Governance of complex environmental situations through social learning: a synthesis of SLIM’s lessons for research, policy and practice

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ABSTRACT

This synthesis of the SLIM project findings deals with the development and deployment of knowledge and research that is useful for actions that transform at socially and ecologically meaningful scales. A diagnostic framework (DF) is elaborated that aims to transform the findings into a tool that could bring stakeholders, in other contexts, to understand better their own roles in complex natural resource management situations. The DF invites the user to engage in successive stages of comprehension by exploring: what are complex situations of change about? What are the main components involved? Why are these components important? How do they influence what we know and how we act? What could be our role in changing the situation? We identify five ‘variables’ that together can account systemically for transformation processes that are constituted in social learning and concerted actions. We show how the DF may be used in situations of complexity and uncertainty by researchers, acting variously as observer, facilitator or co-researcher, and how it may help to guide research practice. We conclude by consolidating key messages about the relationship between knowledge, research, and policy and the main implications for water managers of being open to social learning processes.

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1. Introduction

This paper synthesises the main findings of the SLIM (Social Learning for the Integrated Management and sustainable use of water) research experience (see Ison et al., 2007, for an introduction). Our purpose is to bring readers to become aware that the knowledge they produce, and the way they interact with society, can play a large and constructive role in changing relationships, understanding, and practices. We wish, in short, to reveal the heuristic value of what practitioners, policy makers and researchers say and do. By ‘heuristic’ we mean the conceptual frame pertaining to particular ways of building and solving problems. Our claim is that the choice of the various ways of thinking and various means by which ‘solutions’ are discovered and placed into society is consequential for outcomes.

Our shared concern in the SLIM research project has been the development and deployment of scientific knowledge and research methodologies that are useful for action, and for actions that transform at socially and ecologically meaningful scales. Our case studies have led us to the view that knowing is constructed in action i.e. that it arises within the act of constructing an issue and solutions. Further, we wish to emphasise how creating new relationships between different stakeholder groups can lead to transformative change at multiple scales. The SLIM research explored the processes
required for stakeholders to engage with each other, and the natural resource ‘problem’, in new ways that would enable what we term concerted action. By concerted action we mean action that is coordinated among actors positioned in varying relationships to the resource in question, for purposes that recognise the interdependency of action—‘I can score my goals only if I take account of yours’. When stakeholders become aware of and explore these interdependencies, new collectives can emerge which redefine the relationships stakeholders hold with the resource and among themselves.

In some ways this emergent understanding links to the literature on ‘innovation systems’ (Barnett, 2004; Hall et al., 2003), which emphasises that “working with and re-working the stock of knowledge is the dominant activity in innovation” (Arnold and Bell, 2001). However, SLIM claims a distinctive space for innovation in knowledge processes in conditions of irreducible uncertainty and complexity. As Connor and Dovers (2004) observe, there is a ‘need for policy discourse and learning, especially in the case of sustainability as a profound social goal pervaded by complexity and uncertainty’ (p. 226). In such situations optimal solutions cannot be ‘designed’ but processes for the co-creation of new knowledge can be designed that lead to the emergence of solutions that are sufficient (Williams et al., 1998). In this perspective, we see practices such as computer-assisted modelling and tools such as satellite imaging or internet-mediated communication most effectively deployed as aids in processes of interactive learning and knowledge development.

Our work links to that of Cook and Brown (1999), who write of the “generative dance between knowledge and knowing” and who distinguish an epistemology1 of possession (knowledge that can be built, owned, circulated, used for innovation) and an epistemology of action (knowledge that is produced during the process of acting). This line of research is exemplified, for example, in recent analyses of community-based natural resource management (Tyler, 2006). It also echoes the work of Snowden (2002), who conceptualises knowledge not only as a “thing” but also as a “flow”, i.e. as ephemeral, produced during interactions, used to act, and once used, disappearing in some way. He distinguishes four ‘knowledge management’ domains or situations, each of them demanding a distinctive leadership and way of managing: the known; the complicated but knowable; the complex, unknowable but partly predictable; and the chaotic. And it resonates with the findings of Schön (1995), who speaks of professional practitioners facing the “dilemma of rigor or relevance”. Confronted by “messy” situations, they can make the choice: (i) to stand on the “high ground” where manageable problems lend themselves to solution through the use of research-based theory and technique but are relatively unimportant to individuals or to society, or (ii) to descend to the “swamp” of important problems where the practitioner cannot be rigorous in any familiar way and where problems are messy and confusing and incapable of purely technical solution.

In the remainder of this paper we address these points by synthesising what we have learned about three inter-connected challenges to sustainable water use and catchment management:

1. Placing scientific knowledge effectively within the contexts where landscape scale impacts are desired, and in ways meaningful to others, while also acknowledging these stakeholders’ own knowledge, understanding, and experience;
2. Learning as situated in practice;
3. Acting professionally in interaction with others, and developing the personal and organisational skills and capacities for this.

