

Chapter 9

Knowledge Exchange at Science-Policy Interfaces in the Fields of Spatial Planning, Land Use and Soil Management: A Swiss Case Study



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Abstract In this article, we investigate knowledge exchange at the intersection of science and Swiss public policy in the fields of spatial planning, land use and soil management. Based on a literature review and expert interviews, we identify six types of knowledge exchange, and examine the barriers to and opportunities for knowledge exchange. These six underlying concepts suggest knowledge exchange is a challenging task because different expectations exist on how knowledge should be exchanged.

Keywords Knowledge exchange · Science-policy interface · Spatial planning · Land use · Switzerland

9.1 Introduction

Over the last few decades, the way in which science has been considered to be an instrument to inform policymakers has changed. Science addressing environmental policy issues often has to deal with endemic uncertainties, conflicting values and different goals among actors. This has challenged traditional science, which has been widely understood as a provider of value-free and definite factual knowledge (Funtowicz and Ravetz 1993: 739, 744, 749 et seq.; Ravetz 1999: 647–650). Observing this development, Funtowicz and Ravetz (1993) introduced the concept of “post-normal” science—a “problem-solving strategy [for policy issues], where systems uncertainties or decision stakes are high” (Funtowicz and Ravetz 1993: 749). Systems uncertainties refer to problems that cannot be solved simply by detecting a specific fact, but where a complex reality has to be understood and managed. Decision stakes encompass the diverse interests of different actors concerning an issue (Funtowicz and Ravetz 1993: 744). To deal with these system uncertainties and decision stakes, post-normal science implies that it is not only researchers or

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official experts who should debate the quality of scientific policy inputs, but indeed all the actors affected by the issue and interested in contributing to a solution should be included in the discussion (Funtowicz and Ravetz 1993: 752 et seq.; Ravetz 1999: 651). Gibbons et al. (1994: 1) also observed that the modes of knowledge production had been changing. From their point of view, knowledge is no longer solely produced disciplinarily and in a context of mainly scientific interests (Mode 1 knowledge production), but also transdisciplinarily and in “a context of application” (Mode 2 knowledge production) (Gibbons et al. 1994: 3–5; Zscheischler et al. 2018). However, there has been a shift not only in the way knowledge is produced and who is involved in this process, but also in the way knowledge is exchanged (Bielak, Campbell, Pope, Schaefer, and Shaxson, 2008): referring to the findings of Funtowicz and Ravetz (1993), Gibbons et al. (1994) and Pretty and Chambers (1993), Bielak et al. (2008: 202 et seq.) asserted that

[i]t is no longer tenable to rely on the notion of a linear progression through an orderly research process driven by scientists, to a dissemination phase driven by communication specialists, to an adoption phase in which end users (whether in policy or management) presumably apply research findings directly in their everyday activities. Rather, science must be socially distributed, application-oriented, transdisciplinary, and subject to multiple accountabilities. From a one-way linear process, science is evolving to a multi-party, recursive dialogue.

The positivist perspective of “knowledge transfer”, where knowledge is understood as something that can simply be handed over to other individuals in a one-way exchange process, has been complemented by other (more subjectivist) perspectives (Rogga et al. 2014). Subjectivist perspectives take into account the idea that different kinds of knowledge exist, which are individually and socially constructed (Fazey et al. 2014: 206). Knowledge exchange arising from such a perspective “tend[s] to result in knowledge exchange activities that encourage mutual learning through multi-stakeholder interactions” (Fazey et al. 2014: 206), which is exactly what Bielak et al. (2008: 202 et seq.) postulated. Therefore, today various definitions of knowledge exchange and a broad variety of different terms with diverging underlying assumptions exist including “knowledge sharing, generation, coproduction, comanagement; transfer, brokerage, storage, exchange, transformation, mobilization, and translation” (Fazey et al. 2013: 20; see also Mauser et al. 2013). In this article, we understand knowledge exchange according to Fazey et al. (2013: 20) “as a process of generating, sharing, and/or using knowledge through various methods appropriate to the context, purpose, and participants involved.” However, knowledge exchange does not always operate to the satisfaction of all the actors involved. Recently, various scholars have begun to discuss the challenges of knowledge exchange at the intersection of science and public policy (which we refer throughout to as “science/policy interfaces”) (Böcher and Krott 2014; Saarela and Söderman 2015; van Enst et al. 2014) and how they can be improved (Böcher and Krott 2014; Saarela and Söderman 2015). Others have focused on how knowledge exchange at science/policy interfaces may be implemented most effectively (Reed et al. 2014).

In the following article, we investigate the different types of knowledge exchange that actors in Switzerland have adopted at the intersection of science and public policy

(which we refer to as “science/policy interfaces”) in the areas of spatial planning, land use and soil management, and use our investigations to develop a typology of knowledge exchange. Furthermore, we examine the barriers to and opportunities for knowledge exchange in Swiss spatial planning, land use and soil management. The goal of this article is to better understand how knowledge is exchanged, and to find out what impedes and enhances knowledge exchange, drawing on Switzerland as a case study. We assess in what respects the findings from Switzerland have been represented in previous literature, i.e. which concepts of knowledge exchange our empirically developed typology refers to. By looking at the concepts that underlie the types of knowledge exchange actors adopt, it becomes clear why knowledge exchange is a challenging task: differing concepts of knowledge exchange result in different expectations on how knowledge is to be exchanged.

