate those stakeholders who are included as non-professional 'stakeholders'. For instance: compensate farmers and citizens, but not professional lobbyists and policymakers for whom attending project activities is part of their job. Taking the politics of inclusion seriously, also brings along the responsibility for projects to design participatory activities and implement methodologies that confront asymmetrical power relations, empower the least powerful voices, and prevent hijacking of 'inclusive' trajectories by incumbent interests.

2. **Use widely available tools and methods:** Many R&I projects (and other transition-oriented scholars, practitioners and initiatives) develop methods and tools[98] that help to engage in transdisciplinarity for transformation. These could be creative exercises to develop 'visions' or 'system understanding' using drawings, they might be guidelines to support meaningful stakeholder engagement, or scripts for facilitating

97 I was mostly involved in the first of the policy briefs (Gill et al., 2018), therefore I almost exclusively draw on some of the recommendations presented there.

98 See for instance the FIT4FOOD2030 Knowledge Hub containing 'Tools for Transformation' (www.knowledgehub.fit4food2030.eu) but also the RRI Tools inventory (www.rri-tools.eu).

co-creation workshops. It might also be methodologies to help foster learning[99], or it might be entire governance approaches to guide processes of transitions[100]. As such, there is no need to re-invent wheels. Rather, transdisciplinary R&I projects could actively draw on existing tools and methodologies, and if prudent, adapt them for local contexts. A special emphasis can be put on deploying *creative and out-of-the-box* exercises, even with stakeholders who are not used to working in co-creation, expressing themselves through art, or even theater exercises. The FIT4FOOD2030 experience has shown that even high-level policy makers are happy to make creative drawings!

3. **Design within-project capacity building:** Supporting transdisciplinary engagement is challenging. Simply setting up Labs or other transformative spaces is not enough to create meaningful engagement, nor does this lead to transformative impacts. As we have seen in FIT4FOOD2030, which was a large-scale R&I project that supported multiple types of activities dispersed across different spatial contexts and Labs, it is important to design and implement within-project training and learning programs for those actors coordinating the Labs and ‘doing the inclusion’. Within-project training programs can help to co-create project narratives and ambitions, develop shared system understanding, build trust between project partners, and stimulate learning, reflection and competence development within the project. This is important as transdisciplinary efforts require different sets of competences, such as specific leadership competences, systems thinking, stakeholder engagement competences, listening skills and the ability to deploy creative methodologies.

4. **Support beyond-project capacity building:** Transdisciplinary R&I projects can, through their activities and interventionist character, give a boost to capacity development and build skills in both public and private sectors beyond the project consortium itself. In particular, this means supporting or facilitating education and training for students, citizens, researchers, entrepreneurs, business owners, policy-makers and other professionals in transition-oriented Labs (for instance on systems thinking, transition thinking, stakeholder engagement) in order to enhance actors’ and communities’ transformative capacities. Focusing on stimulating capacity building in those systems that projects aim to engage with can help to accelerate transitional dynamics.

99 Such as Reflexive Monitoring in Action (RMA).

100 Such as Transition Management (TM) or Strategic Niche Management (SNM).

5. **Apply systems approaches:** In the context of transdisciplinary sustainability science, different types of 'systems approaches' have rapidly gained traction. These approaches are valuable as they can unravel the interconnections between different system elements, and might help design for transformative interventions. Yet, embracing a 'systems approach' does not mean that single R&I projects need to, or are able to, transform entire systems by focusing on everything in the system at the same time. Rather, it requires balancing the systemic perspective with applying focus in terms of topics (e.g., food waste, agroecology), stakeholders (local communities, policy makers, businesses) or intervention levels (cities, countries). Taking a systems approach might then help to consider and anticipate interrelations with other societal systems, areas of intervention, governance levels, etcetera. Acknowledging that a systems approach does not imply 'changing the whole system' helps to avoid overpromising project impacts, and to develop targeted transdisciplinary intervention strategies that can create meaningful outcomes for the involved stakeholders and society at large.

6. **Explicate justice dimensions:** R&I projects that advocate transdisciplinary approaches in light of effectiveness-orientation, and/or democratization ambitions, could more thoroughly explicate justice dimensions (and trade-offs) that their work brings along, in addition to focusing on environmental sustainability, social inclusion or economic resilience. How are *procedural* justice dimensions accounted for through participation? Which voices and perspectives are *recognized* and why? How are the benefits and burdens of resulting innovations or pathways *distributed*? And how does the project aim to contribute to *restoring* historical damages to vulnerable communities and ecosystems? This could be a valuable additional perspective that helps to rethink choices in design and implementation of transdisciplinary R&I project activities, and explicates the normative dimensions of sustainable innovation and transition governance.

7. **Design for flexibility:** When R&I projects really strive to have societal impact aimed at sustainable transformation and attain societal needs through transdisciplinary efforts, they need to be designed to be flexible. As we have illustrated for the case of FIT4FOOD2030, multi-stakeholder approaches to transformation need local experimentation and there is no blueprint for the trajectories of Labs or transformative R&I projects as a whole. One does not know in advance the needs that will emerge during the project. This means the project should design and foster flexibility and constantly respond and adapt to local needs and contexts. This in turn requires (1) reserving a budget for unplanned but required interventions; (2) ensuring commitment from project partners to be adaptive if needs emerge, change project activities and shift

budgets accordingly; and (3) stimulating project-wide reflection on whether the project activities still contribute to the project ambitions and the needs of involved stakeholders. Flexible design of R&I projects should, importantly, be facilitated by funding schemes that support adaptation during projects.

8. **Plan for project-wide alignment and reflection for impact:** Though this may seem straightforward, in practice it is a challenging endeavor. In order to be adaptive and reflexive as a project, as well as to avoid 'isolated' work in parts of R&I projects (for instance in different workpackages that each conduct their own tasks but have relatively little interaction, or in different teams within smaller projects), continuous integration should be actively pursued. It might also require the construction of novel structures (taskforces, working groups or activities) to identify and act upon opportunities to increase impact beyond the designated key performance indicators in the project proposal. Assuming that transdisciplinary R&I projects have transformative ambitions, it might help to develop flexible *Theories of Change*, that explicate how project activities aim to contribute to societal impacts. These can be reflected upon, and adapted, during the project depending on the needs of stakeholders, project partners, gained experiences, or policy developments.

9. **Find synergies with ongoing initiatives and policy:** Given the wide variety of ongoing projects and other sustainability initiatives, the 'landscape of transformative initiatives' is getting increasingly crowded. Individual projects will not create system-wide change. In order to foster transformation and seize windows of opportunity, transdisciplinary R&I projects need to be adaptive and responsive to changing contexts (e.g. policy developments, emerging concepts and discourses, socioeconomic shocks and the political climate), as well as the needs of the stakeholders they engage. Particularly important are efforts to find windows of opportunity in policy developments, that might help to reinforce transformative ambitions of projects, and to which projects could connect to increase impact. This is challenging, and requires fostering shared reflexivity about the project, its contexts, goals and vision. It begs projects to ask the questions: are we doing the right things and are we doing them right? In project proposals and implementation, R&I projects could consider ongoing projects and explicate how their work relates, and reinforces, these initiatives (such as is already mandated through some Horizon Europe funding calls). Implementing shared activities such as workshops or conferences can promote synergies.

10. **Work with and against the system:** Paradoxically, if R&I projects aim to create impact in light of transition ambitions, they need to engage both with and work against (incumbent) system dynamics. They need to work against it to open up ap-

praisal for novel and marginalized voices and perspectives, empower communities, and by supporting and enacting novel transition pathways that destabilize regime configurations. At the same time, they have to work with the system (related to point 9), by engaging powerful actors (policy makers, industry) who can help to mobilize networks and create significant impacts, as well as to embed novel innovations in existing organizations and institutions.

12.2 RECOMMENDATIONS FOR R&I POLICY MAKERS AND PUBLIC FUNDERS

1. **Take the lead:** The turn from government toward governance, or toward transdisciplinary co-creation, should not imply that governments and policy makers become mere spectators. Rather, as sustainability transformations bring along radical changes, including for the most vulnerable communities, governments and policy makers must take a leading role in steering toward just and democratically legitimate directionalities, protecting the most vulnerable communities from the dynamics of (non)transformation, balancing different societal interests in governance processes, and ensuring health and wellbeing of human societies and ecosystems. This also begs governments and policy makers to explicitly consider (trade-offs in) justice dimensions of (R&I) transition policy pathways. Catalyzing the energy and transformative potential of multi-stakeholder efforts, while ensuring public accountability and democratic legitimacy does not require less government. Rather, it requires a different and strong government that displays leadership.

2. **Enact strong public R&I funding:** In order to tackle R&I related challenges to sustainability transitions, and in order to adequately respond to market and system failures, there is a need for strong public R&I funding. While private R&I funding is, and has been, crucial to catalyze innovations across the private sector and public spheres, issues of high public interest may not automatically attract funding from private investors. At the same time, there is a need to confront power-concentration (in the private sector) that protects incumbent (private) interests and reinforces lock-ins, effectively preventing acceleration of sustainability transitions. Public-private partnerships that ensure private investments in response to public needs and societal challenges, enhance trust and collaboration between public-private sectors, and adhere to public accountability, can also be important instruments to catalyze transitions, in particular if they support social innovation initiatives as well as small and medium enterprises.