We begin by introducing SLIM’s own heuristic tool, what we call a diagnostic framework (DF). The DF elaborates how a transformational change is situated in a specific history and context that shapes current stakeholders’ practices and understandings (SLIM, 2004a). Changes of understanding and practice can be brought about by the facilitation of the relationships among stakeholders, the ecological dynamic, institutions, and policies. We then develop how the DF can be used to bring stakeholders, including researchers, to become aware of their role in transformational change. We also elucidate the understanding, captured in this diagnostic, that arises out of our own praxis, that is, the dialectic we, as a SLIM project, have organised between our espoused theories and what we have experienced in our case studies.

### 2. Introducing SLIM’s diagnostic framework: a tool for exploring complex situations of change

Conventional policy responses to environmental problems can be broken down into three governance mechanisms (Ison et al., 2007):

- Attempting to modify practices directly through regulations, incentives and penalties targeting human activities;
- Relying on market forces, either by assuming that the invisible hand of the market will resolve the problem, or by adjusting market forces through fiscal policies;
- Raising awareness through the dissemination of information.

These mechanisms conventionally are built upon a specific relationship to knowledge. Data, information and scientific knowledge are supposed to inform all steps of policy development: define the problems, establish the means and rules, assess policy implementation and revise and adapt the policy content (European Environment Agency, 2003). In this context, the increasing demand for public participation – e.g. article 14 of the European Water Framework Directive (WFD) about ‘Public information and consultation’ – poses something of a challenge to the conventional role of expert knowledge in relation to governance. The call for public participation can be understood to have various purposes: make political decisions more transparent, increase social acceptability of policies, involve users in adopting planned measures, and adapt policies to local natural and social specificities. The difficulty is that each of these purposes entangles expert knowledge in

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1 We define epistemology by “Theory of Knowledge”, i.e. the various theories used to better understand the conditions through which different kinds of knowledge are produced.
others’ knowledge domains and experiences. If expert knowledge is presented as uniquely ‘truth determining’ – thereby negating these other knowledge domains – confrontation, mistrust, or disengagement typically results. The claim SLIM researchers make challenges the conventions by developing an understanding of public participation as being about promoting concerted action, i.e. bringing interdependent stakeholders to co-construct the issues at stake and to be involved in ‘knowing’ processes that can lead to technical and social change (Fig. 1).

An approach to water management that includes deliberate effort to co-construct knowledge requires societal arrangements that are open to the necessity or potential for change in governance as a result of the shared learning process. Where such openness does not exist, social learning processes may lead to frustrating or downright dangerous outcomes for the stakeholders concerned. As stated by Sabatier et al. (2005), ‘a final set of threats to the viability of the new approach involves the ability of collaborative processes and partnerships to find a permanent niche in a landscape dominated by single-function agencies (…)’ (p. 11).

The diagnostic framework was elaborated in a feedback process conducted at the end of the SLIM project (SLIM, 2004a). In Section 4 we describe the methodology we used to arrive at that point. We wanted to capture and synthesise the insights derived from our case studies research and to transform them into a ‘tool’ that could bring stakeholders to better understand their own role in complex natural resource management situations. We use the term ‘situation’ here to express the idea that a natural resource management problem brings diverse interests to deal together with the interrelationships of a set of very heterogeneous elements which range from political rules and institutions, to stakeholder practices and perceptions, and biophysical flows. What links these elements together is the experience of some phenomenon, or phenomena, in which something is at stake, perceived to be problematic, or providing opportunity to stakeholders (e.g. manage a river or a nature conservation area or reduce water pollution at catchment scale) and around which social interactions take place and are organised. The network that can be established among these elements constitutes, in Foucault’s terms (1975), a “scheme” (dispositif in French). In all the SLIM case studies we have observed a lack of understanding of these networks, a lack that limits improvement of integrated management of natural resources. The tools we have produced aim at developing greater awareness of the relationships in networks of interdependent interests. They invite the user to engage in successive steps of comprehension in the dynamic of these situations: what are complex situations of change about? What are the main components involved? Why are these components important? How do they influence what we know and how we act? What could be our role in changing the situation?

In the following section we present the main SLIM heuristics and their underlying rationale. We synthesise the main evidence supporting what we claim and that are grounded in our case studies (all of which are presented at http://slim.open.ac.uk). To strengthen the presentation of the synthesis, we have chosen here to compare situations that have led to concerted action—Tweed river (Collins, 2004), Benelux Middengebied (Jiggins, 2004), Natura 2000 (Steyaert, 2004) and Marche region (Arzeni et al., 2004) – with some that did not – Drentsche Aa (van Bommel and Röling, 2004) and Ythan catchment (Watson et al., 2004).

