3

TRANSFORMATIONS

Theory, research and action

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Introduction: a reflexive approach

The previous two chapters have provided a background to the ‘Pathways’ transformative knowledge network (TKN), its genesis, ambitions and overall transdisciplinary approach. This chapter draws attention to earlier work that has engaged with concepts of transformation and describes the long history of action/activist research that has emerged in response to various sustainability problems. This raises questions about the positionality of researchers in this process, and the implications of epistemological frameworks and normative commitments for transdisciplinary science. In considering these implications, the chapter tries to adopt a reflexive approach (in line with wider pathways thinking) that recognises how structures and circumstances condition our work.

In adopting such an approach, it is apt to ask “why write a book?” The years of person-time and the other resources that went in to the production of this output could be seen as being in tension with the project’s transformational ambitions. Even if the original proposal outputs included “possibly an edited volume incorporating experiences and insights at the local and global level”, this was not a firm commitment. Indeed, as our final report provided to the funder made clear, some of our most important achievements were not academic in nature at all, but rather embodied in the actions and networks that had emerged from our work. The fact that we are writing a book, and the nature of the publication itself (and its constituent chapters) is in part driven by our different institutional settings. In various ways these shape the expectations placed upon us, and to some extent cast us in our roles as researchers, scientists or activists. Production of an edited volume can be seen as a response to universities’ demands for “knowledge products” (Russell et al. 2008). But this is only part of the answer. Despite the differences in publishing cultures across the TKN, the documentation of our collective efforts

in this format (alongside many other media, in different formats and languages) was seen as worthwhile. Further, the interactions necessary for the production of this shared output, years after the formal end of the project, helped us to realise our ambitions to learn across disciplines, cultures and contexts. Attempting to distil some of this learning into book form has been an important part of the research process.

This learning highlighted the different emphases on theory, research and action possessed by the various hubs, and the researchers within them. There are transdisciplinary action research histories in each of the different regions from which the TKN membership is drawn, of which many of us are aware. However, their imbalanced representation in formal academic literature (especially that confined to the English language) means that most analyses are deeply situated in the Western tradition. Despite the shared insights and cross-learning that we have achieved, the format of this document to some extent continues in that tradition. Nevertheless, the project offered the opportunity of a considered reflection of transformations research and how science itself may need to be transformed with a focus on coproduction and learning rather than codification of knowledge products. As such, this document should be read as a partial and particular reflection on the TKN's work, rather than seen as the culmination of its activities.

The chapter begins by outlining some of the existing theory around transformations, and then considers the role of research in transformations and the need to reflect on framings. We then move beyond research to action, and point to relevant literatures from around the world that have bridged this divide. Coming back to the project, we consider how we attempted to adopt a reflexive approach that did not prioritise knowledge (theory/research) or action but saw them as tightly interwoven. The learning that emerged was to some extent codifiable but the transformative pathways we sought are much more about the changes in individuals, and in the actions and networks that resulted from the project than whatever is contained within the pages of this book.

Sustainability, change and transformation

For decades, researchers of sustainable development have recognised that the urgency and scale of sustainability challenges require systemic changes rather than changes at the level of individuals, populations, technologies or behaviours (Meadows et al. 1972; Schot et al. 1997; Berkes et al. 2003). The challenges are particularly complex, when we recognise that sustainability itself is viewed from very different perspectives (Leach et al. 2010a) and from global to local levels (Steffen et al. 2015). Hackmann and St Clair (2012) provide an academic perspective on systemic responses to “ever-expanding environmental problems and disaster risks on the one hand, and converging crises of climate, inequality, food, water, finance and social discontent on the other”, highlighting the role of social science. A contemporary political recognition of the need for systemic change is

underlined by the title of the 2030 Agenda for sustainable development and the SDGs ‘Transforming our World’ (United Nations 2015). But multiple transformations can be conceived, each with their own underlying rationales and politics (Scoones et al. 2015). As Feola (2015) argues, “high conceptual elasticity and lack of empirical grounding of the concept of transformation generate the risk of voiding the term of meaning”. Prior to embarking on a study of transformative pathways to sustainability, therefore, it is worth reviewing some of the contours of the conceptual debates around term.