We discuss the following research questions

1. Which types of knowledge exchange do actors adopt at science/policy interfaces in spatial planning, land use and soil management in Switzerland?
2. Which concepts of knowledge exchange do these different types of knowledge exchange refer to?
3. How do actors at the science/policy interfaces in the fields of spatial planning, land use and soil management in Switzerland assess the barriers to and opportunities for knowledge exchange?

In Switzerland, the land and the soil are resources that have come under increasing pressure. Construction and urban sprawl threaten agricultural land, biodiversity and the landscape. A growing population, high mobility (and the resulting consumption of land by transport infrastructure) and growing demand for more per-capita living space have all helped drive this process (Schweizerischer Bundesrat, KdK, BPUK, SSV and SGV, 2012: 1, 4, 6). We understand pressure on the land and the soil to be a typical problem for post-normal science in the sense of Funtowicz and Ravetz (1993): it is an environmental policy issue with high systems uncertainties and high decision stakes. While population growth, mobility and the demand for more personal space have been expressed as reasons for the consumption of land and soil, the role of other drivers (such as zoning policy, tax policy and capital markets) is not fully understood, to say nothing of the interdependencies among the various drivers (Brils et al. 2016: 792; Plieninger et al. 2016; Schweizerischer Bundesrat et al. 2012: 1, 4, 6). Moreover, spatial planning, land use and soil management all epitomise the presence of diverse interests, which are introduced into each issue by a variety of actors. These include the construction industry, real estate companies, private landowners, farmers and conservationists (high-decision stakes). We therefore presume that, in their attempts to find solutions in a complex context like this, actors adopt various types of knowledge exchange, which encompass not only the positivist perspective of “knowledge transfer”, but also other types of knowledge exchange that go beyond that.

9.2 Conceptualising “Knowledge Transfer” and “Knowledge Exchange”

The scholarly debate on knowledge exchange in science/policy interaction has been unfolding for quite some time. According to Fazey et al. (2013: 20), knowledge exchange is “a process of generating, sharing, and/or using knowledge through various methods appropriate to the context, purpose, and participants involved.” Accordingly, this definition implies two basic understandings of knowledge exchange: (a) knowledge exchange in a wider sense, as an overarching concept encompassing a variety of subjacent concepts (e.g. knowledge transfer, the coproduction of knowledge); (b) knowledge exchange as a specific concept, incorporating “a two- or multiple-path process with reciprocity and mutual benefits, maybe with multiple learning, but not necessarily recognition of the equitable value of the different forms of knowledge being exchanged” (Fazey et al. 2013: 20).

In line with these basic understandings by Fazey et al. (2013), other scholars provide similar overviews of knowledge exchange theories and concepts. Nutley et al. (2014) distinguished rational-linear models, context-focused models, interactive models and post-modern models of practice-policy interaction. Stewart et al. (2014) differentiated among “knowledge transfer”, “knowledge exchange” and “knowledge interaction”. They regarded “knowledge transfer” to be linear models of knowledge uptake, dominating between the 1960 and 1990s, which required the effective packaging and communication of knowledge. The concept of “knowledge exchange”, which emerged in the 1990s, was seen as the result of social and political processes, and required effective relationships. Finally, “knowledge interaction”, which has emerged in more recent years, has been regarded as embedded in systems and cultures, and which requires effective integration within organisations. Kamelarczyk and Gamborg (2014) distinguished between knowledge transfer models and knowledge interaction models: for them, knowledge transfer was characterised as a linear and one-way model, clearly separating the worlds of science and policy-making, and working under the assumption that knowledge was produced as a clearly defined, ready-to-use product. In contrast, knowledge transaction sees science and policymaking as an undivided whole, and characterised by blurry boundaries. Here, knowledge is coproduced in cycles. Kamelarczyk’s and Gamborg’s (2014) concept of knowledge transaction thus corresponds to the concepts of knowledge exchange and knowledge interaction proposed by Stewart et al. (2014).

A review of the literature on knowledge transfer and knowledge exchange in science/policy or science/practice interaction reveals that many scholars agree on these two basic concepts of “knowledge transfer” and “knowledge exchange” (Fazey et al. 2014). Firstly, there is a consensus that concepts of knowledge transfer that have emerged since the 1950s (e.g. Lasswell 1956) have understood transfer as a linear, one-way or unidirectional activity of knowledge production, from science to policy or practice (see Stone 2001; Pregering 2004; Birkland 2005; Böcher and Krott 2014; Kamelarczyk and Gamborg 2014; Stewart et al. 2014; Linke et al. 2014). Second, there is also a consensus that knowledge transfer may be complemented or substituted

by more recent concepts of knowledge exchange or related terms, such as knowledge interaction or transaction (see Stone 2001; Keeley and Scoones 2003; Jasanoff 2004; Roux et al. 2006; Turnout et al. 2007; Kamelarczyk and Gamborg 2014; Böcher and Krott 2014; Prager and McKee 2015).