3. **Foster cross-sectoral collaborations:** Cross-sectoral collaborations in policy making are crucial in order to create alignment on different policy goals, strategies or outcomes. This is not only the case for thematic policies, but also regarding R&I policy making, which is often dispersed across departmental silos. Our experiences with the FIT4FOOD2030 project indicate that across EU Member States and governance levels, it remains difficult to foster cross-sectoral collaboration, but they also indicate that cross-sectoral collaborations are considered highly valuable and effective. To ensure policy coherence and alignment, and to foster transformative innovation policies that move beyond single sectors or markets, policy makers from different governance levels and sectors should aim to connect to each other, for instance around collective policy making efforts aimed at creating shared transformative and mission-oriented (R&I) agendas, implementing boundary interventions that target multi-system dynamics, and developing associated integrated policy mixes and funding instruments.

4. **Include non-usual voices in policy making:** In line with calls for further democratizing (R&I) policy making, it is important to include all the relevant voices, perspectives and knowledge (especially the ones not usually included in the process, including those of local communities) in the design, development and implementation of R&I policies, R&I visions and strategies, and R&I design and evaluation criteria. It is especially important to ensure their meaningful inclusion in long-term transformation processes as these bring along radical changes in everyday lives, and thus beg for democratic legitimacy. In FIT4FOOD2030, and other initiatives, transformation-oriented Labs have proven to be meaningful instrument to achieve this goal, addressing a variety of stakeholders such as citizens, farmers, researchers, school teachers, entrepreneurs, small business owners and local policymakers in different countries. To avoid tokenism or participation without realistic benefits for participating citizens, it is crucial to consider the deeply political aspects of inclusion, to create level-playing fields during engagement activities by empowering the least powerful voices, and to confront unequal power relations. It is advisable to investigate new and creative ways to include non-human interests (such as animal rights, or rights of nature) explicitly in policymaking. If done 'right', further institutionalizing the uptake of inclusive R&I policy making might foster legitimacy and effectiveness of transition processes.

5. **Stimulate transformative policy spaces:** Transformative policy agendas and initiatives (such as the EU Partnership on Safe and Sustainable Food Systems) could provide the much-needed long-term financial, institutional and political support for building, maintaining and scaling up spaces for transformation (such as local/na-

tional Food, City and Policy Labs or other multi-stakeholder Labs for transformation). This is particularly relevant for bridging the gap toward mainstreaming and scaling of innovative policy practices, as well as for developing multi-stakeholder collaborations aimed at transformative innovation policy design and implementation. As such, policy makers could (1) initiate transformative policy spaces (related to points 3 and 4) in their own work; (2) support existing initiatives by providing resources, networks and funding; as well as (3) support the establishment and connection of new transformative spaces (such as Labs) through R&I funding mechanisms.

6. **Deploy long-term R&I investments:** There is a need to design and implement funding instruments that fund and support long-term transdisciplinary R&I programs and project portfolios. This is crucial, as long-term projects (>5-10 years) can better support transdisciplinary processes required for sustainable transformation, such as learning, network building, trust building, and competence development. In addition, long-term commitment from funders and policy makers can also ensure the scaling and anchoring of transformative (social, technical and policy) innovations that are often developed in short-term projects, but fail to make lasting societal impact when project funding stops. In the EU R&I domain, the EU Partnerships can provide important support, as long as they also provide adequate resources and retain an inclusive nature cognizant of different values and perspectives.

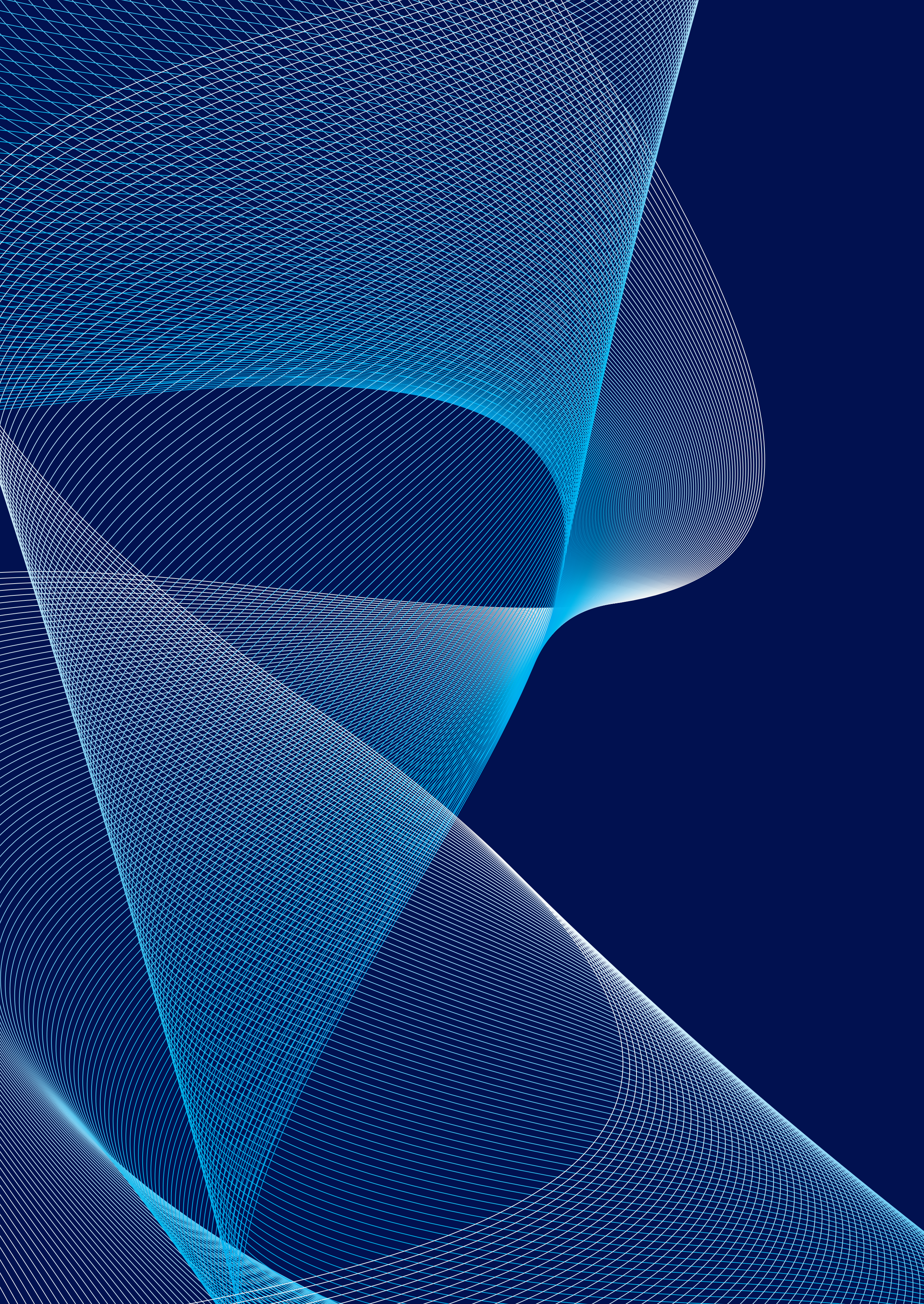
7. **Fund for flexibility:** When R&I projects really strive to have societal impact aimed at sustainable transformation, and when investments are sufficiently long-term (see point 6) this also requires funders and policy makers to design flexible portfolios that can adapt to new (policy) developments and societal needs. In other words: funding systems should allow for within-project changes, support projects in being adaptive and reflexive regarding their relation to societal change. Designing for flexibility also means that funders should allow degrees of 'uncertainty' and 'openness' as part of R&I project design phases that are to be further explicated when projects have received (part of the potential) funding, and plan for R&I evaluation efforts that capture not only (quantitative) outputs and outcomes, but also transformative capacities that are created through project activities.

8. **Invest strongly in the social sciences:** Technical and natural scientific contributions to advancing understanding of socio-technical system dynamics, climate change dynamics, as well as innovations related to for instance sustainable consumption and (agricultural) productivity are crucial. At the same time, the severe challenges pertaining to socio-political, economic, justice-related and cultural dimensions of sustainable transformation (in food systems) beg for investment in (transdisciplinary)

social science approaches. Not only might social science research provide valuable insights into socio-technical system dynamics, they can also help to contribute to solving societal problems and set in motion transformative innovation processes. Hence, there is an urgent need to increase public R&I funding for transdisciplinary social science research.

9. **Support translocal experimentation:** The need to both account for local needs through (localized) transition experiments, as well as the need for coherent and coordinated strategies and overarching policy agendas, begs for enacting translocal experimentation processes, and for fostering strategies to scale innovations that emerge in these projects. Concretely, this means there is a need to fund and support transition-oriented R&I programs that engage with different local contexts under overarching program-umbrellas, where transformative and translocal interactions (i.e., learning, empowerment, diffusion of innovations) between different local experiments are actively supported. These types of programs face distinct coordination challenges in practice, which also means they require additional resources and degrees of freedom in project implementation. Coupling such R&I programs to concrete policy ambitions and strategies helps to provide common directionality, which is useful for maintaining within-project coherence, helps mitigate coordination challenges and could lead to more focused impacts.

10. **Don't forget other policy instruments!:** Though R&I policies and funding schemes are crucial instruments for bringing about transformative change, and in light of point 3, it is crucial to connect processes and outcomes of R&I projects to other (thematic) policy instruments. The focus on transdisciplinary co-creation in R&I does not release governments from the responsibility to implement other appropriate policy mixes to enact sustainability transitions with urgency, such as taxes and regulations. Important in this regard is to effectively and creatively connect approaches (including R&I projects and portfolios) embracing experimentation with both sectoral and broader mission-oriented (top-down) policy instruments, with particular attention to those policy instruments that can bring about structural changes in the political economy.