Approaches to understanding such processes of transformation in social systems date back at least as far as Marx’s (1859; 1867) recognition of shifts in relations between “base” and “superstructure”, or more recently Polanyi’s (1944) work “The Great Transformation”. Such approaches have been characterised by Scoones et al. (2018) as “structural”, in that they focus on deep changes in the structural relations of politics, economy and society. While notions of social sustainability (although expressed in different terms) are fundamental to these analyses, the environment sustainability element is minor. Writers such as Fraser (2014) have taken some of Polanyi’s ideas forward to analyse contemporary ecological, social and financial crises. Individual scholars have adopted structural approaches as a largely analytical lens on transformations, pointing towards the relationships between carbon-based economies and power (Mitchell 2011) and considering the structural implications of decarbonisation (Newell and Paterson 2012) or degrowth (D’Alisa et al. 2014).

More recent work, by growing communities of scholars, has looked at change in socio-technical (Grin et al. 2010), ecological and socio-ecological (Olsson et al. 2014) systems. Scoones et al. (2018) label these approaches ‘systemic’ and characterise them as focussing on particular features such as species, actors or technologies (and the relations between them). Those literatures focussing on socio-technical system *transitions*, especially those adopting a *transition management* perspective (Grin et al. 2010), see government as a central actor introducing incentives, investments and policy initiatives can help to bring about changes in a way that fosters instrumental objectives including social and environmental sustainability (see, e.g. Kemp and Rotmans 2005; Kern and Howlett 2009). Scholarship is seen as being able to inform such policy initiatives, suggesting that knowledge underpins action.

In contrast to such controlled *transitions*, Stirling (2015) points to transformations as “more plural, emergent and unruly political re-alignments, involving social and technological innovations driven by diversely incommensurable knowledges, challenging incumbent structures and pursuing contending (even unknown) ends” (Stirling 2015: 1). Under this perspective, the role of government is less central, and greater agency (sometimes in adversarial relations with government) is attributed to civil society. This might take the form of coalitions and alliances are formed (Schmitz 2015), advocacy ‘from below’ through social movements (Scoones et al. 2015) or action through grassroots innovation networks (Smith and Ely 2015). While this distinction between transition and

transformation is not evidenced by bibliometric analysis of the literatures (at least in the energy field – Chappin and Ligetvoet 2014), it is adopted to varying extents in the chapters of this book and shared by other scholars highlighting resistance movements (Temper et al. 2018) who argue that “while transitions literature tends to focus on artifacts and technologies, we suggest that a resistance-centred perspective focuses on the creation of new subjectivities, power relations, values and institutions”.

Socio-ecological systems scholars draw upon studies of resilience that have emerged from ecology (Holling 1973), applying and extending the concepts to analyse interactions with human (social) systems (Folke et al. 2002). In translating these studies to the policy field, they have largely moved beyond the expert-led decision-making and governmental management approaches to an appreciation of complex socio-ecological systems undergoing adaptive cycles at multiple, hierarchically structured scales (Gunderson and Holling 2002; Olsson et al. 2006). While these approaches have their critics, social-ecological systems play an important conceptual role in informing the notion of T-Labs (Chapter 4) and specific hub work (e.g. Mexico).

Patterson et al. (2015, 2017) and Blythe et al. (2018) also point to these “systemic” approaches in their account of four approaches to transformations, namely, “socio-technical transitions and transition management” and “socio-ecological transformations”, to which they add transformative adaptation (e.g. Pelling 2011) and “sustainability pathways” (e.g. Leach et al. 2010a). There is significant scope for interaction between these approaches (see, e.g. West et al. 2014 on synergies between the socio-ecological and pathways approaches). In a broad review, Foela (2015) offers a sophisticated framework for comparing different systemic approaches, based on “system model”, “form and temporal range”, “seat of causality and social consciousness” and “outcome” to distinguish between different approaches, and makes a plea for the testing of “different concepts and theories of transformation in empirical research” – a plea to which this book responds.