Theories and concepts of knowledge transfer and exchange draw on wider debates on science/policy or science/practice interaction. Following Sybille van den Hove, we define science/policy interaction

as social processes which encompass relations between scientists and other actors in the policy process, and which allow for exchanges, co-evolution, and joint construction of knowledge with the aim of enriching decision-making. (van den Hove, 2007: 807).

In fact, van Enst et al. (2014: 13–16) used this same definition to develop a typology of science/policy interaction, specifying different ways of handling knowledge.

1. The first type, “individual science-policy mediation”, focuses on individual scientists and experts that link science and policymaking by mediating between the two groups and thus help to make knowledge available and utilisable.
2. The second type concentrates on the process of “participatory knowledge development”, in particular transdisciplinary and participatory coproduction of knowledge and common understandings. It includes all actors—from scientists, policymakers and other professionals to laypeople (van Enst et al. 2014: 16).
3. The third type includes “boundary organisations”, which van Enst et al. described as “formal institutions, often having a legal basis, which serve as an institutional bridge between the worlds of science and policy” (van Enst et al. 2014: *ibid.*).

For our article, we interviewed actors representing one or more of these three types of science/policy interfaces in an effort to demonstrate examples of who can provide knowledge and who needs it.

9.3 Methods

We conducted 16 qualitative expert interviews with actors representing science/policy interfaces in Switzerland, including individual science/policy mediators and boundary organisations. The interviews, which took between 50 minutes and 2 hours, were generally conducted at the actors’ work. We recorded these interviews, took minutes, and prepared transcripts. In the questionnaire, we asked the actors to describe how they exchange knowledge themselves, and how knowledge is exchanged in spatial planning, land use and soil management in Switzerland more generally. We thus used “knowledge exchange” as a superordinate concept. Insofar as this concept characterises a two- or multiple-path exchange process, we made clear to the interviewees that knowledge exchange might be understood in many different ways, and thus also asked what other kinds of knowledge exchange they had experienced.

To analyse the transcribed interviews, we performed a qualitative content analysis following Mayring's method (2015). We coded the data with MaxQDA coding software. We started the coding process with concepts from the literature that we expected to appear in the data ("knowledge transfer", "knowledge exchange" or "coproduction of knowledge"). Over the course of the coding process, we complemented this first set of codes with inductively created new codes. Drawing from the coded interviews, we identified barriers and opportunities, and developed a typology of knowledge exchange, including knowledge transfer. We complemented this typology with elements that had not been explicitly expressed in the interviews, but that represented patterns that had appeared in the data. In the following sections, we do not present the interview results in detail. Rather, we focus on the summarised results to present a typology of knowledge exchange, and an overview of the barriers to and opportunities for knowledge exchange.

9.4 A Typology of Knowledge Exchange in Spatial Planning, Land Use and Soil Management in Switzerland

Our analysis of how actors exchange knowledge in Swiss contexts of spatial planning, land use and soil management resulted in a typology of knowledge exchange. Based on the interviews, we were able to identify six types: (1) knowledge transfer, (2) knowledge transfer support, (3) knowledge exchange, (4) knowledge exchange support, (5) participatory knowledge development and use, (6) formal and informal knowledge exchange. These six types exhibit a total of 21 subtypes, characterising different ways of exchanging knowledge (Fig. 9.1).

In the typology, we have distinguished between transfer and exchange processes. We understand knowledge transfer (Type 1) as one-way processes, where knowledge is imparted from one actor to another actor unidirectionally. In contrast, we define knowledge exchange (Type 3) as a reciprocal process operating in both directions. We further differentiate between "knowledge transfer" and "knowledge transfer support" as well as between "knowledge exchange" and "knowledge exchange support". While knowledge transfer as such characterises processes where scientists and policymakers transfer knowledge they themselves have produced or possessed, knowledge transfer support (Type 2) describes processes where boundary organisations or individual knowledge advocates enable the transfer between science and policymaking. Similarly, we differentiate between knowledge exchange (Type 3) and knowledge exchange support (Type 4). Moreover, in some of the subtypes, we then distinguish between direct and indirect processes. Direct knowledge exchange takes place when actors are in direct contact with other actors. This direct contact may also be organised by either a boundary organisation or an individual knowledge advocate, or both. "Indirect knowledge exchange" characterises processes in which actors do not meet or communicate directly. "Participatory knowledge development