13

Concluding remarks

Here we are. We have arrived at the conclusion! In light of the urgent need to **turn the tide** toward sustainable societies, and the associated need to mobilize and institutionalize transdisciplinary R&I as experimental governance approaches, I have explored the following question in the preceding chapters: *"How may we understand the governance and politics of transdisciplinary experimentation in sustainability transitions?"* After first setting the stage in Part I, in efforts to answer this question one small step at a time, co-authors and I theoretically explored different perspectives on the politics of sustainability transition governance (Part II), considering both normative and causal interpretations of politics. In Part III then, we presented a tale of two systems, highlighting how R&I systems are coupled to food systems, and how transdisciplinary approaches aimed at sustainability transitions could be further stimulated. Then, in Part IV a number of empirical studies was presented, elaborating on the governance and politics of transdisciplinary experimentation. These studies resulted from our engagement in the EU FIT4FOOD2030 project. In this part (Part V), I have elaborated on the key findings of each preceding part, presented cross-cutting themes, future research directions and reflections, and I provided recommendations for transdisciplinary R&I projects and policy makers.

The main contributions of this thesis, I contend, are that by combining a strong theoretical focus on the politics of sustainability transitions with our action-oriented engagement in a transition-oriented project, we were able to

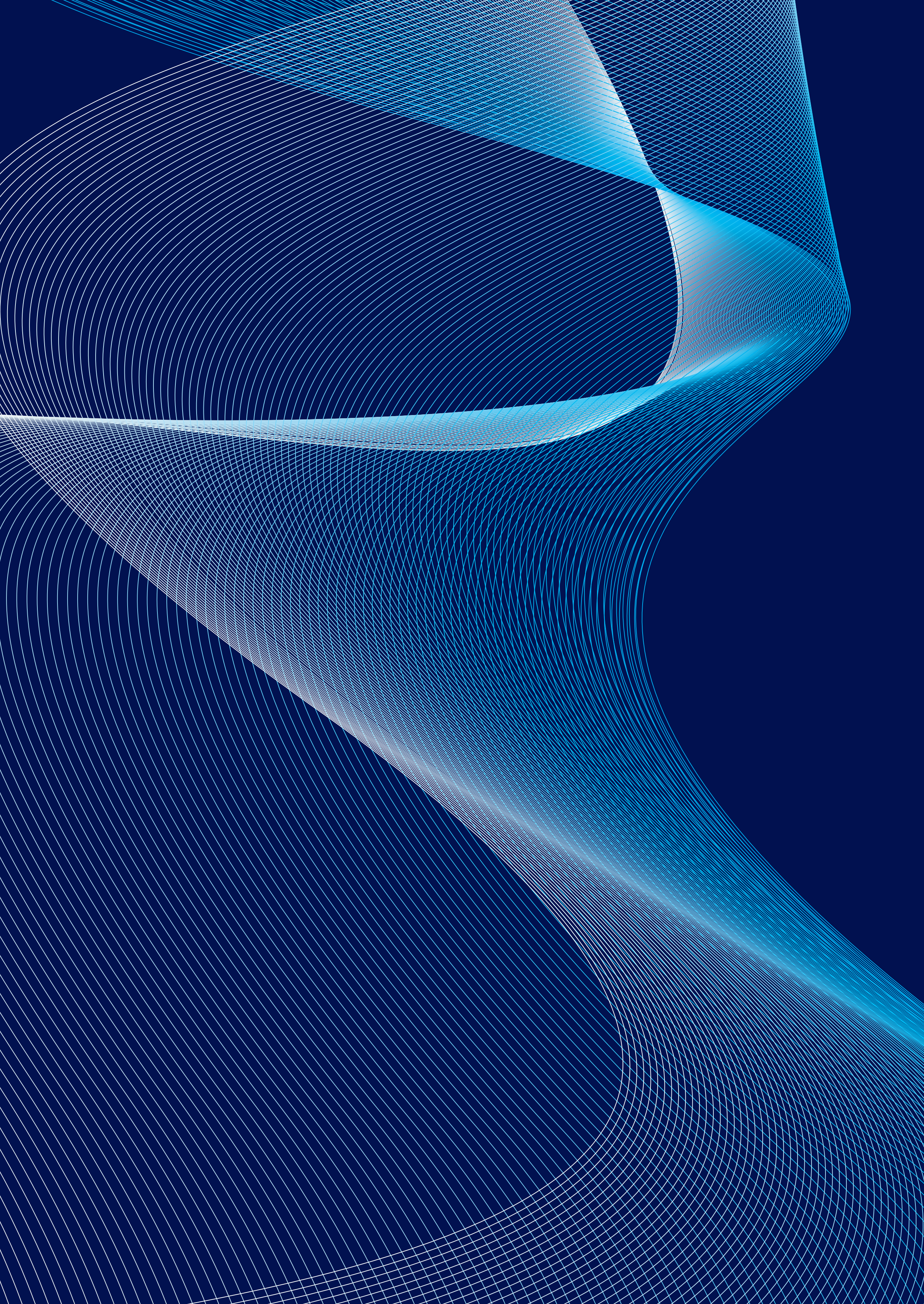
1. *illuminate* the different ways in which multi-scale, multi-level and multi-system dynamics 'hit the ground' in transdisciplinary experimentation processes, shedding light on the translocal dynamics of experimentation and the role of transdisciplinary R&I in EU food system transformation; which helped us to
2. *articulate* inherent and political challenges involved in 'doing transitions' in practice, most notably regarding (i) balancing here-and-now-project dynamics with long-term transformative ambitions; (ii) governing diversities of inclusion with directionalities implied by transformative efforts; and (iii) knowing how and whether project activities contribute to transformative change; in turn allowing us to
3. *formulate* governance strategies for navigating the abovementioned challenges in transition-oriented projects, and to provide recommendations for those working on catalyzing sustainability transitions, specifically tailored to those involved in transdisciplinary R&I projects, as well as R&I policy makers and funders.

This thesis is the collaborative effort of myself and many co-authors and project partners that have helped to construct my conceptual thinking as well as the case study in which I was engaged. As I have sketched in Chapters 2 and 11, as well as in each chapter individually, the work presented in this thesis has many limitations and begs for reflections and reconsiderations. At the same time, I hope that the findings presented in the different contributions, the considerations and reflections that I have raised to stimulate further (academic) debate, and the provided (policy) recommendations can be useful to both researchers and policy makers for their endeavors to both understand and enact urgently needed transitions toward just and sustainable futures.

In other words, I hope that this thesis can be a modest contribution to **turning the tide**.

I am committed to those endeavors, because acting now is our best, only, and last chance.

Amsterdam, June 30, 2022.



POSTLUDE

"The apocalypse is a call to be rational at last, to have one's feet on the ground."

Facing Gaia (p. 218)
Bruno Latour, 2018

"Straks gaan de lichten uit
Dit is de laatste kans
In heel Europa gaan de lichten uit
Dit wordt de laatste dans

Dit is de laatste keer
Dit is de zwanenzang
De muggen dansen bij zonsondergang
Morgen zijn we er niet meer

Er is maar weinig tijd
Dus doe je mooiste kleren aan
Laten we nog één keer dansen gaan
Dansen op een vulkaan

…

De sirenes zijn allang gegaan
Maar we trekken ons er niks van aan
Het is altijd zo gegaan
Nooit iets anders gedaan
Dansen op een vulkaan!"

De Laatste Dans, Foxtrot
Annie M.G. Schmidt & Harry Bannink, 1977

SUMMARY

Transitions toward a sustainable future

Time is running out. We are rapidly exploiting our planet. The challenges are manifold: climate change, a biodiversity crisis, soil degradation, deforestation, and the exorbitant extraction of natural resources. These challenges are strongly entangled with socio-economic and health-related problems such as unhealthy diets (leading to obesity and malnutrition) and extreme social inequalities. The way our societies are organized is untenable. Therefore, there is a need for **turning the tide**, and enact large-scale transitions toward a sustainable future. In this thesis, transitions toward sustainable food systems have our particular attention. Food systems are essential parts of our society, and the above-mentioned challenges strongly converge around the ways in which food systems (from production to consumption) are organized.

Transitions are complex long-term processes and they require fundamental changes in collective thinking (cultures), doing (practices) and organizing (structures). Transitions entail many different dimensions: technological, ecological, cultural, socioeconomic, and of course, political. It has proven to be challenging to govern sustainability transitions. In recent decades, transition scholars have gained many insights into the how and why (not) of transitions. In addition to the fact that societal systems are notoriously complex, they have a strong tendency to remain locked in incumbent states. This means that interventions should provide space for experiments that move beyond incumbent patterns; for experiments that 'do things differently'. Another important insight stresses that the political dynamics (power relations, policies, democracy) can be strong barriers as well as strong drivers for accelerating transitions. In this light, scholars have argued to govern transitions through reflexive, adaptive and pluriform governance arrangements that allow for grasping and confronting the complex political realities at play. Here lies an important role for knowledge: what kind of knowledge do we need to best govern transitions? Sustainability science is increasingly convinced that technical expertise alone is not enough. Rather, knowledge that is co-created with civil society, citizens and policy makers in transdisciplinary processes can be crucial in governing transitions. Such knowledge is action-oriented, could better align with local contexts and tackle problems, and can also be seen as more legitimate and democratic. In fact, transdisciplinary processes that experiment with new ways of thinking, doing and organizing might themselves be seen as a mode of governance: governing change through transdisciplinary experimentation.

The aim of this thesis is to contribute to a better understanding of the governance and politics of sustainability transitions, with a particular emphasis on transdisciplinary

experimentation as a promising mode of governance. At the same time, we hope this work provides insights and recommendations for policy and practice, and may help to accelerate transitions.