A third category of ‘transformations’ studies described by Scoones et al. (2018) highlight the agency and uncertainties inherent in choosing the aims and direction of transformation, and focus on revealing the different values, knowledge and relationships (including power relations) involved in change. These “enabling” approaches emphasise human agency, collective action, political mobilisation and emancipation, and aim to challenge incumbent interests and control, thus representing a move from analysis or policy advocacy to engaged scholarship and research as activism. Examples include community-led environmental action, hacker/maker spaces for grassroots innovation or commoning approaches to sustainable local economies (Scoones et al. 2020). While often attending to localised challenges, enabling approaches often reflect a desire to contribute to structural or systemic transformation at higher levels.

These various concepts can help us not only to understand transformative social-technological-environmental change as it has unfolded in the past, but can also inform work of transdisciplinary scholars working in different contexts

towards the 2030 Agenda. In such a complex sphere, moving from analysis to action means not only identifying (and supporting) alternative pathways, but also challenging incumbency (and the structures with which it is entangled) in contexts where power relations are often highly skewed in favour of unsustainable production and consumption. It raises difficult and fundamental questions for networks embedded primarily within academic research organisations that are not geared towards transformation. It requires attention to political rigour as well as academic rigour (Temper et al. 2018, 2019) and an alertness to the risks through which scholarship in this area may become implicated in unsustainable practices, social inequality and injustice (elsewhere referred to as the “dark side of transformation”; Blythe et al. 2018).

The work described in this book draws insights from structural and systemic approaches, and to varying extents adopts enabling approaches that involve transdisciplinary collaboration, a recognition of different perspectives and framings and a normative commitment to contributing to directions of progressive social change.

The role of research in transformative pathways to sustainability

Brand (2016) writes that the term “transformation” can be used either analytically (to analyse past and present changes in order to assess and explain them) or strategically (to denote the kinds of changes required to overcome environmental and social challenges). Likewise, “transformative pathways to sustainability” can be an analytical tool or a strategic tool. This book explores a move from the use of the pathways approach to understand the direction in which interacting social, technological and ecological systems co-evolve to one that attempts to contribute to the emergence of those directions, supporting plural alternative pathways with a commitment to environmental sustainability, poverty alleviation and social justice. As such, it exemplifies what Feola (2015) describes as the solution-oriented or “transformational social science” (Hackmann and St Clair 2012) perspective as a direct call for the social sciences “to take a more strategic and operational approach to issues of change”, while retaining a commitment to plurality.

Given the different political contexts evidence in the Pathways Network hubs, significant flexibility was required in order to operationalise the notion of ‘transformational social science’, acknowledging the institutional and external pressures imposed on researchers and other members of the teams in each case.

Flexibility was also required due to the different *disciplinary cultures* that were prominent in each hub (see Chapter 2). While the theoretical anchors discussed in the previous chapter (systems, framings, pathways) to some extent provided a common language across each hub, theoretical conceptions of transformation differed. This sometimes translated into divergences in epistemological views, which combined with different objectives and strategies around the appropriate role of researchers in studying or intervening in systems. These different objectives, and the underlying theories of transformation that were applied in each case, are compared in Table 3.1.

TABLE 3.1 Objectives and underlying theories of transformation from TKN hubs

<i>Hub</i>	<i>General objective of project/case study</i>	<i>Underlying theories of transformation that inform the choice of method</i>
UK	To design and implement research and “transformation laboratories” with the aim of enhancing the supply of local, sustainably produced food into Brighton and Hove (and drawing wider lessons for the UK’s agricultural transformations).	Transformation is influenced by changing cognitive, affective and political economic drivers that work across individuals, groups and systems. Pathways, politics of green transformations, governance of sustainable socio-technical transitions, transformative pathways.
Argentina	To design and implement “transformation laboratories” (T-Labs) with the aim of creating an experimental space in which coalitions of heterogeneous actors can agree on a sustainability problem in the agricultural seed sector and develop and prototype possible solutions.	Transformation involves experimentation with novel, more sustainable socio-technical practices and the development of alternative ‘path breaking’ socio-technical configurations.
Africa Hub (Kenya)	To use the T-Lab approach to explore how Kenya can enable sustainable and equitable access to solar home systems for all via mobile-based payment systems, especially those who can’t participate in micro-financing schemes.	The T-Lab involved different stakeholders (government, NGOs, civil society, private sector development partners, research and academia) who provided rich and diverse insights into what needs to be done or changed to enable equitable, sustainable access for all, to solar PV systems via mobile-based payment systems.
China Hub	This study engages in the social dimensions of green transformation in order to provide a more holistic picture of the transformations to sustainability.	Transformations in China are driven by a number of actors. The change agents are different stakeholders in transformation, including laid-off workers, former plant owners, local government officials, scholars, NGOs, etc.
Mexico	To design and implement a process known as “transformation laboratories” with the aim of identifying, mobilising and activating individual and collective agency of actors involved in the social-ecological dynamics of the Xochimilco urban wetland.	Transformation is about bottom-up building of collective agency through reframing systems dynamics – transformations to sustainability; transformative agency; pathways.
South Asia Hub (India)	To design and implement transformation labs as a process with the aim of promoting a collective strategy for intervention to bring together the mobilised publics specifically representing poor and marginalised along with middle classes to develop the collective practical understanding and build alliances for enabling their participation in planning and decision-making processes of water and waste water management.	Transformation is conceptualised as enabling the people as a whole specifically poor and marginalised to enhance their access to resources and capabilities for mobilisation of power to innovate and foster regime change that helps to create conditions for the realisation of ecologically and socially just development.