### 2.1. Complex situations of transformational change

Transformational change relates to a new mode of knowledge production, labelled “Mode 2” by Gibbons et al. (1994) and contrasted with “Mode 1”. “In Mode 1 the problems are set and solved in a context governed by the largely academic interests of a specific community. By contrast, Mode 2 is carried out in a context of application (…)”. In comparison with Mode 1, Mode 2 is more socially accountable and reflexive. It includes a wider, more temporary and heterogeneous set of practitioners, collaborating on a problem defined in a specific and localized context.” The problems people were facing in our case studies mostly were defined initially in and by a political framework (e.g. in Europe policies and designations such as WFD, Nitrate Vulnerable Zones, Natura 2000, agri-environmental schemes) or in initiatives taken by local authorities to deal with resource dilemmas. In all cases, once these frameworks were translated into specific and localised contexts they provoked the expression of multiple perspectives and controversies. This

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**Fig. 1** – From the use of fixed forms of knowledge (left) to the process of knowing i.e. social learning (source: SLIM, 2004a). N.B. This figure is a refinement for communication purposes of Figure 1 in Ison et al., 2007—raising awareness typically involves information provision or ‘education’; further theoretical underpinnings for this figure can be found in Blackmore (2007) in this issue.
means complexity increases: by identifying a situation as problematic the interdependencies between natural, social and technical phenomena become more apparent, and reveal numerous uncertainties. When social interaction among stakeholders begins, the definition of what is problematic is contested, people’s “felt and lived” experiences are confronted with different forms of knowledge, and issues of value come into the discussion. The quality of the interaction is framed initially by the particularistic understanding of the people involved and by their habitual practices. If the unfolding dynamic of the interaction can be constituted in processes of shared learning, then practices and understanding, and sometimes also values evolve. What is expected is an evolution toward a growing awareness of the need for, and the practice of, ‘concerted action’. Fig. 2a presents this dynamic. It emphasises that change is not only about thinking and doing things more efficiently but also about changing the system in which doing and thinking takes place—what Ison and Russell (2000a,b), following Watzlawick, distinguish as first order and second order change.

The situations SLIM researchers have observed and facilitated were diverse in terms of contexts and histories (the history of the situation, as shown in Fig. 2b). These historical and contextual differences mean that the configurations, roles and values of stakeholders vary between and within situations, and it follows that a policy or management practice that ‘works’ in one place may be inappropriate in another. What we have observed in all our cases is a general lack of understanding of the context and history of the problematic situations addressed by policy, although such an appreciation is needed to identify the constraints and the opportunities for new actions to succeed. None the less, most of the case studies, which generally speaking involved long-term social interactions organised among multiple, interconnected spaces for deliberation, arrived at some form of concerted action (Table 1). In a few cases, during the period of research the interactions remained locked into relationships and actions that did not allow adaptive coordination and thus did not evolve toward concerted action. How can these differences be explained? Fig. 2a is not sufficient and more in-depth exploration of what components are involved in integrated catchment management (ICM) situations is needed.

2.2. What are the main components of transformational change situations and why are they important?

In order to deepen our search for systemic coherence in integrated catchment management (ICM), we framed our exploration by means of a set of variables (SLIM, 2004b,c,d,e,f,g). These were initially distilled from the international literature and empirical study based on the simple logic upon which the project was built (Ison et al., 2007). We found four of these variables to be very influential in deliberative processes and together constituted the main variables needed to comprehend ICM situations: stakeholders and stake-holding processes, ecological constraints, institutional frameworks, and facilitation. These variables were characterised as factors influencing transformational change but also, and mainly, as variables in the sense that transformational change may lead to transformation in each of them. In other words, the dynamic we have elaborated above, around changes in issues, practices and understanding, involves also changes in the main elements that ICM, as a practice, links together (Fig. 2b). We thus emphasise the systemic character of Fig. 2b. However, in what follows, the variables are presented individually in order to explain their rationale and to show selected evidence of their role in social learning processes. But the reader has to have in mind that they compose a set of interacting variables and that each of them can take on more or less importance with regard to the dynamic of the whole learning process in a specific situation.