The FIT4FOOD2030 project

A large part of the work presented in this thesis (chapters 5-10) is based on the FIT4FOOD2030 project. This project (2017-2020) was funded by the European Commission. The project had 16 partners (universities, science communication, industry) across Europe. Its goal was to support the European Commission in the implementation of the FOOD 2030 policy framework. This framework in turn aimed to transform research and innovation (R&I) systems in Europe so that they would better contribute to transitions toward sustainable, innovative, healthy and inclusive food systems. This requires transdisciplinary R&I processes that include civil society, citizens, farmers and policymakers in doing R&I. It also requires more systems thinking in R&I, that helps to make visible the interrelations between food production and consumption, or for instance agricultural policies and health policies.

The project tried to support systems thinking and transdisciplinarity in 25 different locations across Europe. It did so in so called ‘Labs’ in which societal stakeholders gathered in a series of workshops over a period of three years. These Labs aimed to build networks, develop visions for future food systems and the role of R&I therein, and to experiment with novel innovations. The project had different types of Labs. There were 7 *City Labs* and 7 *Food Labs* that acted on local levels and were embedded in science museums, science centers or universities. They developed educational modules for different target audiences, which were implemented on for instance schools and museums. There were also 11 *Policy Labs*, that were embedded in national ministries and developed policy innovations (such as novel funding programs and policy strategies). Concrete outcomes and lessons can be found in a publication of the European Commission (EC, 2021). During the project, we were involved as project managers, as trainers of the coordinators of the Labs, in developing novel participatory methodologies, and in the evaluation of the project.

The research presented in this thesis itself is thus action-oriented and transdisciplinary, as we conducted research on the project in which we were also working together with project partners.

Theoretical explorations

After introducing the background and the research design in the first part of this thesis, in the second part of the thesis we zoom in on the question: "How may we understand the politics of sustainability transition governance from a theoretical perspective?"

In **Chapter 3**, this question is approached from a causal point of view: what causes what? In transition studies, there is an increasing emphasis on the political dimensions of societal transformation. At the same time, different schools of thought conceptualize key concepts such as *power* in different ways, also leading those concepts to be used differently. This chapter aims to bridge the gap between insights from socio-material approaches (in which so-called non-humans such as technology and ecosystems, can have a 'political' nature) and complex systems thinking. In this way we aimed to present a more coherent conceptualization of *agency*, *power* and *powering*. We consider that complex systems comprise a multitude of components (humans, technology, ecology) that interact with each other. We describe the properties of these systems (such as non-linear dynamics, self-organization and emergent behavior) and we describe the dynamics of transitions in these systems. Then, we relate the concepts agency and power to transitions in complexity. We consider agency a property of components, and as their capacity for reorientation. Power then we consider a relational phenomenon that emerges from interactions between components and that structures their agency. This allows us to observe different types of power relations. Subsequently, we present six different mechanisms of powering: mechanisms through which power relations can result in (re)distribution of resources and through that, contribute to self-reproducing or transformative dynamics in complex societal systems. We believe our conceptual approach could help to better understand transition processes. Finally, a number of implications for policy are mentioned, including the need to stimulate transformative capacities, not only in individual human actors, but in systems more broadly.

In **Chapter 4**, the politics of transition governance is understood from a normative point of view: how can transitions toward sustainable agri-food systems can be steered in just and democratic ways? By taking this approach, we aim to connect scholarly debates on just transitions with the question of how to democratically govern transitions. The literature describes four different dimensions of just transitions: distributive justice (how are the benefits and burdens distributed?); procedural justice (how are decision processes organized?); restorative justice (how can we account for historical damages done?); and recognition justice (whose values and perspectives are recognized?). In this chapter we argue that realizing just and democratic transitions requires three paradigm shifts in transition governance: (1) from expert toward pluralist understandings of knowledge; (2) from economic materialism toward post-growth strategies; and (3) from anthropocentrism toward reconnecting human-nature relationships. For each paradigm shift we describe how democratization relates to the different dimensions of justice. In our discussion we stress that institutionalizing such new ways of governance will not be easy. In requires researchers and policy makers to navigate (1) different justice dimensions; (2) increased democratization in light of the urgency for transitions; (2) top-down and bottom-up directionalities in governing transitions; (4) dynamics of local and global scales; (5) realistic and idealistic perspectives on just transitions; and (6) the potentially obstructing role of incumbent scientific systems. We conclude that these considerations require thoroughly rethinking transition studies' normative and democratic ambitions.

A tale of two systems

The third part of this thesis tells a tale of two systems that are strongly interwoven and influence each other. The first system is the food system, the second is the R&I system. The main question of this part is: "How may we govern transformative change through transdisciplinary R&I?"

In **Chapter 5**, we describe in which ways transdisciplinary R&I processes could act as a catalyst for complex food system transformation. We first argue that the complexity of food systems, and, in particular, of food system transformation begs for new ways of doing R&I. That is needed as traditional and linear approaches in R&I are not always able to grasp the complexity of the problems at hand, and fail to deliver fitting solutions. Instead, we need transdisciplinary approaches that involve citizens, policy makers and other stakeholders in doing R&I. Bringing transdisciplinarity into practice is not stimulated enough. Therefore a number of policy interventions is needed: (1) foster transdisciplinary R&I; (2) foster transformative research agendas; and (3) stimulate innovative experiments that shape conditions for change. We conclude that such interventions can stimulate transdisiciplinary and transformative R&I that can play an important role in accelerating transitions toward sustainable food systems.

In **Chapter 6**, we present a coupled-systems perspective, in which the R&I system is entangled with the food system. Building on existing literature, we first describe different types of food system transformation research. There is first order transformation research, in which scientists aim to understand the dynamics of transition processes from a distance. There is also second order transformation research, in which scientists are actively involved in transition processes in the systems they are studying. Second order transformation research is action-oriented and often transdisciplinary. In this study, we describe the different barriers to doing such transformative research. These include historically grown disciplinary siloes in scientific institutions, lack of funding structures that support transdisciplinarity; academic incentive structures that hinder novel collaborative ways of working; lack of appreciation for transdisciplinary outcomes and processes in research cultures; methodological within the emerging field of transdisciplinary and transformative research; intrinsic challenges to involving stakeholders in long-term processes of structural change; and a lack of competences in researchers and other stakeholders for doing transdisciplinary and transformative research. In this chapter, we argue that these challenges are so strongly related and interwoven, that we can consider them systemic challenges within R&I systems. That is why we need a coupled-systems perspective. In order to enact food system transformation, there is also the need to transform R&I systems. By using the FIT4FOOD2030 project as an illustration, we conclude by describing how interventions at the boundaries of different systems can contribute to double system transformations.

Empirical elaborations

In this part we present an elaborate study into the FIT4FOOD2030 project. In **Chapter 7**, as an intermezzo, we describe the project with a special focus on the different methodologies and activities (also labeled “tools”) that were used to involve societal stakeholders in the project. Then, in the remainder of the part the following question is considered: “How may we understand the politics, and facilitate the governance, of transdisciplinary experimentation in transition-oriented projects?”

In **Chapter 8**, we investigate the political challenges of including societal stakeholders in transdisciplinary processes. From earlier work we know that it is notoriously difficult to involve different types of societal stakeholders around complex societal challenges, especially if there is a focus on long-term transformation. However, this was exactly the aim of the FIT4FOOD2030 project. The 25 multi-stakeholder Labs included many different stakeholders in their activities and workshops. We investigate what kind of political challenges the coordinators of the Labs encountered while they tried to shape this ‘inclusion’, and we observe four major challenges: 1) the challenge to meaningfully bring together powerful and marginalized stakeholders; (2) combining representation and deliberation of different stakeholder groups; (3) balancing diversities of inclusion with directionalities implied by transformative efforts; and (4) navigating the complexities of establishing boundaries of inclusion processes. In our discussion we describe, amongst other things, that these intrinsic and political challenges find their origin in a paradox: while inclusion considerations beg for ‘opening up’ processes and to strive for broadening diversities, transformation considerations also require making stark choices toward directionalities, requiring the exclusion of actors or perspectives. Choices regarding inclusion and exclusion thus require reflexivity by those who (are allowed to) make such choices, as well as flexibility to deal with unexpected dynamics, and robust methodologies. ‘Doing inclusion’, we conclude, is therefore no moment or point in time, but a continuous and deeply political practice.

In **Chapter 9**, we study how multi-stakeholder Labs aim to create impact in the system in which they operate. Earlier research as shown that short-term experiments, like the FIT4FOOD2030 Labs, do not always yield concrete societal impact. At the same time, we know that transdisciplinary processes in fact do hold value, and can contribute to developing transformative capacities. In this chapter we develop a typology of different types of Lab impact. In particular, we describe the different dilemmas and challenges that Labs face in practice. We argue that transdisciplinary processes in Labs can help to build transformative capacity (as a form of *agency*). They do so by developing new relations, new knowledge and new competences. Then, we describe four ways in which Labs aim to create changes in the system: by transforming networks, practices, structures and cultures. We argue that both capacitating change, as well as creating change could be seen as ‘impact’. At the same time, ‘measuring’ or ‘knowing’ impact remains very tricky, especially for one Lab or experiment. An important insight from this chapter is therefore that evaluating ‘impact’ should not merely consider individual experiments or projects, but should move toward the evaluation of portfolios of experiments and projects to make tangible how different experiments and projects could reinforce each other.