Researchers' framings of sustainability

Researchers play an important role in framing sustainability transformations, and this calls for reflexivity, given the power they hold as actors within them. Working across and beyond different disciplines alerts us to the fact that sustainability is subject to very different and conflicting understandings. One of the tools deployed by the STEPS Centre's "pathways" approach to transdisciplinarity is a conscious appreciation of framings, which are defined as "the different ways of understanding or representing a social, technological or natural system and its relevant environment" (Leach et al. 2010a). The notion of framings is represented in Figure 3.1 and accompanying Table 3.2, both originally drawn from Leach et al. (2010a).

This explicit attention to different framings, adopted within a transdisciplinary approach, aims to recognise the role of power in shaping knowledge and action. Contending *analytical* framings from the various natural and social sciences – let alone contending *actor* framings – differ in "the ways system elements are bounded, characterized and prioritized, and meanings and normative values attached to each" (Leach et al. 2010a: 4). This aspect of the pathways approach has been applied previously in domains such as energy (Byrne et al. 2011), agriculture (Van Zwanenberg et al. 2011), bioenergy (Cavicchi and Ely 2016), health (Leach et al. 2010b) and urban waste management (Randhawa et al. 2020) to understand how the framings of more powerful actors come to dominate in policy discourse over those of more marginalised groups. This can lead to a locking in of policy to the specific pathways favoured by those powerful actors, and the occlusion and crowding out of alternative perspectives and "subaltern" pathways (Stirling 2012). In these cases, framings have been identified empirically in

FIGURE 3.1 Multiple framings (adapted from Figure 3.1 from Leach et al. 2010a, p. 44).

TABLE 3.2 Dimensions of framing

<i>Choice of elements</i>	<i>Subjective judgements</i>
<ul style="list-style-type: none">• Scale• Boundaries• Key elements and relationships• Dynamics in play• Outputs	<ul style="list-style-type: none">• Perspectives• Interests• Values• Notions of relevant experience• Goals

Box 3.1 from Leach et al. (2010a, p. 45).

the narratives that are adopted and repeated (or neglected and ignored) on the basis of documentary evidence.

The ‘Pathways’ TKN’s action-orientation required a different approach. In each of the cases described in this book, attention has been given to how systems and their potential transformations to sustainability have been framed, by both actors and analysts. Each locally defined sustainability challenge (see Chapter 4) reflected a particular framing, emerging from the co-design of each local project. Maintaining a self-reflective and critical approach that recognises the power that researchers (and their disciplinary and theoretical assumptions) have to frame sustainability challenges in particular ways has been important as the research has progressed (Marshall et al. 2018).

The chronological histories presented in Chapters 5–10 illustrate how researcher framings influenced the work carried out in each hub. However, they also show how transdisciplinary interaction led plural framings to guide the work from the outset. Engagement with non-academic partners in each of the cases in this book started at the co-design phase (see Chapter 2 for a discussion of the phases of the project), launching “from the assumption that scientific knowledge combined with others’ knowledge is itself a powerful agent of change” (Moser 2016). Through the T-Labs, these framings evolved as the projects progressed, leading to reframing processes discussed further in Chapter 11. This reflected the project’s shift from research to action, and a focus on transdisciplinary learning.