2.2.1. From the concept of stakeholder to the notion of stake-holding

Many individuals, organised groups and public as well as private agencies are concerned about issues such as the
collaborative stakeholder processes, in order to map stake-
holders and the stakes they defend. But SA provides a static
view of stakeholders and stakes and it requires judgements to
be made on the basis of imperfect information. Our case
studies have provided evidence of how the interests and social
positions of the people involved may change over time in
relation to the issues at stake (Table 2). This finding relates to
theories of collective action where ‘collective’ mainly means
rebuilding the relationship humans establish with natural or

Table 1 – Some examples of how change (or lack of change) in social asymmetry and legitimacy of stakeholder
relationships relates to change in what is at stake (as at end 2004)

| SLIM case studies      | From problems… | …to concerted action
<table>
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<tbody>
<tr>
<td>Benelux middengebied</td>
<td>Regulation and banning of summer irrigation to limit the draw down of groundwater leads to weak compliance and widespread protests</td>
<td>Discussions around the placement and operation of small weirs inserted into field ditches brings farmers and their support organisations to accept that ‘crop follows water’ rather than ‘water follows the crop’</td>
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<tr>
<td>Tweed river</td>
<td>Managing reservoir releases of the Tweed on the basis of historical legacy to protect water quality leads to tension with those who support a ‘quantity’ perspective</td>
<td>Flexible water release protocols are discussed and revised on the basis of monitoring and allow plurality of stakeholders to be engaged in integrated catchment management</td>
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<tr>
<td>Marche region</td>
<td>Sector-related environmental schemes implemented in small watersheds have a low efficiency to limit nitrate pollution at catchment scale</td>
<td>Facilitation by scientists of social interactions at various decision levels creates a growing awareness of ‘catchment’ and of the role of each stakeholder in nitrate pollution</td>
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<tr>
<td>Natura 2000</td>
<td>Preservation of natural components of the marshes in designated areas on the basis of biological monitoring leads to conflict with landowners and crop farmers</td>
<td>Deliberations lead to the emergence of a territorial management plan; main actions are intended to support livestock activities which are recognised as key in nature preservation</td>
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| Case studies          | From problems… | …to problems
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<tr>
<td>Ythan catchment</td>
<td>Scientific data is extensively used to designate the Ythan catchment as a Nitrate Vulnerable Zone and to convince farmers to change their fertilisation practices</td>
<td>The chosen process led to unanimous opposition by farmers to the imposition of a compulsory code of practice</td>
</tr>
<tr>
<td>Drentsche Aa area</td>
<td>Preservation of target plant species in nature reserves requires changes in farmers’ practices in adjacent areas; both fall under a National Landscape designation</td>
<td>Strategic positions of interest group representatives on the official National Landscape platform maintain segregation of land between nature and production areas</td>
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quality, availability, and sustainability of natural resources. However, they do not all hold the same social position with
towards measures proposed or taken to resolve the issues
involved and they do not necessarily share the same view
about what is desirable or what constitutes the ‘purpose’ of
resource management. Stakeholder analysis (SA) (SLIM, 2004a)
often is used as an analytical tool in the start-up phases of
collaborative stakeholder processes, in order to map stake-
holders and the stakes they defend. But SA provides a static
view of stakeholders and stakes and it requires judgements to
be made on the basis of imperfect information. Our case
studies have provided evidence of how the interests and social
positions of the people involved may change over time in
relation to the issues at stake (Table 2). This finding relates to
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rebuilding the relationship humans establish with natural or

Table 2 – Some examples of success and failure with transforming given problems into concerted action (as at end 2004)

| SLIM case studies      | From problems… | …to concerted action
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<tr>
<td>Tweed river</td>
<td>Water releases were managed by Scottish Water (which owns the reservoirs) in agreement with the Scottish Environment Protection Agency. These key stakeholders did not change their management rules (quality standards) despite increase in abstraction pressures and new demands on fishery management (quantity standards). The collaborative process of building up a catchment management plan led to the emergence of a Reservoir Release Group with responsibility for building more flexible rules, based on accommodating both perspectives, and closely linked to assessment and monitoring programmes. Implementation of Natura 2000 led to the emergence of a group of stakeholders adopting a blocking strategy (landowners, crop farmers and a member of the national parliament acting as spokesperson of the group). Change in issue formulation, from a nature preservation focus to a territorial management focus, decreased the power of this group as new stakes and stakeholders emerged. The blocking strategy disappeared and the elected Deputy changed his social legitimacy by becoming the spokesperson of the collaborative process.</td>
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<tr>
<td>Natura 2000</td>
<td>Absence of significant change in social asymmetries and stakes</td>
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SLIM case study

| SLIM case study | From problems… | …to concerted action
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<td>Drentsche Aa</td>
<td>Discussions about change in farming practices to reduce diffuse pollution influencing the ecological functioning of a natural area were organised in an official stakeholder platform where strategic and institutional positions prevailed. The social configuration of this deliberative space did not allow any change in the stakes supported by the represented interest groups. For instance, farmers felt their entrepreneurial freedom would be threatened if they started making any concessions.</td>
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SLIM case studies

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technical objects and, in so doing, transforming the relationships they establish between them (Deverre et al., 2000). We have termed this process stake-holding, i.e. new stakes can emerge from social interactions and as these are constructed they lead to the emergence of new stakeholders. The dynamic of this process may in turn transform the legitimacy of a stakeholders’ position or reveal new social asymmetries.