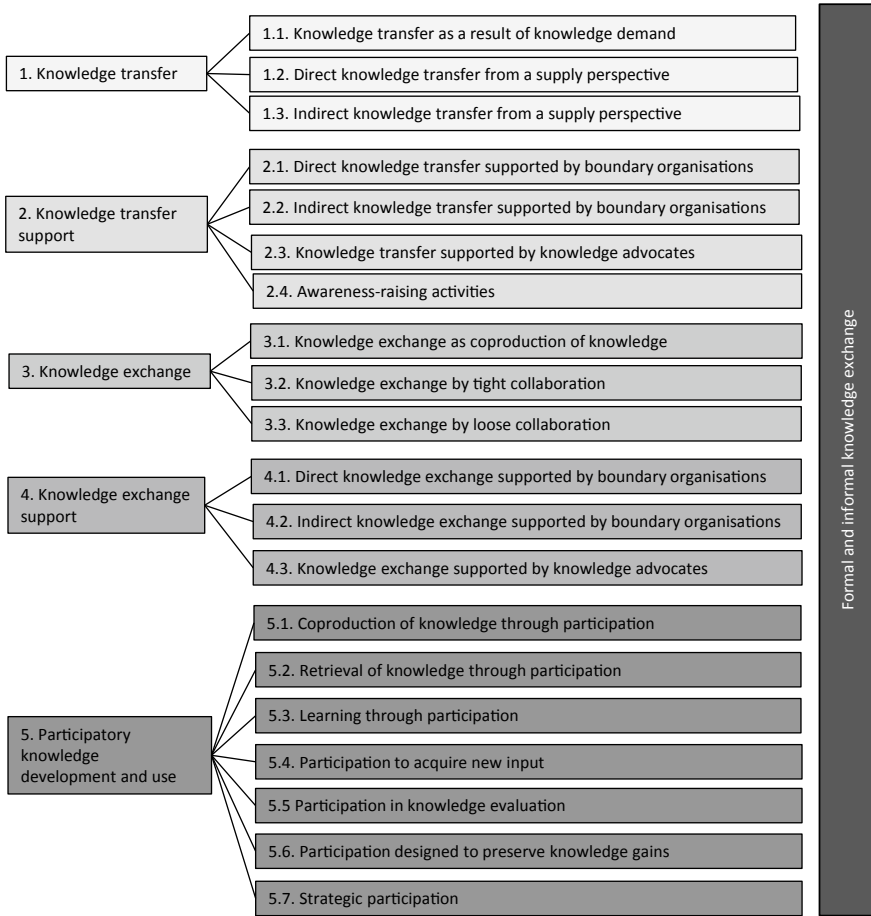


Fig. 9.1. Types and subtypes of knowledge exchange

and use” (Type 5) characterises how and why actors are involved in knowledge exchange processes. “Formal and informal knowledge exchange (Type 6) describes the formality of knowledge exchange processes. The following sections present these types and subtypes in greater detail.

9.4.1 Type 1: Knowledge Transfer

Knowledge exchange Type 1, “knowledge transfer”, refers to knowledge exchange processes that are only one-way. We distinguish among three subtypes:

Type 1.1: Knowledge transfer as a result of knowledge demand. This describes knowledge transfer where either policymakers or scientists express a knowledge

demand that can be met by a one-way transfer process. Knowledge demand, for example, occurs when policymakers approach scientists with a question the researchers can answer promptly (e.g. on the phone).

Type 1.2: Direct knowledge transfer from a supply perspective. This embraces knowledge transfer by researchers who disseminate their results not only via scientific journals, but in ways that also address policymakers directly. We understand this as knowledge transfer coming from a supply perspective, because the scientists impart their findings unasked.

Type 1.3: Indirect knowledge transfer from a supply perspective. This describes indirect knowledge transfer via publications that scientists or policymakers supply. This subtype includes, e.g. popular articles in newspapers, the trade press or factsheets, or scientific reports published by scientists or policymakers.

9.4.2 Type 2: Knowledge Transfer Support

The knowledge exchange type of “knowledge transfer support” is characterised by one-way transfer processes between science and policymaking enabled by boundary organisations or individual knowledge advocates. We established four subtypes.

Type 2.1: Direct knowledge transfer supported by boundary organisations. In this type, scientists and policymakers are in direct contact; knowledge transfer is supported, e.g. by universities within final presentations of research projects.

Type 2.2: Indirect knowledge transfer supported by boundary organisations. This indicates that scientists and policymakers do not meet or communicate directly; knowledge transfer is enabled by boundary organisations that are involved in science dissemination activities.

Type 2.3: Knowledge transfer supported by knowledge advocates. Here, individual advocates are understood to support knowledge transfer from science to policymaking or from policymaking to science in one-way processes, e.g. scientists who send publications directly to policymakers.

Type 2.4: Awareness-raising activities. These encompass events, excursions, marketing campaigns and publications to raise awareness regarding challenges in spatial planning, land use and soil management; they are organised by boundary organisations or individual knowledge advocates. This way, scientific and expert knowledge is transferred to policymakers and laypeople. This subtype shows features of all the other subtypes of “knowledge transfer support”.