From research to action: transdisciplinary research and its intellectual heritages

Working across more than one scientific discipline in parallel (multi-disciplinarity) and in combination (interdisciplinarity) has long been recognised as a feature of problem-oriented, action research. There is increasing interest in transdisciplinary research from the sustainability transformations community (Hackmann and St. Clair 2012; Mauser et al. 2013) alongside significant conceptual efforts from European groups like TD-Net (Hirsch Hadorn and Pohl 2007; Hirsch Hadorn et al. 2008) and a recognition of the diversity of

approaches used in different countries (Von Wehrden et al. 2019). Earlier appeals to transdisciplinarity (although other terms were used) were made by Western researchers in international development (Chambers 1983; Hall 1992 to “participatory research”) or in science and technology policy studies (Gibbons et al. 1994 to “mode 2” knowledge production). However, many of these ideas developed alongside and were pre-dated by a multitude of different intellectual heritages from across the globe.

Influenced by Paolo Freire’s notion of *conscientization* and Nyerere’s policies in Tanzania (among other phenomena), the original ‘Participatory Research Project’ at the International Centre for Adult Education in Toronto in 1976 had interacted with and learnt from other colleagues in India, Venezuela, Tanzania and the Netherlands (Rahman 2008). Latin American scholars in the 1970s and 1980s called for new forms of research combining theory, action and participation (Fals-Borda 1979), as others sought new trajectories of socio-technical change that better responded to local priorities, problems and circumstances (Herrera 1979; Sunkel and Gligo 1981).

Reflecting a long history of participatory action research in South Asia (Rahman 1985) and debates around the role of science and society dating back to Gandhian-based Sarvodaya movement (e.g. Krishna 2001), components of the Indian research system have attempted to foster collaboration with non-academic (especially rural) sectors of society since shortly after independence. In China, non-expert (“peasant scientist”) participation in research was encouraged during Mao’s time (Oldham 1964); however, has more recently been less well-established outside specialist groups, e.g. in the agricultural domain (e.g. Li et al. 2009; Song and Vernooy 2010).

African scholars and practitioners have also pointed towards ideas that resonate with the notion of transdisciplinarity, highlighting the importance of knowledge being rooted in particular socio-cultural and historical contexts (Urama et al. 2010). Much of the work from the continent – theoretical and experimental – has roots that go back to post-colonial periods and reflect both nationalist ideologies and pan-Africanist politics (Mangu 2006; Nabudere 2006).

In contemporary Europe, transdisciplinary research thrives around networks associated with the Wuppertal Institute (<https://wupperinst.org/en/>), ETH Zurich and TD-NET (www.transdisciplinarity.ch/en/td-net/Ueber-td-net.html) and DRIFT (<https://drift.eur.nl/>) among others. Considering transdisciplinary research as a component of sustainability science Brandt et al. (2013) investigate the process phases, knowledge types and the intensity of involvement of practitioners displayed by 236 peer-reviewed transdisciplinary papers. Their findings are presented in relation to five pre-identified challenges, represented in Table 3.2.

As transdisciplinary research has been formalised to become a focus of study and excellence in itself, terminologies have become entrenched within particular networks and to some extent more fragmented (as noted by Brandt et al. 2013). Klein (2020) provides a wide-ranging review of sustainability and

TABLE 3.3 Challenges for undertaking transdisciplinary approaches in sustainability science

<i>Challenge</i>	<i>Finding of review (Brandt et al. 2013)</i>
Coherent Framing.	Transdisciplinary Research in Sustainability Science is Increasing, but Under Diverse Term
Integration of Methods	Method Sets Used are Independent of Process Phases and Knowledge Types
Research Process and Knowledge Production	There is a Gap Between ‘Best Practice’ Transdisciplinary Research as Advocated and Transdisciplinary Research as Published in Scientific Journals
Practitioners’ Engagement Generating Impact	Knowledge is Interchanged, Yet Empowerment is Rare Generating Transdisciplinary Research with High-Scientific Impact Remains Challenging

Derived from Brandt et al. (2013).

transdisciplinarity by focussing in on specific keywords to elucidate shifts from interdisciplinarity and different forms of learning and knowledge.