2.2.2. Ecological components of ecosystems

This variable relies on what stakeholders know about the ecological components and processes of ecosystems. These can be identifiable and quantifiable elements that cannot be overwhelmed—the agency power of objects (Callon, 1986). However, what is known about these processes tends to be fragmentary, and based on expert, sectoral knowledge or derived from experiential interaction with these processes (Table 3). The social relationships which frame and structure people’s interaction with ecological phenomena and processes condition the kinds of data, information, and understanding that they hold to be true. It follows that by changing social relationships, change in understanding arises (Hatchuel, 2000; Maturana and Varela, 1987). The unknown part of ecosystem functioning (the larger part) and the fragmentary knowledge of stakeholders results in a high diversity of perceptions, leading to a ‘learning paradox’: on the one hand, these perceptions may constrain or even block learning processes; on the other hand, learning processes are needed to change these perceptions and to build more adequate shared understanding that enables concerted action.

2.2.3. Institutions and policies constitute a framework for deliberative processes

Institutions play a significant role in shaping the management of natural catchments and in providing the norms and values that underpin and inform policy decisions and management practices. In the SLIM project, institutions were understood in two senses: (i) as corresponding to organisations, understood as a hierarchical network of behaviour and roles designed to elicit desired individual behaviour and coordinated action and obeying a system of rules and procedures; (ii) as “regulative principles or conventions subservient to the needs of an organised community” (The Oxford English Dictionary), that is, as established laws or social norms. These elements constitute ‘institutional frameworks’ that span different scales, ranging from local to international levels and which often contain many conflicting elements that work against each other—for example, the Common Agricultural Policy and European nature conservation initiatives.

Institutional frameworks are needed to motivate and organise deliberative processes: frameworks allow stakeholders to specify one or another aspect of the problem and to understand and describe natural events or piloted action (Goffman, 1991). But, at the same time, the deliberative processes that are set in motion tend to force change in the initial framework, challenging the legitimacy, power relationships and identity of the human communities that emerge (Latour, 1999; Dodier, 2003), and thus finally to lead to transformation of institutional settings (Table 4) (Lightfoot et al., 2001). This raises a key question: how do institutional frameworks constrain or enable concerted action and in turn, how could the outcomes of concerted action (new norms, values, coordination mechanisms) be institutionalised?

2.2.4. Facilitating learning processes and coordination among stakeholders

The last – but probably most important – variable is facilitation. This is the means by which scientific knowledge and researchers’ interventions in action can be supported to play a significant role, which we will more specifically discuss below. Facilitation is understood here as a combination of skills, activities and tools used to support and guide learning processes among multiple interdependent stakeholders. Its main role is to bring about systemic change in complex situations for achieving concerted action. It is about the management of deliberative processes and social interactions that help the stakeholders involved to better understand ‘what they are doing’ (first order learning), and ‘why they are doing what they do’ (second order learning) (Groot and Maarleveld, 2000).

In the SLIM project, various tools have been used to assist facilitation and have shown their importance in learning processes: mapping and diagramming techniques based on systems approaches (Powell and Jiggins, 2003); media technologies like GIS (Gibbon et al., 2004); intermediary objects and

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<td><strong>Case studies</strong></td>
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<td><strong>Marche region and Ythan catchment</strong></td>
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concepts (Vinck, 1999; Teulier and Hubert, 2004; Steyaert et al., 2007); performance arts like theatre events (Toderi et al., 2007) or even metaphor exploration (McClintock et al., 2003, 2004).

The Diagnostic Framework introduced above (Figs. 1 and 2) itself can be regarded as a facilitation tool. We explore this further in the next section.

3. Linking the diagnostic framework to theories: the consequences for its use

Snowden (2002) provides insights for management in the ‘complex domain’ in which we locate the work of SLIM: “The nature of the complex domain is the management of patterns (...) These patterns are, to use the language of complex adaptive systems theory, emergent properties of the interactions of the various agents. By increasing information flow, variety and connectiveness either singly or in combination, we can break down existing patterns and create the conditions under which new patterns will emerge, although the nature of emergence is not predictable”. He adds: “In a complex space we cannot sense and respond, but must first probe the space to stimulate pattern understanding or formation, then sense the patterns and respond accordingly” (p. 17).