9.4.3 Type 3: Knowledge Exchange

“Knowledge exchange” describes knowledge exchange where dialogues or other interaction between actors from science and policymaking takes place. Here, knowledge is exchanged reciprocally. However, the kind of knowledge that science

and policymaking exchange with each other are not necessarily the same. While science is understood to introduce scientific knowledge into the exchange process, policymakers impart knowledge on practical problems, on social networks or on administrative or legal processes. This type includes three subtypes:

Type 3.1: Knowledge exchange as coproduction of knowledge. This subtype is characterised by knowledge exchange between policymakers and scientists, where scientists carry out a research mandate for public authorities and subsequently coproduce knowledge. This does not mean working together constantly, but it does mean developing it in an iterative, collaborative way.

Type 3.2: Knowledge exchange by tight collaboration. Like Subtype 3.1, knowledge is exchanged between public authorities and scientists executing a research mandate. Here, policymakers only give input and feedback to accompany the research process closely.

Type 3.3: Knowledge exchange by loose collaboration. Again, like Subtypes 3.1 and 3.2, knowledge exchange takes place between public authorities and scientists executing a research mandate. Here, however, the contact between the two parties is only “loose”. Policymakers provide feedback only occasionally, and do not follow the research process closely.

9.4.4 Type 4: Knowledge Exchange Support

The knowledge exchange type “knowledge exchange support” is characterised by reciprocal knowledge exchange between science and policymaking, but supported by boundary organisations or individual knowledge advocates. Once again, there are three subtypes.

Type 4.1: Direct knowledge exchange supported by boundary organisations. This is characterised by knowledge exchange between scientists and policymakers that occurs when boundary organisations arrange meetings, workshops, conferences, excursions and other events where actors meet directly.

Type 4.2: Indirect knowledge exchange supported by boundary organisations. This describes knowledge exchange processes where science and policymaking do not meet directly. Instead, knowledge is received from science and imparted to policymakers through boundary organisations.

Type 4.3: Knowledge exchange supported by knowledge advocates. In this subtype, individual knowledge advocates enable knowledge exchange between science and policymaking. This exchange is carried out, e.g. by interns in government agencies. Interns are often simultaneously students at a university, so that public authorities not only impart knowledge to interns, but also receive scientific knowledge back from them.

9.4.5 *Type 5: Participatory Knowledge Development and Use*

The “participatory knowledge development and use” knowledge exchange type describes actor participation in research projects and in policymaking. Who these actors are, how they are included in the process and for what purpose can vary. To show this variety more clearly, we have differentiated the subtypes of this knowledge exchange type into two groups: the first three subtypes focus on how participation is organised. The fourth to seventh subtypes describe the reasons participation is taking place, i.e. the purpose of introducing participation. Accordingly, the subtypes include two different aspects of participation (how and why) that overlap. There are seven subtypes in total:

Type 5.1: Coproduction of knowledge through participation. This is characterised by actor participation where knowledge is being coproduced by scientists, policymakers or actors from civil society. Coproduction means that actors can be involved, e.g. through stakeholder workshops, expert interviews or assessments. In transdisciplinary research projects, the coproduction of knowledge begins immediately, with different actors jointly defining the problem and setting project goals.

Type 5.2: Retrieval of knowledge through participation. This is focused on actor participation in workshops or surveys to retrieve knowledge. Here, participation does not imply a joint act of generating knowledge, but a demand-side act of requesting and receiving knowledge from actors.

Type 5.3: Learning through participation. This entails enabling individual learning or mutual learning between scientists and policymakers.

Type 5.4: Participation to acquire new input. The goal of this is to understand the variety of the actors’ knowledge, opinions and interests; participating actors may be scientists or policymakers, as well as individuals from civil society.

Type 5.5: Participation in knowledge evaluation. This is characterised by actor participation with the goal of generating specific feedback on documents, prototypes, results, solutions or recommendations. Here, participation does not focus on acquiring new input, but on getting feedback and making evaluations.

Type 5.6: Participation designed to preserve knowledge gains. This concept refers to participation that incorporates crucial influential people who would need to be consulted before a policy could be applied.

Type 5.7: Strategic participation. “Strategic participation” refers to participation as a strategy to legitimise outcomes. Policymakers may ask for feedback by scientists, or scientists may be (formally) included in policymaking by public officials. Participation is only “pro forma”, and designed to indicate that the actors have been involved, rather than actually exchanging knowledge as the primary goal.

9.4.6 Type 6: Formal and Informal Knowledge Exchange

The “formal and informal knowledge exchange” knowledge exchange type describes the formality of knowledge exchange. On the one hand, it describes in which setting (formal, informal) the other types of knowledge exchange in this typology take place. On the other hand, the subtypes can also represent themselves (e.g. informal knowledge exchange at conferences). It is important to note that we do not see “formal” and “informal” knowledge exchange as two completely separated types of knowledge exchange, but rather as extremes along a continuum. Knowledge exchange is a complex phenomenon, and often consists of multiple interactions between actors; for this reason, the formality of an exchange can change over time, e.g. informal exchange can lead to a project that is regulated by a formal agreement. This knowledge exchange type appears in two subtypes.

Type 6.1: Informal knowledge exchange. This occurs when actors exchange knowledge with other actors in an informal setting. This may include unofficial parts of meetings or conferences, as well as informal workshops organised by public agencies to stimulate creative and open exchange between policymakers and scientists in a confidential setting.