In **Chapter 10**, we consider the translocal dynamics of transition experiments within an overarching transition program. Transition studies has in recent years provided ample insights on how single transition experiments can be facilitated. There are also more insights into how innovation processes in different spatial contexts can be connected and how they can reinforce or hinder each other. In this way, *translocal* dynamics might emerge that could help in accelerating transitions. Yet, there is a need to investigate how translocal dynamics can actively be supported by multi-sited transition programs that conduct experiments in different locations. This is what we considered in this chapter, taking the FIT4FOOD2030 with its 25 transition experiments (in the Labs) as a case. Based on the literature we consider five elements of transition experiments: (1) mobilizing networks and resources; (2) visioning and directionality; (3) developing and scaling innovations; (4) learning and reflection; and (5) creating legitimacy. We observed that translocal dynamics entailed a superposition of different interactions: local interactions within an experiment; interactions between different experiments; and interactions between experiments and the overarching program. Our results describe these interactions for each of the above-mentioned elements of experimentation. In our discussion we suggest that these transition-programs face challenges, including bringing together local needs with program ambitions, as well as linking to ongoing policy developments at different scales. We conclude that multi-sited transition programs can be important contributors to accelerating transition dynamics, if they are able to make sure that experiments reinforce each other, leading the program to become more than the mere sum of its individual experiments.

Discussion and conclusions

In the general discussion (**Chapter 11**) the different research questions for each part are answered, and I discuss the interrelations between the findings of the different chapters.

In particular, I point to five overarching and cross-cutting themes that also present directions for future research. A first theme concerns the matter of *impact:* how can we assess the impact of short-term transdisciplinary projects? How do concrete outcomes relate to less tangible, but no less important capacities that can be reinforced? A second overarching theme revolves around the role of *complexity.* In this thesis, an emphasis was put on the complexity of transitions and their governance. But if things get too complex, does not that serve as a barrier for the effective implementation of transition governance? Here, I therefore reflect on the relation between complexity and *makeability*, and the relation between experiments and top-down policies. A third theme considers making *connections* in policy and governance. The research presented in this thesis stresses the importance as well as the challenges in connecting different systems (R&I systems and food systems); policies (how can innovation policy that supports experimentation be coupled effectively to thematic policies that act upon the political economy?); and scales (how can local experiments contribute to large-scale transformation?). A fourth theme considers the role of *non-humans* (e.g., technology, social structures and ecology) in transitions. In the first chapters, we have shown how non-humans play a role (or, do not yet play a role) in the politics and governance of transitions. Here, I reflect on how non-humans were present throughout this thesis, and what that entails for how we can further democratize transition governance. A fifth and final theme, reflects on the role of *academic systems*. Can these really contribute to sustainable transformation, if doing 'ideal' transdisciplinarity faces so many challenges, and if universities themselves face persistent problems regarding exclusion and injustices?

In this chapter I also reflect upon the different choices that are made to use specific concepts throughout the thesis, and upon the different roles I had within the FIT4FOOD2030 project.

In **Chapter 12**, recommendations are presented. This involves 10 recommendations for transdisciplinary R&I projects, and 10 recommendations for R&I policy makers and funders.

In **Chapter 13**, the main conclusions are summarized. The main conclusion of this thesis is three-fold: by combining a strong theoretical focus on the politics of sustainability transitions with our action-oriented engagement in a transition-oriented project, we were able to

1. *illuminate* the different ways in which multi-scale, multi-level and multi-system dynamics 'hit the ground' in transdisciplinary experimentation processes, shedding light on the translocal dynamics of experimentation and the role of transdisciplinary R&I in EU food system transformation; which helped us to
2. *articulate* inherent and political challenges involved in 'doing transitions' in practice, most notably regarding (i) balancing here-and-now-project dynamics with long-term transformative ambitions; (ii) governing diversities of inclusion with directionalities implied by transformative efforts; and (iii) knowing how and whether project activities contribute to transformative change; in turn allowing us to
3. *formulate* governance strategies for navigating the abovementioned challenges in transition-oriented projects, and to provide recommendations for those working on catalyzing sustainability transitions, specifically tailored to those involved in transdisciplinary R&I projects, as well as R&I policy makers and funders.

SAMENVATTING

Transities naar een duurzame toekomst

De tijd raakt op. In sneltreinvaart putten we de aarde uit. De uitdagingen zijn veelvuldig: klimaatverandering, een biodiversiteitscrisis, het degraderen van de bodem, ontbossing en exorbitante extractie van natuurlijke hulpbronnen. Deze uitdagingen zijn sterk verstrengeld met sociaaleconomische en gezondheids-vraagstukken zoals ongezonde voedingspatronen (met obesitas en ondervoeding tot gevolg) en extreme sociale ongelijkheid. De manier waarop onze samenlevingen georganiseerd zijn is niet houdbaar. Daarom is het nodig om het **tij te keren**, en grootschalige transities naar een duurzame toekomst te bewerkstelligen. In dit proefschrift kijken we in het bijzonder naar transities richting duurzame voedselsystemen. Voedselsystemen vormen een essentieel onderdeel van onze samenleving, en de hierboven geschetste uitdagingen komen ook bijzonder sterk samen rondom de huidige wijze waarop voedselsystemen (van productie tot consumptie) georganiseerd zijn.

Transities zijn complexe lange-termijn processen en ze vergen radicale veranderingen in het collectieve denken (culturen), doen (praktijken) en organiseren (structuren). Transities omvatten ook vele dimensies: technologisch, ecologisch, cultureel, sociaaleconomisch, en natuurlijk ook politiek. Het is niet eenvoudig (gebleken) om sturing te geven aan duurzaamheidstransities. De laatste jaren hebben transitiewetenschappers veel inzichten opgedaan over het hoe en waarom (niet) van transities. Naast het feit dat maatschappelijke systemen complex zijn, hebben ze sterk de neiging vastgeroest te blijven zitten in ingesleten patronen. Dat betekent dat interventies ruimte moeten maken voor experimenten die voorbij gaan aan die ingesleten patronen; voor experimenten die ‘het anders doen’. Een ander belangrijk inzicht is dat politieke aspecten (machtsrelaties, beleid, democratie) zowel sterk belemmerend als stimulerend kunnen werken in het aanjagen van transities. In dit licht pleiten wetenschappers er dan ook voor om sturing te geven aan transities op een reflexieve, adaptieve en pluriforme wijze die in staat is de complexe politieke werkelijkheid te vatten en te veranderen. Hier is een bijzondere rol weggelegd voor kennis: wat voor kennis hebben we eigenlijk nodig om transities het beste te kunnen sturen? De duurzaamheidswetenschap raakt er meer en meer van overtuigd dat we er met alleen technische kennis niet gaan komen. Juist kennis die samen met maatschappelijke partijen, burgers en beleidsmakers wordt ontwikkeld in *transdisciplinaire processen* kan cruciaal zijn in het sturing geven aan transities. Zulke kennis is actiegericht, kan beter aansluiten op lokale context en bijdragen aan het oplossen van problemen, en kan ook als meer legitiem en democratisch worden gezien. Sterker nog, transdisciplinaire processen die experimenteren met nieuwe manieren van denken, doen en organiseren kunnen zelf worden gezien als een sturingsfilosofie:

sturing geven aan maatschappelijke verandering door middel van transdisciplinaire experimenten.

Het doel van dit proefschrift is dan ook om een beter begrip te ontwikkelen voor sturing en politiek van duurzaamheidstransities, met een bijzondere focus op transdisciplinaire experimenten als een sturingsfilosofie. Tegelijkertijd hopen we dat de opgedane kennis relevant is voor beleid en de praktijk en kan helpen om transities te versnellen.

Het FIT4FOOD2030 project

Een groot gedeelte van het werk in dit proefschrift (hoofdstukken 5- 10) komt voort uit het FIT4FOOD2030 project. Dit project (2017-2020) werd gefinancierd door de Europese Commissie. Het project had 16 partners (universiteiten, wetenschapscommunicatie, industrie) in Europa. Het doel van het project was om de Europese Commissie te ondersteunen in de implementatie van het FOOD2030 beleidsraamwerk. Dit raamwerk had ten doel om onderzoeks- en innovatiesystemen binnen Europa dusdanig te veranderen dat deze een betere bijdrage leveren aan transities richting duurzame, innovatieve, gezonde en inclusieve voedselsystemen. Dat vergt transdisciplinaire onderzoeks- en innovatieprocessen die maatschappelijke partijen, burgers, boeren en beleidsmakers betrekken in het doen van onderzoek en innovatie. Het vergt ook meer systeemdenken in onderzoek en innovatie, dat in staat is de verwevenheid tussen voedselproductie en voedselconsumptie, of bijvoorbeeld landbouwbeleid en gezondheidsbeleid zichtbaar te maken.

Het project probeerde systeemdenken en transdisciplinariteit te stimuleren op 25 verschillende plekken in Europa. Dat deed het in zogenaamde ‘Labs’ waarbij maatschappelijke actoren gedurende drie jaar samen kwamen in een serie van workshops. Daarbij probeerden de Labs netwerken te bouwen, visies te ontwikkelen voor toekomstige voedselsystemen en de rol van onderzoek en innovatie daarin, en te experimenteren met nieuwe innovaties. Het project kende verschillende typen Labs. Er waren 7 *City Labs* en 7 *Food Labs* die op lokaal niveau waren ingebed bij wetenschapsmusea, wetenschapscentra of universiteiten. Deze Labs ontwikkelden nieuwe educatieve modules voor verschillende doelgroepen, die geïmplementeerd werden op bijvoorbeeld scholen en in musea. Er waren ook 11 *Policy Labs*, die waren ingebed bij nationale ministeries en nieuwe beleidsinnovaties ontwikkelden (zoals nieuwe financieringsinstrumenten of beleidsstrategieën). Concrete uitkomsten en lessen van het project zijn ook te vinden in een publicatie van de Europese Commissie (EC, 2021). In het project waren wij betrokken als projectmanagers, als trainers van de coördinatoren van de Labs, in de ontwikkeling van nieuwe participatieve methoden, en in de evaluatie van het project.