We identify three links between the SLIM diagnostic framework and Snowden’s thinking:

- Probing the space is the main aim of SLIM’s Diagnostic Framework: its systemic perspective invites reflective practitioners to be involved in a systematic enquiry of relationships among the whole set of variables that constitute complex situations of change;
- The nature of emergence is not predictable. The DF invites its users to look at transformational change and the dynamic of issue formulation, rather than at given problems that could be resolved by the use of fixed forms of knowledge. This requires researchers as stakeholders to become aware of what they ‘do not know’ and to become pro-active to the situation and how it evolves. It invites the user purposefully to manage social interactions and enable social learning processes without knowing the outcomes in advance. It directs attention away from the habits of resolving a predefined problem and toward the new skills and tools for questioning and probing existent patterns and finding new ones in association with others, and toward understanding issues as co-constructed by interdependent stakeholders;
- Processes of ‘sense-making’ thus are central to both the SLIM and Snowden’s perspectives. The sciences are critical to effective sense-making but they do not of themselves constitute a sufficient social practice for making sense of complex situations and how to manage them.

We synthesise these linkages in a new picture of what SLIM researchers have done (Fig. 3). Social learning processes, when they occur and are purposefully managed, lead stakeholders...
to change their interconnected patterns of knowing, doing, and being.

This model relates to that of Illeris (2002) in his classic text on contemporary learning theory. He positions a wide range of learning theorists and theories in what he calls the tension field between the cognitive, the emotional, and the social (see also Blackmore, 2007). Our approaches to social learning have focussed in our case studies on the links between the cognitive and the social, but we have discovered thereby the role and importance of the emotional. Working in the field of natural resource management, which is about co-determinant technical change and social change, we have found it necessary to distinguish – but not disconnect – social relationships (as being) and the relationship stakeholders establish with natural resources (as doing). Indeed, following Cook and Brown (1999) who define knowing as “the epistemic work that is done as a part of action or practice”, we have shown how knowing occurs through people’s interactions with what composes the social and physical world.

What then about researchers’ role in these processes? In the SLIM project, we have adopted three different positions (see also Ison et al., 2007): observer, facilitator and co-researcher. Whatever the position adopted, we have tried to avoid the trap identified by May (2005) in the case of multi-disciplinary studies “in which social science joins science as the means through which application is addressed among stakeholders, leaving justifications for scientific productions unchanged” (p. 536). We show below how, depending on the position adopted by the researcher in interaction with a problem situation, the DF may help to guide research practice.

The observer works within and uses a particular tradition of understanding to analyse and understand a real world situation. This does not, as such, differ from traditional sociological research. But in SLIM’s approach, those who adopted this position (Jiggins et al., 2007; Steyaert et al., 2007) used the outcomes of the research to organise and facilitate ‘reflective meetings’ with stakeholders and various coordinators of social interaction, at key moments in the dynamic of change described in the DF. This brought SLIM’s researchers on the one hand to document and reflect on the contribution of their findings and practices to social learning and on the other hand, helped our partners to step into a process of reflection on their own role in action. As stated by a regular partner of French researchers (Director of Departmental Agricultural Services), “we have our own increasing working tasks and targets to achieve and we have no time to think about why we do what we do. These moments and your point of view are crucial to help us take some distance from our daily work and to change” (pers. com., November 2003).

The facilitator position was the one most frequently adopted by SLIM researchers. In this case, the DF can be used in a comprehensive manner to better understand when it is necessary to facilitate, what kind of facilitation activities or tools could be appropriate to the situation, and what changes can be observed during and after something is facilitated. It is in this field in particular that we see how better linkages can be built between ‘hard science’ and social sciences. We have shown how scientific knowledge, encapsulated in statements and data considered as valid, represents the thinking and doing of the researcher. However, when presented as an authoritative and sufficient claim to be a truthful representation of the issues that are at stake, scientific knowledge can block processes of knowledge creation that are essential to further evolution of policy and practices. Alternatively, if by means of facilitation and process design scientific knowledge can be placed in society in a different way, opportunities open up for the co-creation of understanding and action that lead to transformational change. We have observed in all our cases that when researchers closely link the knowledge they produce to the processes by which issues come to be defined in interaction with others and when they explain the thinking and the assumptions that underlies their research questions, their knowledge gains additional heuristic value. The value added is precisely that of helping the stakeholders who have been brought into a new relationship with each other and the resource to make better sense of and thus act more effectively in the situation. In other words, the stabilised knowledge of science can enable learning processes that are effective at societal scales and may play an “intermediary” role in building common narratives that reduces complexity and uncertainty (Callon, 1986).

The position of co-researching differs from the other two in that its aim is to research with people, and not about or for (McClintock et al., 2003). It is a joint research process where the dichotomy between the researcher and its subject, the doing and the using of research is dissolved. The DF in this case becomes a tool, as a mediator between the various perceptions and understanding of stakeholders, including researchers, in order to jointly research what new patterns are needed to improve the situation.

4. Methodological issues

The contributors to this issue write of their experience of “doing research” in the context of messy and confusing situations where they became part of the social interactions at play. The experience, as the papers show, theoretically questions the relationship between science and society, between knowledge and action. But it also brings into question the practices of research and the ethics of being a researcher—issues that we determined from the beginning that we would reflect on throughout the SLIM experience.

