Chapter 13

Transcending the Loading Dock Paradigm—Rethinking Science-Practice Transfer and Implementation in Sustainable Land Management

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Abstract Modern science is increasingly called on to produce societally relevant and usable knowledge to tackle global challenges. Academics respond by conducting research projects that transcend the boundaries of single disciplines and institutions by actively engaging with non-academic actors. Such institutional arrangements open up entirely new perspectives for science communication and the problem-solving of real-world issues. However, they also call for elaborate management tasks and demand learning processes on the part of all those involved. This chapter introduces transfer and implementation (T&I) as a conceptual pair of terms to grasp the challenges, without compromising the opportunities of this new research mode. In doing so, this chapter discusses contemporary approaches of science knowledge transfer, and promotes a notion that prioritises knowledge transfer over information transfer through artefacts. After reframing T&I as a management area in research projects, I present three strategic policy pathways for sustainable land management.

Keywords Transfer · Implementation · Science-practice collaboration · Transdisciplinarity · Sustainable land management · Societal impact · Conceptual framework · Strategy

13.1 Introduction

After the discovery of the “ozone hole”, it took policymakers five years to adopt effective measures to reduce ozone-depleting substances induced by humans on a global scale. What appears to be a long haul is actually a spectacularly short time scale if the cause of the discovery—a scientific study by Joe Farman et al. published in *Nature* magazine in May 1985—is placed in relation to the action—a global ban on the production of ozone-depleting substances in June 1990. In fact, the Farman report is a rare, yet outstanding example of scientific knowledge being transferred

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T. Weith et al. (eds.), *Sustainable Land Management in a European Context*, Human-Environment Interactions 8, https://doi.org/10.1007/978-3-030-50841-8_13

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directly to society, i.e. scientific evidence that led to concrete action being taken by decision makers in line with the authors of the study.

The case of the ozone layer is often cited when addressing the potential societal impact induced by research. The science-practice transfer, which appears as a straight path in our example, is rather diffuse and acts in a permeable environment at the intersection of science and society in which information is shared, reassembled and re-evaluated. What appears to be an action arena that is too complex to steer, or even to fully understand, is an upcoming field of investigation for scientific action that aspires to bring about societal effects as a result of the research undertaken. To be clear from the outset: science-to-practice transfer cannot be conducted and planned to the full extent. This is especially true for contested policy arenas, within areas of high scientific uncertainty, and areas of application involving a variety of actors. It is nonetheless possible to design science-policy interfaces that increase the likelihood of science results being adopted by societal actors. But how should such interfaces be designed in the field of sustainable research?

In this chapter, I seek to reframe the science-society interface in sustainable land management (SLM). The result is not a “how-to manual”, but rather a framework for initiating and guiding SLM processes with a focus on the transfer of knowledge. SLM encompasses a purposeful process of managing land use and development by integrating scientific and practical knowledge. From my perspective, SLM embraces project-based research processes in which actors from practice and academia form a project consortium for a certain period with the common goal of achieving the more sustainable use of land resources. As such, SLM project partners form an alliance that proactively seeks to intervene in the highly regulated field of land use. I refer to these proactive intervention measures as **transfer and implementation** (T&I), despite a variety of related terms, including diffusion, impact or outreach.

T&I is applied in a wide variety of contexts such as political science, information technology and other domains. Nevertheless, this chapter will show that T&I, as a conceptual pair of terms, is ideal for supporting the framework for that particular area of SLM practice that receives greater attention as research is increasingly asked to “perform” with a higher societal impact. Besides the societal performance aspect, I also apply T&I as *guiding principles* for transdisciplinary processes. In doing so, I take into account the fact that T&I activities in SLM encompass more than a sole compilation of artefacts (i.e. books, reports and software) that are gathered and compiled at the end of a project cycle. Thus, I seek to transcend the prevalent practice that Cash (2006) calls the “loading dock paradigm” of transfer.