In other work, transdisciplinary interactions between researchers and other societal groups throughout the process have been referred to “co-production”. Differing from both interactional constitutive co-production (as defined by Jas-anoff 2004) this term has assumed an important role in recent research in transformations to sustainability. Miller and Wyborn (2018) review the history and theory around co-production from a much broader set of disciplines and fields (including public and business administration, science and technology studies and sustainability science), arguing that some convergence is visible across traditions. They argue that co-production practices should recognise and value both process and outcomes, summarising as follows:

- 1 Be inclusive in the diversity of participants, the power accorded to them, and the processes and objectives of co-production. Ensure that the institutions that enable co-production attend carefully to the credibility, legitimacy, and accountability this entails.
- 2 Acknowledge that co-production is a process of reconfiguring science and its social authority. Such processes require participants to be reflexive about the inherently political nature of producing knowledge in the service of changing social order at local to global scales.
- 3 Recognise that public engagement, deliberation, and debate will shape the content and relevance of knowledge and its ability to help construct and empower institutions to facilitate sustainability.

Norström et al. (2020) put forward their own principles for knowledge co-production, which they describe as “part of a loosely linked and evolving cluster of participatory and transdisciplinary research approaches that have emerged in recent decades”; their perspective urges that coproduction processes be

“context-based”, “pluralistic”, “goal-oriented” and “interactive”. They suggest that “many researchers still face incentive structures that primarily reward disciplinary science that does not engage with society” while “many practitioners work within organisations that do not incentivise critical reflection, ongoing learning and revision of actions”. But coproduction challenges the distinction between research and practice (pointing towards a praxis mode), and indeed between knowledge and action. If “co-production is a process of reconfiguring science and its social authority” as Miller and Wyborn suggest, then it implies questioning the modernist assumption that (research-based) knowledge should inform action in the first place. Instead, action research by individuals, teams and networks proceeds through a constant negotiation of unfolding pathways, which is conditioned by the various knowledge systems, power relations and institutional structures within which the various actors are embedded. Whether or not this implies a necessity for modernist practices themselves to be transformed (Arora 2019), it at least calls for attention to positionality and an engagement with power in transformative action research. Within the wider context of this book, it leads us to question whether “transformative pathways” may involve shifts in authority away from science, and incorporate processes both of learning and unlearning.

Transformation, positionality and learning

As discussed in Chapter 2, the hubs in the TKN shared a normative commitment to understanding *and supporting* pathways to sustainability, and ambitions during the project to evaluate change and understand “what has worked”. The diversity of contexts presented particular challenges with respect to the double loop learning approach, which is more reflexive than linear models of evaluation and learning that often adopt predefined theories and indicators of change.

Just as they had adopted different conceptual understandings of transformation, the TKN hubs defined different theories of change (representing their understandings of how their own interventions would contribute to transformation.) We had started to do this at the inception workshop in Buenos Aires using an adapted participatory impact pathways analysis approach (PIPA – see Ely and Oxley 2014) and at the T-Labs training and reflection workshop in Dundee in 2017, where hub teams drew diagrams describing the strategies adopted. The discussions in Dundee also provided us with an opportunity to reflect on our positionality as researchers. Brief notes from the discussion – a snapshot capturing the thinking at the time – are represented in Table 3.4. The positionality of researchers as “elites” in many contexts, and the power imbalances between hub teams and others in the T-Labs (also discussed in Chapter 4) had already been recognised at earlier stages of the project (see Ely and Marin 2017) but the Dundee meeting allowed them to be revisited in the light of project work to date (resonating with insights from another of the TKNs on ‘political rigour’ as a necessary complement to academic rigour in transformations research – see Temper et al. 2019).