As indicated in papers one and two of this issue (Ison et al., 2007; Blackmore, 2007), we began as individual researchers from various disciplines, sharing an interest constituted by a common awareness of resource dilemmas but appreciated through various “traditions of understanding”. Our first common act was to identify ourselves as a “learning group” and to adopt an explicit praxeology—the theory that would guide our shared practice. We acknowledged diversity from the start by recognising that there would be both team-specific elements, and elements shared at the level of the whole SLIM project. The shared content of our enquiry consisted in questioning our various theories on social learning by means of collective inquiry into each of the cases, and by the systematic exploration of the variables captured in the Diagnostic Framework through the use of questions such as: why is the variable important; what is it about, how might it be researched? This questioning provided entry points for
structuring the shared elements of the enquiry and suggested how we might search for systemic coherence and meaning within and across the chosen cases. The variables also were explored during workshops that were organised around field study visits to the selected cases. The workshops and field studies typically also included partners from one or other case study.

We deliberately chose not to construct a research process based on matching ‘case comparisons’ or statistical analysis of (sample) populations of cases because – in our view – of the inadmissibility of such procedures when dealing with situated experiences embedded in specific histories and responding to the particularities of framing conditions that were themselves evolving throughout the period our research was conducted (as depicted in Fig. 2 of the editorial to this issue). How, then, to achieve synthesis whilst respecting the contingent and the particular? Eventually we all came to understand that we had developed a methodological focus on trying to understand processes of knowledge management and of learning as situated in practice.

The synthesis along these two axes came about as our learning group (including members of case study organisations) evolved into a Community of Practice (Wenger, 1998; Blackmore, 2007). Our community of practice survives in ongoing professional relationships, mutual exploration of intellectual controversies, and further common research actions. We created a shared history through experiential learning and shared reflection on that experience in open discussion—a process that was at times uncomfortable and even confrontational but which allowed us explicitly to become accountable for our own learning, our results, and our practices. Our espoused theory of research and our researching practice were legitimised in transformed research relationships that continue to offer space for meaning and understanding to emerge. This was achieved by embedding the emergent understanding in locally relevant cultures and contexts, experiencing concrete situations together, managing the research process collectively, and taking shared responsibility for learning processes and outcomes.

However, this praxis raises the issue of proof of claims to success of such a methodology. Do our own perceptions and assessment of what we experienced constitute proof? Each workshop included sessions allowing for joint reflection and evaluation. Monitoring and evaluation of our own learning was assisted on two occasions by means of external researchers, who joined a workshop and provided feedback on the processes and interactions observed. External reviewers commented on written statements of our emergent body of theory and analysis. A methodology support team, within SLIM, also assisted the country teams to record and document the experience systematically throughout and to carry out a final analysis, using a variety of participatory techniques, which was written up as an internal working paper. This body of rich material is being prepared for publication.

We also can refer here back to our earlier discussion of questions of legitimacy and authenticity—the proof that the methodology is valuable and is valued also by the concerned stakeholders is evidenced in, for example:

- The concerned case study and policy actors’ willingness to maintain relationships built with and through the researchers;
- Social, organizational, and technical outcomes that are considered as promoting sufficient change in the desired direction, within a desired time frame;
- The emergence of a formal language for writing professionally, as in this issue, about the research experience and its outcomes.

5. Implications for research and researchers

Here we bring together what has been learned about the relation between knowledge and research action. We argue, on the evidence of the special issue, that the relationship at the individual level is constituted in and by the development of new skills, roles and responsibilities, and at the social level by new institutional arrangements, norms and values. Institutions are society’s means for stabilising relationships and action; change in institutions can be experienced as increasing instability and are thus resisted. However, if change is seen as a process of learning, then enduring structural changes can result. The papers presented here show clear evidence of, for example:

- The creation of capacity for adaptive management and situated experiments;
- Policy development informed by intervention research;
- Processes of embedding (stabilising) emergent relationship and knowledge, practices in institutional arrangements, norms, routines, and rules of engagement;
- The contribution of facilitation and the development among case study organisations of capacity and skills in this area;
- The effective exercise of stake-holding.

What we want to highlight are the following:

1. The evolution of new norms (Jiggins, 1994) for the validity and rigour (effectiveness) of intervention research. We suggest that they include:
   - redefining (expanding) science’s responsibility to society;
   - dealing with asymmetries of knowledge;
   - negotiating accountability for the researching process with partners.

2. The implications for researchers of involvement in the social spaces for interaction. At a minimum they require that researchers:
   - understand what is at stake, as a researcher, in the context;
   - discover the boundaries, with the stakeholders, between the independence (autonomy) of research practice, contracted research under stakeholder control, and co-researching;
   - embed the results of negotiating these boundaries in agreements;
   - gain awareness of and respect for other actors’ perceptions of the roles researchers are playing (as delivering objective truth, as a partner, as observers... )—or that they desire researchers to play;
• recognise that the outcomes of the above have huge consequences for the management of scientific knowledge.