The “loading dock” is a metaphor for a location or deposit where scientific results are stored for the one-way transfer of results from science to other areas of society. These results, often peppered with scientific jargon and offering limited opportunity for feedback, are indeed generally available to everybody (unless they are hidden behind paywalls), but do not specifically address non-scientific target audiences. In addition, the “loading dock” oversimplifies the complex intersectional network that emerges in the transition area between science and society, which leads to a linear, causal understanding of how knowledge transfer actually works (ibid.).

Even though the knowledge base about the question of “how to transfer knowledge” is growing annually, the “loading dock approach” is still pervasive in many academic areas. However, I consider it to be outdated for the purposes of research on sustainability issues, which places communication and social learning in the centre of research activities (Fazey et al. 2013).

Clearly, the discussion on transfer and implementation is played out against the background of a new understanding of a reflexive, engaged and process-minded form of science that faces unknown challenges and seeks to gather new forms of knowledge. Thus, in Sect. 13.2, I briefly describe this new mode of science and how it differs from other (more conventional) approaches. Against that backdrop, I argue in Sect. 13.3 how transfer and implementation can be understood in transdisciplinary science approaches in contrast to prevailing transfer models. In Sect. 13.4, I present a T&I framework for transdisciplinary research projects, and apply this framework to SLM in Sect. 13.5.

13.2 Science, Society and the Drive Towards Transformation

New demands have recently been placed on science as an institution. Science is increasingly called on to serve society and justify the resources invested in it (“return on investment”). Academia is to make a greater contribution to solving *real-world issues* that society expects from science. These real-world issues, such as climate change and demographic change, differ from conventional scientific questions. They entail normative dimensions (i.e. human values, norms and preferences); they are complex (i.e. factors influencing the systems under investigation are manifold and sometimes unknown); they must be solved within democratically legitimised processes; and they call for a synthesised approach that incorporates the knowledge of many perspectives. Consequently, this new mode of science is asked to “produce” different forms of knowledge (Pohl and Hirsch-Hadorn 2006; Zscheischler et al. 2017), namely:

- *systems knowledge* about systemic interrelations in a given research context (the real-world issue),
- *target knowledge* about desired future developments in society, and
- *transformative knowledge* about strategies and instruments on how to approach the desired future.

Whereas the production of *systems knowledge* may be provided by established research methods, the production of *target knowledge* and *transformative knowledge* calls for entirely new methods that incorporate multiple scientific disciplines as well as so-called practitioners or stakeholders.¹ This novel mode of science (often

¹For easier understanding, I refer in this text to “practitioners” as non-academic project partners (i.e. they represent non-academic institutions, but are contractually bound to the project consortium)

referred to as “transdisciplinary research”, “transformative science” or “intervention science”) seeks to change the current (non-sustainable) state of our societies by different means (and intervention levels), backed up by scientific evidence.

Not only is it necessary to generate new sets of knowledge that—unlike disciplinary knowledge—are “different” and are fed from society to science. It is also necessary to adequately communicate and feed back knowledge, and vice versa, if it is to be effective. This is at least the inherent claim of many sustainability-oriented research activities (cf. Jong et al. 2016).

From a systems theory perspective, the trend towards transdisciplinary science can be summarised as follows: The boundaries between the scientific subsystem and the other subsystems of society become more permeable. At the intersections of these subsystems, new intra- and inter-directional communication patterns are established that work bi-directionally. Transdisciplinary research projects can be located at these intersections. They form boundary organisations (Guston 2001) in which knowledge is produced and transferred to multiple subsystems such as science, politics, economy and administration.

If we continue the notion that transdisciplinary research is accompanied by new patterns of communication, then it follows that research outputs change as well since they reflect the changing mode of communication. Modern science, as it has evolved since the nineteenth century, has developed elaborated media channels for communicating within its own system boundaries. However, these communication channels may have changed in the digitised world, yet the supposed output of science has remained the same: the production of truth. As the outcomes of sustainability research change, so does the adaptation of what science has previously considered the output of a research project. Thus, concrete questions arise for the areas of T&I in the context of changing research, since T&I forms the bridge between “output” and “outcome”.