Het onderzoek in dit proefschrift is dus zelf ook transdisciplinair en actiegericht, waarbij wij onderzoek deden naar het project waar we samen met partners uit Europa in samenwerkten.

Theoretische verkenningen

Nadat ik in het eerste deel van het proefschrift de achtergrond en de onderzoeksopzet heb geïntroduceerd, doen we in het tweede deel van het proefschrift onderzoek naar de vraag: "Hoe kunnen we de politieke aspecten van het sturing geven aan duurzaamheidstransities begrijpen vanuit theoretisch perspectief?"

In **hoofdstuk 3** wordt deze vraag behandeld met een focus op causaliteit: wat veroorzaakt wat? In de transitiewetenschappen neemt de studie naar de politieke dimensies van maatschappelijke transformaties een steeds centralere rol in. Tegelijkertijd zijn er verschillende gedachtenstromingen binnen het vakgebied die concepten zoals *macht* op een andere manier definiëren, en daarmee ook op een andere manier gebruiken. In dit hoofdstuk is geprobeerd inzichten vanuit het socio-materiele denken (waarin zogenaamde niet-mensen, zoals technologie en ecosystemen, een 'politieke' aard kunnen hebben) te verenigen met het denken over complexe systemen. Daarmee hopen we tot een meer verenigde conceptualisering van de begrippen *agency*, *macht* en *machtsuitoefening* te komen. We beschouwen dat complexe systemen zijn opgebouwd aan een veelvoud van componenten (mensen, technologie, ecologie) die met elkaar interacteren. We beschrijven eigenschappen van zulke complexe systemen (zoals non-lineaire dynamica, zelforganisatie, en emergent gedrag) en we beschrijven hoe transities in deze systemen verlopen. Vervolgens relateren we de begrippen *agency* en *macht* aan transities in complexiteit. We beschouwen agency als een *capaciteit tot heroriëntatie* dat we kunnen toekennen aan componenten binnen complexe systemen. Dit betekent dat agency ook toegekend kan worden aan netwerken van mensen en niet-mensen. Macht zien we als een *relationeel fenomeen* dat oprijst uit de interacties tussen componenten en wat de agency van die componenten structureert. Dit stelt ons in staat verschillende types machtsrelaties te observeren. Vervolgens presenteren we zes verschillende mechanismen voor machtsuitoefening: mechanismen waardoor machtsrelaties kunnen resulteren in (her)verdeling van middelen en daarmee kunnen bijdragen aan zelf-reproducerende of transformatieve dynamiek in complexe maatschappelijke systemen. Onze conceptuele benadering kan bijdragen aan het beter begrijpen van transitieprocessen. Tot slot worden een aantal implicaties voor beleid benoemd, waaronder de noodzaak tot het stimuleren van transformatieve capaciteit, niet alleen in individuele menselijke actoren, maar systeem-breed.

In **hoofdstuk 4** wordt de politiek van sturingsvraagstukken begrepen vanuit een normatieve invalshoek: hoe kunnen transities naar duurzame voedselsystemen op een democratische en rechtvaardige manier worden gestuurd? Met deze insteek proberen we de wetenschappelijke discussies over rechtvaardige transities te verbinden met de vraag hoe op democratische wijze sturing gegeven kan worden aan transities. De literatuur beschrijft vier verschillende dimensies van rechtvaardige transities: distributieve rechtvaardigheid (hoe worden de lasten en lusten verdeeld?); procedurele rechtvaardigheid (hoe is het besluitvormingsproces vormgegeven?); herstellende rechtvaardigheid (hoe kan in het verleden toegedane schade worden gecompenseerd?); en erkenningsrechtvaardigheid (wiens waarden en perspectieven worden erkend?). In dit hoofdstuk stellen we dat het realiseren van rechtvaardige én democratische transities drie paradigma-veranderingen nodig heeft in transitiesturing: (1) van technocratische kennis naar een pluraliteit van kennis; (2) van economisch materialisme naar post-groei strategieën; en (3) van antropocentrisme naar het her-verbinden van mens-natuur relaties. Voor elk van deze paradigma-veranderingen beschrijven we hoe democratisering samenhangt met de verschillende dimensies van rechtvaardigheid. In onze discussie stellen we dat het niet eenvoudig zal zijn om zulke nieuwe manieren van sturing geven te institutionaliseren. Voor onderzoekers en beleidsmakers vergt dat een balans te zoeken tussen (1) verschillende rechtvaardigheidsdimensies; (2) verdere democratisering en de urgentie van transities; (3) top-down en bottom-up richtingen in het sturing geven aan transitieprocessen; (4) dynamiek op lokale en globale schaalniveaus; (5) realistische en idealistische perspectieven op rechtvaardigheid; en (6) de mogelijk belemmerende rol van huidige wetenschappelijke systemen. We concluderen dat deze afwegingen een heroverweging vereisen van de normatieve en democratische ambities van transitiestudies.

Een verhaal van twee systemen

Het derde deel van dit proefschrift vertelt een verhaal van twee systemen die sterk met elkaar vervlochten zijn en elkaar beïnvloeden. Het ene systeem is het voedselsysteem, en het andere systeem is het onderzoeks- en innovatie systeem. De vraag die in dit deel centraal staat is: "Hoe kunnen we transformatieve verandering sturen via transdisciplinaire onderzoeks- en innovatieprocessen?"

In **hoofdstuk 5** beschrijven op welke wijze transdisciplinaire onderzoeks- en innovatieprocessen als katalysator kunnen dienen voor de verandering van complexe voedselsystemen. We beargumenteren eerst dat de complexiteit van voedselsystemen en, in het bijzonder, voedselsysteemverandering noopt tot nieuwe onderzoeks- en innovatie methoden. Dat komt omdat traditionele en lineaire benaderingen niet altijd in staat zijn de complexiteit van de problematiek te vatten en passende oplossingen aan te dragen. In plaats daarvan zijn transdisciplinaire benaderingen noodzakelijk die burgers, beleidsmakers en andere belanghebbenden betrekken in het doen van onderzoek en innovatie. Het daadwerkelijk ten uitvoer brengen van transdisciplinariteit wordt nog niet voldoende gestimuleerd. Daarom zijn de volgende beleidsinterventies noodzakelijk: (1) stimuleer transdisciplinair onderzoek en innovatie; (2) ondersteun transformative onderzoeksagenda's; en (3) stimuleer innovatieve experimenten die condities voor verandering scheppen. Concluderend stellen we dat zulke interventies kunnen bijdragen aan het stimuleren van transdisciplinaire en transformatieve onderzoeks- en innovatieprocessen die een belangrijke rol kunnen vervullen in het aanjagen van transities richting duurzame voedselsystemen.

In **hoofdstuk 6** presenteren we een gekoppeld-systeem-perspectief, waarbij het onderzoeks- en innovatiesysteem sterk vervlochten is met het voedselsysteem. Voortbouwend op de literatuur, beschrijven we eerst de verschillende typen onderzoek naar transformaties van voedselsystemen. Er is eerste orde transformatie-onderzoek, waarbij wetenschappers op afstand van het systeem onderzoek doen naar de dynamiek van transitieprocessen. Er is ook tweede orde transformatie-onderzoek, waarbij wetenschappers actief betrokken zijn bij transitieprocessen in het systeem dat ze tegelijkertijd bestuderen. Tweede orde transformatie-onderzoek is actiegericht en vaak transdisciplinair. In deze studie beschrijven we verschillende barrières die er zijn voor het doen van dit type transformatieve onderzoek. Deze zijn bijvoorbeeld de historisch gegroeide verkokering van wetenschappelijke instituten; het gebrek aan financieringsstructuren die transdisciplinariteit stimuleren; carrière-prikkels binnen de academische wereld die nieuwe samenwerkingsvormen verhinderen; het gebrek aan waardering voor transdisciplinaire processen en uitkomsten in onderzoeksculturen; methodologische uitdagingen binnen het zich ontwikkelende veld van transdisciplinaire duurzaamheidswetenschap; intrinsieke uitdagingen in het betrekken van actoren in lange-termijn processen gericht op maatschappelijke verandering; en een gebrek aan competenties bij onderzoekers en andere actoren voor het doen van transdisciplinair en transformatief onderzoek. We stellen in dit hoofdstuk dat deze uitdagingen dusdanig sterk en vervlochten zijn, dat we kunnen spreken van systemische uitdagingen binnen het onderzoeks- en innovatiesysteem. Daarom betogen we dat een gekoppeld-systeem perspectief nodig is. Om voedselsysteemtransities te bewerkstelligen, is ook de transformatie van onderzoeks- en innovatiesystemen noodzakelijk. Aan de hand van het FIT4FOOD2030 project als een voorbeeld beschrijven we ten slotte hoe interventies op de grenzen tussen verschillende systemen kunnen bijdragen aan een dubbele systeemverandering.

Empirische studies

In dit deel presenteren we een uitgebreide studie naar het FIT4FOOD2030 project. In **hoofdstuk 7** beschrijven we als intermezzo het FIT4FOOD2030 project, waarbij er een speciale nadruk ligt op de verschillende methoden en concrete activiteiten (ook wel "tools" genoemd) die het project gebruikt heeft om maatschappelijke actoren te betrekken in het project. In het vervolg van dit deel staat de volgende vraag centraal: "Hoe kunnen we de politiek begrijpen van, en sturing geven aan, transdisciplinaire experimenten in transitie-georiënteerde projecten?"