These networks are especially important before projects are formulated, when actors informally exchange information with their counterparts about problems they observe, about knowledge needs they have or about possible solutions they perceive.

The second subtype is 6.2: Formal knowledge exchange. This describes knowledge exchange that is embedded in formal structures and processes. For example, this subtype includes meetings organised by public agencies to gain insights on the opinions of different actors concerning a particular topic. Such meetings are designed in the formal style of a consultation, where the statements of the invited actors are written down and the course of the meeting is rather predetermined. However, this subtype also embraces formal calls for proposals and knowledge exchange that is regulated by agreements that define the tasks and duties of two contracting parties.

9.5 Barriers to and Opportunities for Knowledge Exchange in Spatial Planning, Land Use and Soil Management in Switzerland

Based on the interviews, we identified 11 “barriers” to and five “opportunities” for knowledge exchange (Tables 9.1 and 9.2). “Barriers” refer to factors that constrain knowledge exchange, while “opportunities” refer to factors that improve knowledge exchange. Basically, both barriers and opportunities are crucial factors influencing knowledge exchange. Obviously, barriers can turn into opportunities, and vice versa.

Table 9.1. Barriers to knowledge exchange

No	Barrier
1	The divide between science and policymaking
2	The different time frames of scientists and policymakers
3	Different “languages” of science and policymaking
4	A lack of science/policy interfaces
5	Difficult access to scientific knowledge
6	A lack of applicability of scientific findings
7	Information overload
8	Pressure to publish in scientific journals
9	A lack of financial resources and time
10	Conflicts of interest and power issues
11	A lack of links between soil and spatial planning experts

Table 9.2. Opportunities for knowledge exchange

No	Opportunity
1	Federalism and multilingualism
2	A small but well-connected expert community
3	The availability of informal and personal contacts
4	General openness to new developments
5	Motivation and a commitment to collaboration

9.5.1 *Barriers to Knowledge Exchange*

Some of the barriers to knowledge exchange that we identified can be classified into groups. One group of barriers refers to the interaction between science and policymaking (Barriers 1–4). A second group of barriers refers to issues around the use of knowledge (Barriers 4–8). Three other issues complement the list of barriers (Table 9.1).

Science and policymaking are often perceived as two distinct fields following different rules and demonstrating different characteristics (Barrier 1). They are seen as having a different “culture”—in terms of their ways of thinking, their methods, the knowledge they have and produce (scientific knowledge vs. practical knowledge), their spatial focus (international versus national), and/or their expectations regarding the outcomes of research. Scientists and policymakers also have different timeframes (Barrier 2). Science is perceived as long-term, policymaking as short-term.

Next, science and policymaking use different ways of expression (Barrier 3). Scientific knowledge has to be revised, edited and “translated” into language policymakers can understand and make use of. Moreover, the knowledge that has been produced needs to be calibrated for its target audience. Public agencies, consultants, farmers or civil society organisations all must be addressed differently, and need different degrees of detail. Policymakers look for solutions to practical problems,

while scientists try to find a scientific gap in which they can perform their research and publish it.

To bridge the paradigmatic divide between science and policymaking, it is essential that scientists and policymakers have a common idea of the problem at hand, and that they exchange long enough to really understand what the other side knows and wants. To start with, science/policy interaction would immediately improve if the different expectations of science and policymaking regarding research were expressed and clarified, and if both sides would accept that these expectations will not always converge.

Finally, boundary organisations support science/policy interaction. They help bridge science/policymaking divides. However, it is obvious that a lack of science/policy interfaces represents a crucial barrier of knowledge exchange (Barrier 4). Clearly, this finding is strongly in line with the literature on transdisciplinarity (Zierhofer and Burger 2007; Zscheischler et al. 2018).

Knowledge exchange takes place when knowledge is used. Difficult access to scientific knowledge (Barrier 5), especially to research findings, results and guidance for practice hinders this usage of knowledge. For policymakers, researching knowledge can be an exhausting task. Furthermore, access to scientific publications and data is not always open access and free of charge.

However, even if knowledge is accessible, its usage is not guaranteed. Transferability, applicability and practicability of scientific knowledge is not self-evident (Barrier 6). Knowledge (e.g. a new method for land management) has to be tested and adapted to conditions in practice.

Another knowledge-specific barrier is the problem of selecting relevant information, and identifying new, innovative ideas in an age of information overload (Barrier 7).

Knowledge producers are often scientists. The reward system of scientists can in fact impede knowledge exchange at science/policy interfaces, because researchers are rewarded—and are mainly measured—by the frequency of their publications in high-ranking scientific journals (Barrier 8). This dissuades researchers from “wasting” time at the science/policy interface.

Afterall, it is obvious that knowledge exchange takes time and costs money. Accordingly, financial and time pressure in research projects result in fewer knowledge exchange activities organised by scientists or boundary organisations (Barrier 9).