13.3 From the “Loading Dock” to Reflexive Discourses—A Short Anthology of T&I as Objects of Scientific Investigation

The term **implementation** is used primarily in the fields of computer science, data processing and, most prominently, in the fields of politics and administration (Nohlen 1998). In the innovation context, implementation refers to the phase in which innovation has reached “market maturity” and is distributed to anticipated customer groups accordingly (cf. Ibert 2003). This applies in modified form to non-economically exploitable innovations, too. The innovation will be linked to certain goals, but these may have unintended consequences.

and “stakeholders” when I mention actors or actor groups affected by the issue under investigation. Stakeholders may become part of the research process (via participatory methods, public hearings, exhibitions, etc.), but are not bound to the project by contract.

Despite a variety of usage contexts, **transfer** can be defined as a “transmission” of information or objects between a sender and a receiver, some of which operate in specific contexts. In application-oriented research, transfer is conventionally equated with the transfer of research results to potential users. In this context, transfer becomes an instrument that appears in the context of innovation and diffusion research (Schröder et al. 2011).

In applied science, aspects of T&I have been the focus of numerous empirical studies on the diffusion of innovations since the 1920s and 1930s. Since then, mainly application-related disciplines, such as engineering and technical sciences, medicine and geography have addressed questions relating to T&I research. The aims of research activities include the systematic analysis of transfer conditions and modelling approaches (Gräsel et al. 2006: 479).

From the perspective of research on T&I, different approaches have been developed. Of particular note here are *actor-centred approaches*, which operate with a typology of persons (groups) in the diffusion process. According to these approaches, innovations by persons or groups of people are adapted at different speeds (Hägerstrand 1952; Rogers 1995). Another approach, based on the findings of the *network theory*, considers actors as objects in a superordinate social network whose connections are of central importance (see, for example, Granovetter 1973).

A third model that has been widely adapted in German innovation policy (Blümel 2016) is the *linear model of technology push or science push* (based on Bush (1945)). According to this model, innovations go through a gradual evolution that ranges from basic research, through applied research, to product development and innovation. This model is also based on unidirectional knowledge transfer, which understands “society” as the addressee of scientific results.

The principle of unidirectional transfer was dominant in the past (between the 1960s and the 1990s), but increasingly came under criticism. Cash et al. (2006) used the metaphor of the “loading dock” of science transfer to describe its deficiencies. According to this term, scientists perform their research activities in a house (with an adjacent loading dock) that symbolises academia. At the end of the research cycle, the results are eventually stored as readymade “information packages” or “products” on a dock and made available to potential end users: “*You take it out there, and you leave it on the dock and you say, there it is. And then you walk away and go back inside*” (ibid. 484). This approach is based on the premise that the information that reaches the recipient triggers appropriate action, or that research results are adapted from the practical side.

In the field of science communication, this phenomenon is also known as the “information deficit model”, which attributes public scepticism to science to a lack of understanding, resulting from a lack of information. In science-based consultancy, an artificial separation of scientific information from policymaking was promoted by its clients (Weith 2011) and thus manifested the inherent logic of the loading dock metaphor.

The loading dock approach underlines the notion of a purely knowledge-driven science which, as the sole knowledge producer, remained separate from the application-relevant areas of knowledge (“policy knowledge”). It not only leaves

potential user groups undefined, it also vaguely describes the benefit of research. It is assumed that the public needs innovative products and scientific knowledge of solutions. In addition, numerous empirical studies have shown that the implementation of practice transfer has fallen short of expectations (Böcher and Krott 2013; Ascher et al. 2010; Fry et al. 2003; Pregernig 2000, etc.) (Table 13.1).

Contemporary transfer approaches that especially concentrate on knowledge transfer and advocate a move beyond the transfer of artefacts reflect much more on the fact that the generation of knowledge requires a co-constructed (learning) process (Fazey et al. 2013). This means that the mere provision of knowledge in different media forms of preparation is not the same as the successful transfer of that knowledge. The way in which actors tap into knowledge plays an increasingly important role.