TABLE 3.4 Summarised notes around theories of change and positionality identified by Pathways TKN hubs at the T-Lab training and reflection workshop Dundee, 2017

	<i>Argentina</i>	<i>UK</i>	<i>Mexico</i>	<i>India</i>	<i>China</i>	<i>Kenya</i>
Theory of Change	Looking at alternative forms of agriculture, working towards empowering farmers directly and indirectly. Open-source seed system in place.	Goal to change the land use around the city. Small and marginal farmers.	Strategy oriented towards informally organised groups. Aim to reframe the problem.	Assertive, agenda-setting, mobilisation towards building new imagination about the problem.	Green policies that are already in place, so not looking for concrete intervention. By creating knowledge and awareness they are fostering change beyond the project.	Role of knowledge production.
Positionality	Collaboration with different agencies and working to ensure access to seed availability to farmers.	Generating new knowledge as well as synthesising existing knowledge.	Facilitators developing action towards creating agency. Risk: will agency be maintained?	Researchers cannot be drivers without being transformed themselves, so main role is trying to link the objectives of the groups, identify opportunities and try to mobilise the groups.	Knowledge facilitators by empowering actors, e.g. existing knowledge. Agent of empowerment.	Also knowledge facilitators and synthesisers of knowledge – by putting actors together they understand how the technology impacts. Acting as agents of understanding.

Note that these should be viewed as a partial “snapshot”, and continued to evolve as the project progressed (see Chapter 12).

The T-Lab training and reflection workshop (Dundee) 2017 provided 21 members of the TKN (meeting in person) the opportunity to identify emerging themes that were most deserving of discussion and reflection. These included framing and reframing, theories of transformation and theories of change, research methods, innovation and alternatives, and networks and collective agency. These were discussed (as far as time allowed) at the workshop, and elements of these themes were drawn upon to devise a common format for the hub-specific chapters that follow (Chapters 5–10).

The workshop also raised the issue of how we might monitor and evaluate our interventions, leading to discussions of the kinds of ‘impacts’ we were seeking in each hub. These differed greatly, which made it difficult to identify or characterise any general ‘baseline’ against which transformative change could be measured. While some hubs monitored specific changes that could be seen as an element of transformation (e.g. the area planted to open-source seed that was used as a measure in Argentina, or the network methods applied in Mexico in Chapter 9), most hubs struggled to identify ways to measure transformation, let alone to evaluate the role that research had played within it.

Monitoring and evaluation has in recent years been moving towards approaches that employ participatory and reflexive use of theory of change both as a process and as a product (e.g. Britt and Patsalides 2013; Douthwaite et al. 2017; Moore et al. 2018). In contrast to naïve linear views that see research leading to outputs, leading to outcomes and thus impact (which is subject to measurement), these recent approaches focus instead on reflecting on underlying assumptions about how change happens in line with the ambitions of double loop learning described in Chapter 2. Through regular reflection, the aim is to build middle range theory of how change happens, as it happens.

The use of adapted PIPA approaches, followed by reflection and learning both within hub teams (individual T-Labs) and across hub teams (in Dundee and Nairobi), served this aim. While we struggled to build any overarching theory, the TKN’s move from the linear view towards a more complexity-aware approach helped us to understand better how – in different contexts – transdisciplinarity can contribute to transformational outcomes.

This led to a deeper appreciation of the role of transdisciplinary research and engagement in transformative change that (re-)emphasised the importance of emergence. In most hubs (as is clear from Chapters 5–10), exogenous factors such as policies, parallel movements or specific events contributed at least as much to outcomes as the work of the research teams. The structural and systemic perspectives on transformation described above helped us to understand these contributions and in many cases to work with them to enable transformative pathways.

The process of reflection thus saw research and action proceeding in parallel rather than either one being seen as prior. Knowledge about transformation was being built as the hub processes developed; however, in many cases, commitments to action were made in advance of any codification or theorisation of what needed to be done. These processes of coproduction are difficult to record in

real-time and even afterwards, but they delivered “less conventional outcomes” (Norström et al. 2020) such as internationally embedded networks including Bioleft (Chapter 6), methodological innovations (see Chapter 9), collective practical understanding (see Chapter 10), new institutions, trusted relationships and a shared sense of understanding and commitment that long-outlasted the funded project (see Chapter 12).

As such, the formal research paradigm (and resulting knowledge products such as this book) captures only a subset of the experimentation and learning that took place within the emergent T-Lab processes. The remaining chapters of this book try to capture some that learning in a way that is accessible to researchers and others. But a far greater proportion of the learning (and unlearning) remains uncoded, residing in the individuals and (international, intergenerational) networks that have emerged since the early stages of the project. The essence of the transformative pathways to sustainability sought in the project is embodied in these individuals and networks as much as in any of the resultant publications, even if it is the publications that receive the academic attention.

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