Spatial planning, land use and soil management affect different sectors of the economy. Construction, tourism, agriculture and forestry, among others, all demand different uses for the land and the soil. Those with an interest in developing land could oppose those with an interest in preserving high-quality soil (Pütz 2011). Correspondingly, different interests make knowledge exchange difficult. Conflicts of interest and power issues might hinder the free flow of knowledge and its comprehensive exchange (Barrier 10). Related to the barrier concerning conflicting interests is the fact that experts in spatial planning, land use and soil management usually come

from different disciplines and scientific communities as well as various fields of experience. This is especially true for the lack of links between soil and spatial planning experts, which typify the divide between natural sciences and social sciences.

9.5.2 Opportunities for Knowledge Exchange

Switzerland is a rather small country, with 8.3 million inhabitants. It is composed of 26 small cantons, within which are about 2,500 municipalities. Switzerland's federal structure and multilevel governance system, plus its four linguistic regions, result in a variety of ways to deal with spatial planning, land use and soil management. Correspondingly, a variety of different options exist to experiment and find distinct solutions. In light of both the smallness as well as the large number of entities, we identified five opportunities for knowledge exchange, summarised in Table 9.2.

Of course, the large number of small entities could potentially lead to either fragmentation or integration, and could thus be interpreted as either a barrier or an opportunity. According to the interviews, however, the advantages of the Swiss system and its practices outweigh the disadvantages. Therefore, we frame these factors as opportunities. The interviewees particularly noted the different linguistic areas and the necessity to coordinate across administrative levels and sectors as a challenge, but also as an opportunity. The German, the French and the Italian-speaking part of Switzerland have all taken the majority of their cues from concepts originating from the neighbouring countries with whom they share the same language, planning culture and ways of thinking.

9.6 Discussion

9.6.1 Types of Knowledge Exchange

Our typology of knowledge exchange shows that in Swiss spatial planning, land use and soil management actors exchange knowledge in six different ways. These six types do not always perfectly correspond to the concepts in the existing scholarly literature. The next few paragraphs highlight how our six types confirm or add to the debate.

Type 1, “knowledge transfer”, describes one-way knowledge transfer processes. In the subtypes, we distinguished between knowledge transfer coming from either a demand or a supply perspective. This implies that knowledge is a thing that one actor has and another actor wants or lacks, and that can easily be conveyed from a holder to a receiver. This type clearly corresponds with Fazey et al. (2013: 20) who conceptualised knowledge transfer as a linear, one-way process, where knowledge is delivered and received, and is understood to be portable.

Type 2 (knowledge transfer support) and Type 4 (knowledge exchange support) characterise one-way transfer processes and reciprocal exchange processes, respectively. However, in these types of knowledge exchange, transfer and exchange are encouraged by boundary organisations or by individual knowledge advocates, rather than by the scientists and policymakers producing or possessing the knowledge. Boundary organisations and individual knowledge advocates supporting knowledge transfer and exchange in our typology correspond to the individual science/policy mediators and boundary organisations identified by van Enst et al. (2014: 13–16) in their typology of science/policy interaction, who conceptualised them as individuals or formal institutions operating as a bridge between science and policymaking (van Enst et al. 2014: 13–16). In our typology, individual knowledge advocates and boundary organisations also function as connecting elements between science and policymaking. However, we additionally distinguish between the knowledge transfer and the knowledge exchange that these third parties support.

Type 3, “knowledge exchange”, characterises reciprocal exchange processes where interaction, dialogue or learning takes place. The exchanged knowledge does not necessarily have to be the same kind of knowledge: while scientists introduce scientific knowledge into the exchange, policymakers introduce practical knowledge and presumably also tactical knowledge for scientists (e.g. about funding opportunities). Fazey et al. (2013: 20) described knowledge exchange as reciprocal two-way or multiple-path processes, including learning, which is exactly how we conceptualise it.

Type 5, “participatory knowledge development and use”, is characterised by the involvement of actors in policymaking processes. van Enst et al. (2014: 15) classified processes of participatory knowledge development as a third type in their typology of science-policy interfaces. However, they focused on participatory coproduction of knowledge, which only corresponds to one of our subtypes, 5.1—“the coproduction of knowledge through participation”. We have demonstrated that participation can also be perceived in a more unidirectional way of simply retrieving knowledge (Subtype 5.2), where knowledge is not coproduced, but instead requested and received from actors; it may also be understood as mutual learning or individual learning within a collective body (Subtype 5.3). Apart from the Subtypes 5.1–5.3 that explain *how* participation operates, we also included four subtypes (5.4–5.7) that focus on *why* participation is organised. van Enst et al. (2014: 5–9) also discussed how knowledge is “strategically” used and produced. Our Subtype 5.7, “strategic participation” corresponds with that of van Enst et al. (2014) in terms of the strategic use of knowledge by policy of “knowledge being used selectively”, which includes “politicians ask[ing] for advice only to legitimize their pre-formed decisions” (Hoppe 2005: 201 in van Enst et al. 2014: 7).