Best and Holmes (2010) see two paradigms of knowledge transfer as an extension to the linear model. First, relationship models, in which knowledge producers and consumers come together in collaborative networks and exchange knowledge,

Table 13.1 Comparison of linear transfer models versus systemic transfer models by characteristics (own source)

Characteristic	Linear transfer model	Systemic transfer model
Transfer impulse	Science-pushed or demand-driven	Science-pushed and demand-driven
Direction of transfer	Unidirectional; from science to practice	Reflexive and iterative between science and practice
Dimensions of transfer	Transfer of research results (technological transfer, transfer of codified information)	Transfer of research results (technological transfer, transfer of codified information); knowledge transfer (exchange of individual, disciplinary and organisation-based knowledge)
Date of transfer	Ex-post	Continuous and ex-post
Content of transfer	Results of research	Results of research, perspectives of disciplines and stakeholders, experiential knowledge of practitioners and stakeholders, data, evaluation of complex issues
Who transfers?	Science (via intermediaries)	Science and practice
Instruments of transfer	Publications (artefacts and presentations), academic teaching	Publications (artefacts and presentations), academic teaching, methods of knowledge exchange and integration
Transfer objects	Artefacts, scientific publications and dissemination formats (written and oral)	Artefacts, scientific publications and dissemination formats (written and oral), tools, policy briefs, exchange forums, decision support systems, etc.

have increasingly been discussed since the 1990s. Transdisciplinary research projects represent a suitable form of organisation in this case.

Second, “system models” that assume transfer-relevant knowledge is embedded in organisations or other system units have increasingly been addressed for about ten years. These models reflect the priorities of an organisation and its “culture”. In this approach, transfer extends to the aspects of the integration, translation and mobilisation of knowledge (Partidario and Sheate 2013, p. 28).

13.4 Reframing T&I for SLM

Based on an extended understanding of T&I, I advocate a **multi-dimensional concept of transfer and implementation**. This concept extends the hitherto dominating unidirectional, mostly technology-oriented transfer concept that is science-driven and focuses on practice diffusion.

Communication and cognitive science aspects of T&I are stressed as the notion shifts from the *transfer of information* through artefacts to so-called *knowledge transfer*. Knowledge transfer is defined as a process in which knowledge (or information) is externalised and communicated internally and intrapersonally by means of media (Beckers 2012, p. 95). Accordingly, transfer takes place not only between individuals in the form of interaction, but also involves intrapersonal processes of learning, describing and explaining. Transfer is no longer just a process in which “knowers” connect with “non-knowers”. It rather reflects a more dynamic view of how knowledge is generated; and that knowledge is embedded in individual and organisational contexts, and circulates among the actors involved, (ideally) creating a meta-learning process (co-learning) that runs parallel to individual learning (cf. Kaiser et al. 2017).

Given the context of transdisciplinary research, T&I activities tie in with the inherent goal of stimulating change in both the academic world (as new modes of knowledge production are tested) and the real world.

T&I can be captured in a bi-dimensional, conceptual framework that includes an **internal and external dimension** (see Fig. 13.1). In the following section, the framework is projected onto the SLM case study, but can in principle be adapted for any transdisciplinary research activity.

Our unit of consideration is the transdisciplinary research project, i.e. a temporally, financially and staff-wise limited unit of activities in relation to one or more related research goals (Newig et al. 2019) that exists within a real-world research setting (see Fig. 13.2). Following the normative and programmatic nature of transdisciplinary research, the project involves different actors from academia and practice (i.e. the project consists of at least two different parties); it involves conducting research in a collaborative fashion and aspires to transcend its boundaries by tackling real-world issues. The boundaries of a research project are thus constituted not only by resources (namely time, workforce and money), but also by the affiliation of the

Fig. 13.1 Multidimensionality and causal links between T&I in transdisciplinary projects (own source)

Fig. 13.2 Basic model of a transdisciplinary research project and its boundary (own source)

project members. In externally funded projects, project partners are often contract-bound and, thus, form the boundary of a project by the receipt of grants (as opposed to non-grantees).²

Either way, successful research activities, outputs and outcomes in those kinds of institutional arrangements cannot be taken for granted (Newig et al. 2019) as they

²In reality, however, project boundaries cannot be drawn in such a clear-cut way because project partners may also be bound simply by cooperation agreement without the awarding of grants.

form complex management tasks. I therefore stress the **internal dimension** of T&I as a key field of action that should be covered by project coordination.