3. And at the level of involvement in the fabric of existing societal arrangements, it implies that researchers are implicated in:

• the institutionalisation of the new practices of knowledge management within research organisations;
• networking with policy makers regarding (local, area-based, national, EU) attempts to stimulate innovation by creating space and time for new meaning and practices to emerge (building conducive policies);
• playing a role in deepening societies’ capacity for adaptation to resource crises by creating the conditions for multi-stakeholder learning and the management of knowledge in dynamic complex systems.

6. Conclusions

The dominant ideology in water governance in Europe has been that nature is manageable and that people can use, control, and exhaust resources without creating unmanageable risks and dangers to their own survival – and that if surprises are encountered, these can be managed through technological innovations. Whether researchers and professional practitioners recognise it or not, they are historically complicit in the events and processes that are giving rise to the resource dilemmas that result.

Growing awareness of the limits to this way of thinking and acting has led to a new societal agenda for research that has been incorporated in major policy frameworks. It is an agenda that is not going to go away. It demands a new response from researchers and research organisations, a response that no longer places them outside the phenomena observed. Thus there is a rather urgent need for practitioners and policy makers to enrich and expand their capacities, and to explore and expand their agreements with other societal actors (Stilgoe et al., 2005).

This offers fresh opportunities for researchers and practitioners to play a privileged role in the emergence of a new kind of socio-technical democracy, i.e. in the development of grassroots scientific literacy, and the co-creation of knowledge and understanding, in ways that safeguard appreciation of the contribution of science to societal evolution, and strengthen societies’ capacity and willingness to make problems discussable and to confront the risks involved in change. What is required is far different, we stress, from a simple shift from approaches based on technical design, knowledge transfer, and one-way communication of expert information, to social engineering responses and more sophisticated communication tools! Tools such as simulation modelling, scenario construction and analysis, or remote imaging are undoubtedly allowing researchers to capture and present multi-layered data in new ways and to develop new interpretations of patterns and associations, at a range of scales, and this is helpful for research purposes. But for resource management in interaction with others, such tools need to be placed in sophisticated processes of dialogue, adapted for use with a range of stakeholders, and to allow for joint interpretation—also of the kinds of information and data that might be better handled outside the format or structure of any particular tool (Lahsen and Nobre, 2007). Similarly, the rapidly expanding and evolving infrastructures and platforms for communication potentially offer greatly expanded capabilities for interactive learning, at a variety of scales, but here also we need to be creative and to learn more about how to exploit the potential.

This special issue shows various ways of meeting the increasing demand for evidence-based policy-making, and for data and scientific evidence as the essential knowledge base for technological decision-making. The contributors show how responses can be linked to the need to create stabilised frameworks of understanding so as to effect change over ever-widening scales. Importantly, they also show how this might be done while closing the gap between these efforts and what happens at local levels, and between the stabilised, authoritative frameworks of meaning and the diverse meaning that different actors give to action and data.

The experiences detailed in this issue call into question whose knowledge counts and what constitutes knowledge useful for action. It is easy to hide from the scrutiny of others the expertise embodied in technologies and in technical/professional decisions, as well as to conceal the pre-analytic assumptions about how the world works that are embodied in these. Scientific knowledge, when presented as conclusive, can increase asymmetries of understanding and conflict especially if the values and meaning entailed by that knowledge are not subject to public scrutiny and discussion.

Multi-stakeholder learning processes, if adequately conducted, open space for people – including scientists and policy makers – to speak about their assumptions, values, and norms so that decisions become based less on the defence of autonomous interests and hidden meaning and more on appreciation of the interdependency of collective interests. However, such processes encounter a difficult time issue. On the one hand, the seeming urgency of problems and heightened perceptions of risk pushes people toward the risk of draconian, coercive interventions under authoritarian governance, driven by the claims of necessity. On the other, social learning processes undoubtedly take time. For example, the engagement of the actors in the Benelux Middle Area case, or the Maraichine case (Brives, 2004) have been evolving over at least 15 years but they do offer an alternative response—and the only real decision involved here is to start experimenting with your own practice in a real context.

None the less, the contributors to this issue are not arguing for a one-sided social learning approach. As Connor and Dovers (2004) conclude, promoting sustainability (including the sustainable use of water) ‘requires multiple policy and institutional strategies in a sophisticated mix...ones that unsettle and disturb the existing institutional system’ (p. 227). It is legitimate to ask whether we could not find a more effective balance between approaches to natural resource governance based on market, regulatory, and social learning measures that shape the relationships between social, natural, and technical phenomena. We still have much to learn about such a complementarity.
REFERENCES


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