In **hoofdstuk 8** onderzoeken we de politieke uitdagingen van het betrekken van maatschappelijke actoren in transdisciplinaire processen. Uit de literatuur weten we dat het erg lastig kan zijn om verschillende soorten maatschappelijke actoren samen te brengen rondom complexe vraagstukken, zeker als er ook een focus ligt op lange-termijn transities. Dat was echter precies het doel van het FIT4FOOD2030 project. De 25 multi-actor Labs includeerden veel verschillende actoren in hun activiteiten en workshops. We onderzoeken wat voor politieke uitdagingen de coördinatoren van de Labs ondervonden terwijl ze deze 'inclusie' probeerden vorm te geven, en observeerden vier grote uitdagingen: (1) het op betekenisvolle wijze samenbrengen van machtige en gemarginaliseerde actoren; (2) het afwegen van deliberatie en representatie van verschillende (groepen) actoren; (3) een balans vinden tussen het vergroten van diversiteit en een (gezamenlijke) richting uitzetten; en (4) het vaststellen van de grenzen van het Lab en daarmee, wie of wat er geïncludeerd moet worden. In onze discussie beschrijven we onder andere dat deze intrinsieke en politieke uitdagingen een oorsprong vinden in een paradox: aan de ene kant is het vanuit inclusie-overwegingen wenselijk om het proces 'open te gooien' en te streven naar verbreding, aan de andere kant is het vanuit transformatie-overwegingen ook nodig om keuzes te maken, en dus ook bepaalde actoren of perspectieven te excluderen. De grond waarop inclusie en exclusie plaatsvindt vergt daarom veel reflexiviteit van degenen die dergelijke keuzes (mogen) maken, alsmede flexibiliteit om met onverwachte ontwikkelingen om te gaan, en robuuste methoden. Het 'doen van inclusie', concluderen wij, is daarom ook geen moment of eenmalige gebeurtenis, maar een continue uitdaging en hele politieke praktijk.

In **hoofdstuk 9** bestuderen we hoe multi-actor Labs proberen impact te creëren in het systeem waarin zij opereren. Uit eerder onderzoek weten we dat kortlopende experimenten, zoals de FIT4FOOD2030 Labs, niet altijd hele concrete maatschappelijke impact tot gevolg hebben. Tegelijkertijd weten we ook dat transdisciplinaire processen wel degelijk waarde hebben, en kunnen bijdragen aan het ontwikkelen van transformatieve capaciteit. In dit hoofdstuk ontwikkelen we een typologie van verschillende soorten impact die Labs kunnen hebben. In het bijzonder beschrijven we daarbij de afwegingen en uitdagingen die Labs in de praktijk tegen komen. We stellen dat transdisciplinaire processen in Labs op drie manieren kunnen bijdragen aan het opbouwen van transformatieve capaciteit (als een vorm van *agency*). Dat doen ze door het creëren van nieuwe relaties, nieuwe kennis en nieuwe competenties. Daarna beschrijven we vier manieren waarop Labs veranderingen proberen te realiseren in het systeem: middels het transformeren van netwerken, praktijken, structureren en culturen. We beargumenteren dat zowel het versterken van transformatieve capaciteit, als het creëren van veranderingen kan worden gezien als 'impact'. Tegelijkertijd blijft impact 'meten' of 'weten' erg lastig, zeker van één experiment of Lab. Een belangrijk inzicht uit dit hoofdstuk is dat evaluatie van 'impact' niet alleen over individuele experimenten of projecten moet gaan, maar richting het evalueren van portfolio's van projecten en experimenten om zo zichtbaar te maken hoe verschillende projecten en experimenten elkaar kunnen versterken.

In **hoofdstuk 10** onderzoeken we de translokale dynamiek van transitie-experimenten binnen een groot transitie-programma. De transitiewetenschap heeft de laatste jaren veel inzichten opgedaan over hoe individuele transitie-experimenten kunnen worden vormgegeven. Er wordt ook steeds meer bekend over hoe innovatieprocessen op verschillende locaties met elkaar verbonden kunnen zijn en hoe die elkaar kunnen versterken (of belemmeren). Op die manier kan *translokale* dynamiek ontstaan die kan leiden tot versnelling van transities. Er is echter nog ruimte om te onderzoeken hoe translokale dynamiek actief kan worden vormgegeven door programma's die op verschillende locaties experimenteren. Daar hebben we in dit hoofdstuk naar gekeken met als casus het FIT4FOOD2030 project dat 25 transitie-experimenten (in de Labs) ondersteunde. Op basis van de literatuur onderscheiden we vijf belangrijke elementen in transitie-experimenten: (1) mobiliseren van netwerken en middelen; (2) ontwikkelen van visie en richting; (3) ontwikkelen en implementeren van innovaties; (4) leren en reflectie; en (5) creëren van legitimiteit. Wij zagen daarnaast dat translokale dynamiek bestond uit een optelsom van verschillende interacties: lokale interacties binnen één experiment; interacties tussen verschillende experimenten; en interacties tussen experimenten en het overkoepelende programma. Onze resultaten beschrijven voor elk van de bovengenoemde elementen de verschillende typen interacties. In onze discussie stellen we dat dergelijke transitieprogramma's grote uitdagingen kennen, waaronder het samenbrengen van lokale behoeften en programma-ambities, en het aanhaken van programma's bij relevante beleidsontwikkelingen op verschillende schaalniveaus. We concluderen dat transitieprogramma's met experimenten op verschillende locaties een belangrijke bijdrage kunnen leveren aan het versnellen van transitiedynamiek, als ze in staat zijn de verschillende experimenten elkaar te laten versterken, zodat het programma meer wordt dan de optelsom van de individuele experimenten.

Discussie en conclusies

In de algemene discussie (**hoofdstuk 11**) worden de verschillende onderzoeksvragen per deel beantwoord, en licht ik de verwevenheid van de bevindingen van de verschillende hoofdstukken toe.

In bijzonder richt ik me hier op vijf overkoepelende thema's die de verschillende hoofdstukken doorsnijden, en waar ook richtingen voor vervolgonderzoek worden aangegeven. Een eerste thema is daarbij het vraagstuk rondom *impact*: hoe kunnen we impact van kortlopende transdisciplinaire projecten 'weten' en 'meten'? En hoe verhouden concrete uitkomsten zich tot wat meer onzichtbare, maar daarom niet minder belangrijke capaciteiten die kunnen worden versterkt? Een tweede overkoepelend thema omvat de rol van *complexiteit*. In dit proefschrift is de nadruk gelegd op de complexiteit van transities en van sturing geven. Maar als alles té complex wordt, vormt dat dan geen belemmering om transitiebeleid effectief en snel te implementeren? Hier reflecteer ik dan ook op de relatie tussen complexiteit, maakbaarheid, en de verhouding tussen experimenten en top-down beleid. Een derde thema gaat over het maken van *verbindingen* in sturing en beleid. Het onderzoek in dit proefschrift benadrukt zowel de noodzaak als de uitdagingen in het verbinden van verschillende systemen (onderzoeks- en innovatiesystemen met voedselsystemen); beleid (hoe kan innovatiebeleid dat gericht is op experimenteren, effectief gekoppeld worden aan thematisch beleid dat ingrijpt in de politieke economie?), en schaalniveaus (hoe kunnen lokale experimenten bijdragen aan grootschalige verandering?). Een vierde thema betreft de rol van *niet-mensen* (bijv. technologie, sociale structuren, ecologie) in transities. In de eerste hoofdstukken hebben wij laten zien hoe niet-mensen een rol spelen (of juist nog geen rol spelen) in de politiek en sturing van transities. Hier reflecteer ik op hoe niet-mensen in het werk in dit proefschrift een rol speelden, en wat dat betekent voor hoe we democratisering van transitiesturing verder kunnen vormgeven. Het vijfde thema, ten slotte, reflecteert op de rol van *academische systemen*. Kunnen deze wezenlijk bijdragen aan duurzame verandering, als het doen van 'ideale' transdisciplinariteit zoveel uitdagingen kent, en universiteiten zelf te kampen hebben met persistente problemen rondom uitsluiting en onrechtvaardigheid?

Ik reflecteer in dit hoofdstuk ook op de verschillende keuzes die gemaakt zijn om bepaalde concepten te hanteren in dit proefschrift, en op de verschillende rollen die ik had binnen het FIT4FOOD2030 project.

In **hoofdstuk 12** worden aanbevelingen gepresenteerd. Het betreft 10 aanbevelingen voor transdisciplinaire onderzoeks- en innovatieprojecten, en 10 aanbevelingen voor beleidsmakers en financiers op het gebied van onderzoek en innovatie.

In **hoofdstuk 13** worden de belangrijkste conclusies samengevat. De belangrijkste conclusie van dit proefschrift is drievoudig: een sterke focus op de politiek van transities, in combinatie met actiegerichte betrokkenheid in een transitie-project, heeft ons in staat gesteld;

(1) *zichtbaar te maken* hoe multi-level, multi-schaal en multi-systeem dynamieken de grond raken in transdisciplinaire experimenten, wat licht doet schijnen op de translokale dynamica van experimenten en de rol van transdisciplinariteit in EU voedselsysteemtransformatie; dat stelde ons in staat te

(2) *articuleren* wat de inherente en politieke uitdagingen waren in het ‘doen van transities’, in het bijzonder betreffende (i) het balanceren van hier-en-nu-project dynamica met transformatieve lange-termijn ambities; (ii) het sturen van diversiteiten van inclusie in samenspraak met richtinggevende transformatieve ambities; en (iii) het weten of en op welke wijze project activiteiten nu daadwerkelijke bijdragen aan verandering; dat hielp ons in het

(3) *formuleren* van strategieën voor sturing, die de bovengenoemde uitdagingen kunnen navigeren in transitie-projecten; en het aandragen van aanbevelingen voor diegenen die werken aan het versnellen van transities, in het bijzonder toegespitst op diegenen die betrokken zijn in onderzoeks- en innovatieprojecten, en beleidsmakers.