In this context, **transfer** refers mainly to the realm of knowledge transfer among project team members. It includes processes that aim at informative exchange about knowledge stocks (expert knowledge, interests, agendas, norms, values, etc.) and at an integration of different epistemologies for the cause of the research question. Transfer evolves into a field of coordination action that must be continually considered and highlighted during the early stages of the project cycle in which fundamental research issues are framed that may be impossible to correct at later stages of the research process. Transfer in this context can also be understood as processes of knowledge internalisation (individual learning, group learning) and externalisation (i.e. making tacit knowledge explicit).

To foster internal transfer, it makes sense to **implement** a set of rules and regulations, as well as integration methods, i.e. methods that support the exchange of people and their knowledge. Research projects usually consist of relatively loose networks that are bound by their common research interest and that are not subject to any other regulations than those provided by the project funding agency and the research partners' respective affiliation. Thus, project rules such as control mechanisms and codes of conduct are ideally a result of negotiation processes within the project. In other words, internal implementation is a matter of transdisciplinary research design.

Another notion of implementation in this context refers to projects that form experimental spaces or work on technological innovations. In the course of research projects, prototypes or comparable artefacts may be implemented to gather data or observe their performance in a laboratory setting.

Whereas the internal dimension covers activities *within* the project boundary, the **external dimension** of T&I highlights action arenas *beyond* the boundary of the research project.

In this context, **transfer** invokes processes and activities of interaction with the project environment (e.g. public relations, participation, and feedback loops). The purpose and function of external transfer can range between simply providing information about research activities and empowering target audiences. Transfer is not solely considered as a punctual, one-way minded, communicative act, but rather understood as a reflexive mode of science that stimulates social learning and as a vehicle to close the application gap of scientific results.

In contrast, external **implementation** can be understood as a result of external transfer activities. It describes two realms: first, it is the strategic approach (or pathway) on how to stimulate change towards a preferred direction in a given research context. This requires a mental model acquired by the research team about how transformations actually (might) work in their project setting to be effective. Second (and in accordance with the conventional understanding of implementation in applied research), it describes the output(s) of a research project; the communicative format or artefact that is designed to suit the target audience's expectations.

13.5 T&I Strategic Policy Pathways in SLM

Up to this point, I have outlined the framework for all kinds of subjects in which transdisciplinary research can be performed. In the following section, this framework is applied to **land management settings** (see Fig. 13.2), seeking to achieve a strategic mental model of T&I. This mental model is suitable as a starting point for considering and planning T&I activities in land-related research projects that seek to stimulate change towards sustainability. To capture the rich nature of land-based issues, the model picks a rather high level of generalisation. My description of the elements of the model will include practical examples to facilitate understanding.

The model was inspired by theoretical assumptions from the literature on T&I using deduction (see Sect. 13.3) as well as by observed transfer strategies applied by SLM projects (from the funding measure under the same title 2010–2016; see also Weith et al. 2019), acquired by induction during project activities.

The *research project* is the starting point and central subject of the model (Fig. 13.3; left side). Even though the project assembles a group of individuals with very specific goals and interests, I assume that the central connective element is the mutual goal to make *land use more sustainable* (Fig. 13.3; green circle). This also includes scientists, because they demonstrate a high degree of commitment to the normative goal of SLM projects (Zscheischler et al. 2018). Thus, the research project is considered to be a unit that proactively pushes towards sustainability by means of various measures.