Type 6, “formal and informal knowledge exchange”, focuses on the setting (formal, informal) in which knowledge exchange takes place. The Swiss respondents identified the informal component of knowledge exchange to be particularly important. Reed et al. (2013: 313) argued that “[k]nowledge exchange and transfer often take place through informal networks as well as through formalised and depersonalised forms of communication such as the mass media.” This corresponds with

our findings. However, they specified mass media as an example of formal knowledge exchange. Our data revealed other examples of formal knowledge exchange that emphasised the formality of the process more clearly, e.g. formal calls for proposals or bilateral agreements regulating knowledge exchange.

9.6.2 Barriers to and Opportunities for Knowledge Exchange

Our data showed that diverging differences in philosophy and priorities, as well as a lack of communication generally all impede knowledge exchange in Swiss spatial planning, land use and soil management. These include divides in “culture” and ways of thinking between scientists and policymakers, differences in the timeframes they work in, differences in the way they express themselves and a lack of institutionalised links between them. The two communities thesis, “[f]irst elaborated by Caplan (1979)... assumes that a fundamental gap exists between research and policy which is held to be the result of cultural differences between these two communities” (Nutley et al. 2014: 99). Referring to van Buuren and Edelenbos (2004); Wiltshire (2001) and Strydom et al. (2010); van Enst et al. (2014: 9 et seq.) also pointed out that differences in expression, timeframes and perceptions of reality between scientists and policymakers created problems for the science/policy interface. However, our data indicates that these divides, differences and lacking links that constrain knowledge exchange between science and policymaking are not limited to a gap between science and policymaking as such. They also include different “ways of thinking” and different concepts dominating in the different linguistic areas in Switzerland, administrative differences originating from Swiss federalism and a lack of communication paths between soil and spatial planning experts.

Interviewees mentioned several barriers to knowledge exchange between science and policymaking concerning the handling of scientific results. They criticised the results for sometimes being in a language policymakers did not understand or for being inapplicable or inaccessible. Hence, the interviewees called for adapting the communication of scientific results to the language of the addressees, investing in efforts to render the results applicable and providing open-access publications. The first two of these aspects correspond to the findings of Reed et al. (2014: 341 et seq.) whose interview partners suggested that an “effective” knowledge exchange would provide tangible and useful outputs, and would include outside actors in the formulation of policy implications so that the communication of results would actually reach the target audience. Referring to Sarawitz and Pielke (2007), van Enst et al. (2014: 10) also identified “insufficient access to knowledge” as a problem of the science/policy interface, which is in line with our findings.

Other barriers to knowledge exchange expressed in the interviews included the reward system of scientists, which encourages them to concentrate more on writing scientific publications, and less on providing guidance and ready-to-use tools; a lack of financial resources and time for knowledge exchange; an overload of information; power struggles and competing interests constraining knowledge exchange;

and informal contacts that may render knowledge exchange non-transparent. Reed et al. (2014: 340 et seq.) have indicated that adequate funding resources and time for knowledge exchange have to be included directly in the research design if the exchange is to be effective; this corresponds to our findings.

Aside from the barriers, the interviews revealed several opportunities for knowledge exchange. Some of these related explicitly to the Swiss situation. Interviewees considered the small expert community in Switzerland, where people know each other and communication paths are short, to be an opportunity for knowledge exchange. Similarly, the Swiss system of federalism, which produces a wide range of spatial planning solutions, facilitates learning about other cantons or even other language areas. Informal contacts and networks were also identified as opportunities for knowledge exchange. This corroborates findings by Reed et al. (2014: 341), who found that informal exchange between scientists and other actors were crucial for effective knowledge exchange. Another important factor in the facilitation of knowledge exchange was motivation and openness to new, different experiences among the actors involved. However, it also became clear that the Swiss system of federalism, the different language areas and informal networks could also serve as barriers to knowledge exchange.

9.7 Conclusions

Swiss actors in spatial planning, land use and soil management exchange knowledge in many different ways, corresponding to a variety of different concepts from the literature. Most of the actors use more than one way of exchanging knowledge, but they nevertheless exchange knowledge differently depending on the decision situation, the context or person they work with. A given actor might facilitate knowledge transfer as a knowledge advocate, but may also organise participatory and transdisciplinary processes of knowledge development and use.

In practice, multiple types of knowledge exchange occur at the same time and in parallel. Moreover, different situations, contexts and actors require different types of exchanging knowledge. Associated with these overlaps is the fact that actors have different expectations about knowledge exchange and bring in different understandings of what knowledge exchange is. Our article clearly confirms that knowledge exchange can be understood differently (e.g. to coproduce knowledge, to accompany research projects, to retrieve knowledge) and thus functions differently as well. Balancing different expectations and types of knowledge exchange is the crucial challenge to successfully exchanging knowledge.

We have shown that there are specific factors that impede knowledge exchange, including philosophical divides, differences in perspectives, a lack of links between actors and a lack of resources. Working to break down these barriers as well as making use of the opportunities for knowledge exchange will help Swiss scientists and policymakers improve knowledge exchange in the fields of spatial planning, land use and soil management.

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