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CURRICULUM VITAE

Kristiaan Paul Willem Kok (July 18, 1993) was born and raised in Amstelveen, the Netherlands. After graduating from the Keizer Karel College in 2011, he pursued a bachelor in Bèta-Gamma (Natural and Social Sciences) at the University of Amsterdam (UvA). He majored in Physics and Political Sciences and completed his degree cum laude in 2015. In 2017 obtained a MSc in Advanced Matter and Energy Physics at the UvA, where he graduated cum laude on the dynamics and structure of phase transitions in colloidal glasses. During this research, he was a visiting researcher at the School of Engineering and Applied Sciences of Harvard University. After returning to the Netherlands, he completed a MSc (cum laude) in Political Sciences, track Public Policy and Governance at the UvA, where he graduated with a thesis on the politics of sustainability transitions.

In 2018, he started his PhD at the Athena Institute of the VU University in Amsterdam, under the supervision of Prof. Dr. Jacqueline Broerse and Dr. Barbara Regeer. His work focuses on the politics and governance of sustainability transitions, with a particular emphasis on the role of democratization and power dynamics. He is mainly interested in understanding and supporting transdisciplinary experimentation processes. He was involved in the FIT4FOOD2030 project, that supported the European Commission in future-proofing food systems through transdisciplinary research and innovation. This project forms the empirical bulk of the thesis.

He has been playing classical accordion for over 20 years, and as part of the group Kwintetto he has been performing in the Netherlands and abroad. He likes theater, going to concerts, cycling and to be around friends and family.

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De academie is één ding, maar uiteraard is er meer. Wat niet iedereen weet, is dat ik al decennia lang de dinsdagavonden vrij hou omdat ik dan *acte de préséance* geef bij 'accordeon'. Samen muziek maken houdt je scherp en goedgemutst, en ik ben daarom alle spelers van MDA en Kwintetto (in het bijzonder **Doris, Francien, Jacqueline, Jorn, Marianne, Martini** en natuurlijk **Robert**) dankbaar voor alle muzikale en de andere gezellige momenten. De vele reizen en vooral die naar Innsbruck waren fantastisch, zowel muzikaal als feestelijk (uiteraard bedoel ik de *Abend der Nationen*).

De zaterdagen zijn natuurlijk gereserveerd voor niemand minder dan de **Zatterdag**. Het begon bij bèta-gamma, en naast de Sinterklaasviering als jaarlijks hoogtepunt doen we ook graag aan wandelon door de bergon (er is zelfs een bijbehorend lied!), en wordt er flink wat gegeten, gedronken en natuurlijk, belachelijk veel gelachen. De politieke antenne is vaak scherp afgesteld, wat ook tot de nodige maatschappelijk relevante discussies kan leiden. Een podcast gaat er zeker komen. Lieve **Emiel, Eva, Evita, Joost, Lisa, Maja** en **Moed**, dank voor alle mentale steun en de vele fijne momenten de afgelopen jaren. Ik ben trots hoe iedereen een eigen pad kiest, en ik kijk uit naar het moment dat we allemaal weer in hetzelfde land wonen! Zoals een wijze vrouw al eens schreef: allemaal heel erg bedankt!

Veelvuldig zilver maakt nog lang geen goud. Dat weten de sterspelers van het ondergewaardeerde doch overijverige pubquiz-team **Boudoir en de Blote Banjo's** maar al te goed. Met maar liefst vier (soon-to-be) doctoren in het team, wint de hoogmoed het maar al te vaak van het verstand. Dat leidt vooral tot lege flessen en hoge rekeningen. Ter verdediging, de vragen kunnen dan ook niet altijd over kinderdarmen (Dr. **Sjoerd**), verkouden fretten (Dr. **Koen**) of opgevouwen chromosomen (bijna-Dr. **Claire**) gaan. Gelukkig hebben we de onuitputtelijke muziekkennis van **Josie** en de spelmentaliteit van **Ruben** nog. Het NK komt er aan, en met nieuwe koninklijke dilemma's in aantocht gaan we nog jaren plezier, champagne en tweede plaatsen tegemoet.

Tranen van het lachen is het volgende gezelschap niet vreemd, maar wat verwacht je ook van een groepering met als geuzennaam de **Ratten**? Boottochtjes, pretparken (samen in het schommelschip) en weekenden weg. Een collectief dubieuze doch heerlijke muzieksmaak, waar enthousiast bij wordt meegezongen. Ook filosofische discussies worden niet geschuwd: is het nou on omdat het off is, of gaat het off omdat het on is? Dergelijke uitspattingen zijn natuurlijk te verwachten van een toneelgezelschap. **Anniek, Elmer, Jelle, Josie, Mirthe en Ruben**, sjatten, onwijs veel dank dat jullie er de afgelopen jaren voor me waren, op de hoge en lage momenten. Wanneer zijn we eigenlijk voor het laatst… In elk geval, ik kijk er naar uit om snel weer wat diepte-interviews af te nemen op een weekend, en naar alle andere hilarische momenten die absoluut gaan volgen.

Dat roept ook de vraag op: wanneer zetten we de volgende stap? Ik heb het gevoel dat we daar na mijn promotie meer tijd voor hebben. **Jur** en **Mick**, jullie zijn inmiddels met z'n drieën, dat kan alleen maar nóg meer plezier betekenen! **Roos**, onze gezellige vaste lunch bij de krokettenzaak geeft altijd hernieuwde kracht. **Iris**, het stelt mij gerust dat wanneer ik de verdediging grandioos weet te verknallen, er een spetterende toekomst gloort met Bar Krisis. Dat de arbeidsproductiviteit in de maand december traditiegetrouw naar een dieptepunt daalt heeft alles te maken met de hersenkrakers in de AIVD kerstpuzzel. Een puzzel die **Jorn** en ik samen met het associërend vermogen van **Eske** en sporadisch de brute programmeerkracht van **Marjo,** met de jaren tot een beroerder einde weten te brengen.

In een ver verleden werd mij verteld: *"Kris, you should think out of the box!"* **Isabel**, dank voor de wijze lessen, je betrokkenheid en de gezellige borrels! **Sandra**, hoeveel maanden Pandemic moeten we nog spelen? Dank voor alle vrolijke momenten, en de vele keren dat ik 's avonds weer eens bij jullie op de bank zit! **Emma**, je bent de meest Gucci classica die de wereld ooit gekend heeft! Veel dank voor je denken over macht en de rosé. **Anne**, bij jou komen veel werelden samen. Ik kijk weer uit naar de volgende excursies naar het concertgebouw, een stuk snoeihard trappen, en nieuwe praatjes. Heel veel dank!

Van de wieg tot het graf is een passende uitdrukking voor de **Heren**. We overleefden samen de Piet Hein, het KKC, de Amsterdamse studententijd en tegenwoordig verwonderen we ons over het "volwassen" bestaan. Jaarlijks terugkerende evenementen zijn de gezamenlijke vakanties (uit pure noodzaak opgeschroefd naar twee per jaar), het minigolftoernooi (bij de gedachte aan de Rode Lantaarn breekt het angstzweet me uit) en een reflexieve Nieuwjaarsviering. Een gezelschap met veel hoogste woorden. Waar het aan scherpte nog wel eens kan ontbreken, weten we gelukkig te compenseren met overtuigingskracht. Ik vrees dat we over de hele wereld een verpletterende indruk hebben achter gelaten. **Camiel, Cor, Joël**, **Joris, Lucas, Matthieu en Yves**, ik kan me geen wereld indenken zonder jullie als constante factor. Dank voor de gulle (en valse) lach, de jarenlange vertrouwdheid, en natuurlijk een arsenaal aan herinneringen (daar getuigen ook de vele gezamenlijke kinderfoto's van). Ik kijk uit naar nog vele jaren op de achterbank.

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We gaan nu in reprise, maar dat is volledig gerechtvaardigd omdat ik mijn twee paranimfen nog wil bedanken. **Matthieu**, het is niet meer dan logisch dat jij tijdens de verdediging naast me staat. Ik kan me geen feest herinneren dat we níet samen hebben georganiseerd. Allemaal unaniem een belachelijk groot succes natuurlijk. Als huisgenoot kan je me na afloop ook nog eens veilig naar huis brengen. Veel dank dat je er ook deze dag bent! **Jorn**, er wordt wel eens gezegd dat ik jouw tweede huwelijk ben (straks écht nota bene!), maar dat zou treurig zijn want dat maakt jou mijn eerste huwelijk. Of toch niet? In elk geval heeft ons Jut en Jul gehalte ons over de hele wereld gebracht, en gaan we straks eindelijk allebei als doctor door het leven. Ik ben blij met onze vriendschap, dank voor heel veel!

En tot slot, hoe kan het ook anders, mijn allerliefste ouders Truus en Wim. Jullie hebben mij altijd ten volste gesteund, aangemoedigd, uitgedaagd, liefgehad, en in mijn kracht gesteld, daar ben ik heel dankbaar voor. **Pap**, ik wilde altijd net als jij ‘in de wetenschap’ en we hebben dezelfde (flauwe) humor. Je bent dan met pensioen, we maken nog steeds af en toe samen muziek! **Mam**, ik vind het heel fijn om te zien dat je met zo veel plezier nieuwe (creatieve!) dingen doet. Je weet precies hoe ik me voel en stelt me altijd gerust. Ik ben heel blij dat we dit feestelijke moment samen gaan delen, kijk uit naar nog heel veel jaren vol leuke en mooie momenten, en ik ben heel gelukkig met ons drie!

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