Since research projects (usually) lack the capacity to directly transform land use practices (cf. Lux et al. 2019), the mental model incorporates intermediate actors as transmitters that are proactive in both directions. Besides building a bridge from the research project to land use decision arenas or decision makers, they fuel and enrich the research process by feeding knowledge (e.g. factual knowledge, experiential knowledge) back to the research project. Thus, they may be a part of the research

Fig. 13.3 Strategic conceptual model of T&I in SLM (own source)

project itself (bound by contract), as this increases the likelihood that research results will be adopted after the end of the project cycle (Lux et al. 2019). Numerous studies on transdisciplinary research indicate that an early and continuous involvement of practitioners in the research process (e.g. mutual problem definition, co-design of the research process) correlate with the higher societal impact of (transdisciplinary) research (Lux et al. 2019; Jong et al. 2016).

For SLM, such intermediaries are introduced as “*key actors of land use*” (KALU). In the model, they constitute both the main addressee of external T&I actions and the co-producers of knowledge in internal T&I activities. KALU can be individuals or (representatives of) institutions that play a decisive or influential role in the land use context such as.

- (a) individuals or collective institutions that possess direct decisive power over land use options on a given plot (e.g. farmers, agricultural enterprises, forest owners, land owners in general).
- (b) institutions that steer land use by setting the legislative and regulative framework of land use in a given spatial context (e.g. planning authorities, administrations).
- (c) institutions that influence land use by setting decisive context conditions and/or incentives for land use decisions (e.g. markets, politics), and
- (d) individuals or collective institutions that influence the societal discourse of land use in society. The latter covers the full range of institutions such as NGOs, political parties, professional organisations, the media, civil society actors, businesses, and science-policy interface organisations. Individuals can also be considered key actors, e.g. if they own the capacity and commitment to achieve sustainable land use change in a given context or if they make a significant contribution to filling crucial knowledge gaps to enhance the understanding of the issue under investigation.

Identifying the “right” KALU is one of the key tasks in SLM. It requires a thorough stakeholder analysis that is backed up by scientific methods. The heterogeneity of the actor landscape evolves from the way in which land governance is performed in post-modern societies. Land as a commonality is the subject of an inextricable network of different regulations and actors’ accesses and interests. A multitude of institutions (usually at different scales; from international to local) may have a direct or indirect impact on land use on a certain plot of land. In addition, context conditions such as market forces or environmental conditions such as climate change have an indirect (if not direct) impact on land use practices. Also, as in most democratic systems, significant changes in land use regulations presuppose democratic negotiation processes that can substantially extend project time schedules. In sum, every change in this highly regulated action arena must consider the limiting borders, as well as the enacting and supportive forces. Apart from the fact that this should be part of an expectation management process conducted in every project at an early stage, I suggest three **strategic policy approaches** (or impact pathways) that provide orientation and support strategic project decisions for T&I.

Each approach constitutes an ideal path to influence land use decisions made by KALUs. They should not be considered as an exclusive strategy that leaves other

approaches unnoticed. On the contrary, depending on the goal(s) of the research project, these paths might be used alternatively or even in combination, as they may generate synergies. Any given measure along these paths should be continuously evaluated according to its impact and (if necessary) readjusted accordingly.

1. The **actor-centric approach** (or persuasive transfer approach) involves measures that address KALU directly and integrate them into communication and learning processes. Institutionalised agricultural advisory services have followed this approach for decades, addressing farmers to communicate information, produce knowledge and enhance skills (Labarthe et al. 2013). By pursuing this path, research projects seek to improve individuals' knowledge base on which they base their decisions. Depending on the knowledge base of the targeted KALUs, the communicative goal may vary between raising awareness for a hitherto neglected issue (e.g. effects of land sealing), concrete policy options or even hands-on training via "how-to-do SLM" manuals. If considered as a two-way communication setting, research projects may also benefit from feedback. This transfer option, however, requires exact knowledge of the setting of target groups in the investigated field and presupposes stakeholder analysis methods. Since persuasion is a relatively "soft tool" for initiating change, activities in this direction should be persistent and repetitive in order to have an effect. Assessing the effectiveness of persuasive methods is equally challenging.

2. Another transfer approach can be described as an indirect form of the persuasion of KALU. In the **prototype approach**, transfer measures aim to establish technological, procedural or institutional innovations in the form of pilot projects. This approach picks up the diffusion of innovations theory by Rogers (1995) and the Multi-Level Perspective framework (Geels 2002) by designing innovations in niche contexts first that, eventually, diffuse into a broader context. The niche innovation is nurtured by specific actors at the micro scale that have been withdrawn from the influences of market and regulation.

Besides being particularly feasible for projects that focus on techno-societal innovations, this transfer path is increasingly applied to social innovations, too. It is worthwhile cooperating with businesses in this case, since they have a genuine interest in driving innovations that invoke marketing potential. However, cooperation with economic partners also harbours a number of risks for research projects (e.g. confidentiality of results vs. scientific publications).

Projects that apply the prototype approach may benefit from the cognitive phenomenon that artefacts (such as prototypes) suggest visible and tangible progress, and convey the feeling of being able to "get a grip" on the problems that are being investigated across research groups (Ukowitz 2012, p. 303f.). This effect seems to be magnified for haptic interactions that users may experience when testing a prototype or tool. Also, it inhibits positive effects on the visibility and legitimacy of research on the ground, and often corresponds to the stereotype of the scientist as an inventor (ibid.).

The adoption potential of a new technique for tillage, for example, that has been designed and tested in a project context is greater if test sites show the

effects to other farmers. These innovative products, processes or institutions alone, however, are not the result of SLM but, in turn, are only further persuasive vehicles to indirectly influence land use decision makers. A successful prototype approach should therefore implement suitable instruments from the actor-centric approach to increase its effectiveness. This might include field days for farmers or farming business representatives, on-site performances and corresponding Q&A sessions with an expert farmer who may also be a research partner for the new technique.

With this approach, target group sensitivity is therefore a *conditio sine qua non* for the required knowledge transfer. It necessitates a thorough analysis of the connectivity potential of such prototypes, its (unwanted) side-effects and trade-offs. If applied, design-thinking methods, boundary objects or adjacent creative methods may be suitable. Depending on the research question, the prototype approach can boost the transfer potential of projects.

3. Since land use is embedded in a highly regulated environment (market, laws, regulations, planning, etc.) that operates at all spatial levels, another transfer approach exists for influencing KALUs: **the context management approach**. Steering the development of a given system by stimulating its given framework conditions is adapted from systems theory thinking (Willke 2014). Among the described transfer paths, changing the regulative framework for land use is certainly the most demanding and least manageable option for research projects. Nonetheless, it holds the biggest potential of transformation as it sets the rules for post-project timetables.

The context management approach seeks to involve actors and institutions that set the framework conditions for land use or interact with intermediate institutions that prepare political decision-making, feed in recommendations to decision-making levels, advance agenda-setting processes or form opinions. Interestingly, the framework approach is still deemed to be the conventional pathway for scientific knowledge that “leaks” into society. In this concept, “excellent scientific work” either catches the attention of science-policy networks that perform at higher scales (such as IPCC or IPBES) or directly finds its way to decision-makers. In our introductory example of the ozone hole, knowledge transfer took that path as the news of a global danger “quickly” found its way into the highest levels of global politics. I must stress that this example represents an extreme exception.

However, the context management approach in SLM is slightly different as it adds another dimension by proactively seeking to change context conditions that, for instance, slow down the implementation of sustainable practices. Also, research projects actively seek to advance options that hold more potential for sustainability (e.g. by simplifying approval processes, and setting standards and incentives). Other target groups of T&I activities could also be politicians, administrations, spatial planning institutions, companies and citizens, as they influence land use indirectly (e.g. market conditions, public discourse). The degree of influence varies greatly between actor groups as well as the possibility of influencing

existing regulations and assessing the impact of the transfer measure taken. It is certainly easier to launch a regional campaign for sustainable land use in public than to influence existing legal framework conditions, especially if these are set at supraregional level.

The conceptual model of strategic T&I in SLM described may be used by project architects and coordinators at different stages of the research cycle. It is of particular value as a “tool” for planning outreach activities during the starting phase of projects. However, it can also be used as a project management method that sparks debate between project partners on the desired impact and the realistic output of SLM projects, i.e. to develop a mutually shared “model of change” in real-world settings.

Nonetheless, the model invokes various limitations that should be briefly noted. First, it depicts an idealised form of a complex “transfer reality”. Actors cannot be classified into rigid roles as they appear in the model, nor do they think and act consistently and rationally in the sense of sociological institutionalism. Transdisciplinary research means scrutinising existing structures and modes of operation, and dissolving boundaries between actors. In addition, addressing a broad spectrum of actors is a practical challenge that is virtually impossible to operationalise in this form.

Second, additional actors of knowledge transfer that influence research projects are left out, such as traditional forms of academic knowledge transfer in which academia constantly feeds collaborative research with current developments in research. In addition, the quality and salience of research results are fundamental if research wants to have an impact on society. Economic institutions that are left out play an important role in rather technology-based solutions, especially when it comes to marketability and, ultimately, to stabilising solutions after the end of the project cycle.

Third, an evaluation of token T&I measures is not easy to apply as time lags prevail, i.e. diffusion effects might be visible after a certain period. As stated above, changing the regulative and institutional framework that influences land use usually presupposes democratic processes at multiple hierarchy levels. Also, attribution between measure and effect may not be clearly identified. If, for instance, a whole set of different transfer activities led to a desired effect, then how do we know which of them was effective? Both aspects complicate the adaptive management of T&I processes during an ongoing project.

Each transfer approach pathway is not exclusive and isolated from each other. Instead, actors, measures and framework conditions mutually influence each other in the transfer process. A combination of different approaches therefore seems necessary. It is therefore strongly recommended to integrate different perspectives for the area of SLM as they hold the potential for synergies and catalytic effects (see Leach et al. 2010; Stringer and Dougill 2013). The choice of path is determined by efficiency criteria on the one hand and the actual content of the research project on the other.

13.6 Conclusion

In this chapter, I have argued that the conventional “loading dock approach” of science transfer is not applicable for research projects that proactively seek to drive societal change towards sustainability. Conventional transfer channels of scientific results are still viable, but are inappropriate in SLM settings if they are the only strategic approach to transfer. Bi-directional communication channels that involve science and societal actors are needed to enhance the societal relevance and applicability of outputs. Moreover, innovative ideas in SLM require an interpersonal level in which key actors of land use (KALU) can share, interpret and contextualise information.

In a mental model, three strategic impact pathways for T&I activities in SLM have been presented. Each represents an ideal, heuristic approach towards KALUs that had been identified as the main addressees of T&I activities. These actors differ widely depending on the research context, and can impersonalise individuals and institutions alike. Notable resources in project planning should be tied to activities that analyse the environment of stakeholders and the system under investigation (and its inherent ties and interrelations), in order to identify crucial actors that should be approached.

T&I are activities that should be considered continuously during a research process, and be an element of strategic project management from the very beginning of the project cycle. Undoubtedly, T&I activities tie up additional management resources and cause trade-offs with other activities in the research project, which must be considered. T&I activities need professional experts who are paid and recognised for their work. Conceptualising and conducting T&I activities as described in the previous section requires professional expertise that is rarely taught in academic curricula as yet. If taken seriously, T&I should not be done part-time and in addition to a “real” function within a research project.

Moreover, there is no guarantee that T&I activities (even if conducted to perfection) will lead to a desired impact in society because external factors that cannot be influenced make transdisciplinary research projects vulnerable. Thus, T&I should be seen as activities that increase the potential for research impact only. After all, it is not the product, the process or the model of a prototype that stands for successful transfer alone; it is the knowledge of an innovation and its functioning, and its strengths, weaknesses, risks and opportunities that influence or slow down the dissemination of innovations.

Acknowledgements I thank Thomas Weith, Thomas Aenis, Jana Zscheischler and Andrea Rau for their scientific advice and support. I also thank numerous (not further mentioned) colleagues for noteworthy inputs and fruitful discussions.

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