Focus Article

Social learning and climate change adaptation: evidence for international development practice

Jonathan Ensor[1]* and Blane Harvey[2]

The potential for social learning to address complex, interconnected social and environmental challenges, such as climate change adaptation, is receiving increasing attention in research and practice. Social learning approaches vary, but commonly include cycles of knowledge sharing and joint action to co-create knowledge, relationships, and practices among diverse stakeholders. This results in learning and change that goes beyond the individual into communities, networks, or systems. Many authors have focused on analysis of case studies to better understand the contexts in which such learning occurs. In this paper, we look across this literature to draw out lessons for international development practice. To support those looking to purposively design social learning interventions for adaptation, we focus on four areas: lessons learned and the principles adopted when using a social learning approach, examples of tools and methods used, approaches to evaluating social learning, and examples of its impact. While we identify important lessons for practice within each of these areas, three cross-cutting themes emerge. These are: the importance of developing a shared view among those initiating learning processes of how change might happen and of how social learning fits within it, linking this locus of desired change to the tools employed; the centrality of skilled facilitation and in particular how practitioners may shift toward being participants in the collective learning process; and the need to attend to social difference, recognizing the complexity of social relations and the potential for less powerful actors to be co-opted in shared decision making.

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INTRODUCTION

Interest in social learning as part of the response to the challenges of climate change adaptation has grown significantly in recent years. For practitioners, particularly those working in developing country contexts, this shift builds on a long history of action-research in natural resource management and food security in which social learning has been employed to address interconnected social and ecological problems that engage stakeholders with diverse perspectives. These complex or 'wicked'[1] problems have been seen to require learning and reflexivity in place of conventional management regimes.[2–4]

In the literature, much attention has focused on how social learning can support this by developing shared understandings and actions among researchers, communities, and policy makers. Recognition of the

*Correspondence to: jon.ensor@york.ac.uk

[1]Stockholm Environment Institute, University of York, Heslington, York, UK

[2]Collaborative Adaptation Research Initiative in Africa and Asia, International Development Research Centre, Ottawa, ON, Canada

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complexity of social-ecological systems, and of the uncertainty and differing understandings of risk and value associated with climate impacts and adaptation actions, has led to an emphasis on better understanding emerging problems and potential solutions. As Lonsdale et al.[5] suggest in advocating social learning approaches, '[n]o one person has the whole answer … and there is a pressing need to come up with imaginative solutions.' Here, we use the phrase 'social learning approaches' to denote actions taken that are designed to create the conditions in which social learning is likely to occur. In this paper, our purpose is to clarify the potential of social learning approaches for adaptation in developing countries, highlighting and bringing structure to evidence that is currently dispersed among diverse case studies. In so doing, we hope to support those actors and organizations looking to use social learning approaches in adaptation programming with communities in the global South.

The roots of social learning theory can be found in work concerned with the psychology of (individual) learning[6] and the sociology of (shared) learning,[7,8] as well as in traditions that understand learning as a process of critical reflection within individuals[9] and collectives.[10] While social learning emerged from Bandura's insights into individual learning that occurs in a social context (through the production of mental models derived from observation), current practice in natural resource management and climate change owes more to theories of 'situated learning' that emphasize the social setting and its role in structuring what is learnt.[11,12]

This social turn has exposed how learners, as participants in a community of practice, are embedded in a particular context, culture, and set of practices. This situation shapes, and is in turn shaped by, their thinking. Learning emerges from the collaborative processes that allow a shared sense of meaning to be arrived at by the community. Practitioners seeking to support behavior change have embedded this understanding of learning as a relational, social process into cycles of action and reflection. Efforts focus on enabling new meaning to be found through interaction with those who have a different perspective, in a process of shared 'sense-making' around particular issues or challenges.[13]

Much recent literature has focused attention on establishing a definition of social learning. Reed et al.'s 2010 review is emblematic of this trend, attempting to secure an unambiguous response to the question: what is social learning?[12] Yet their underlying presumption—that such clarity is necessary for effective practice—is contested by Ison et al.,[14] who suggest that the power of social learning lies in the diversity of ways in which it can be interpreted and applied. Rather than seeking a rigid and final definition of the concept, knowledge of social learning is understood to be emerging through practice—and as such the onus is on the user to be clear about how it is being used and toward what kinds of ends.[14] This approach reflects the body of experience now found in the literature, which document action-orientated social learning approaches in a variety of contexts. Recognizing this, we define social learning broadly, as emerging through practices that facilitate knowledge sharing, joint learning, and co-creation of experiences between stakeholders around a shared purpose in ways that:

1. Take learning and change beyond the individual to communities, networks, or systems; and
2. Enable new shared ways of knowing to emerge that lead to changes in practice.

To date, reviews of social learning have largely been based on individual case studies[15,16] and analyses of how social learning has been framed in different initiatives.[2,17] While recognizing the value of case studies to better explore the contexts in which learning does or does not occur,[15] our research has highlighted a need to focus more specifically on how social learning is put into practice.[18,19] With this in mind, we look to build upon existing literature by adopting a comparative approach, drawing out trends that have relevance for adaptation practice from within peer-reviewed case studies. In taking this approach, we aim to distil findings from a range of social learning case study literature and provide evidence that can inform development organizations considering integrating social learning into their institutional practice of adaptation programming. In referring to 'development organizations' in this context, we are broadly focused on non-governmental and inter-governmental organisations, and funding agencies that are concerned with action on climate change in developing countries. For this community, uncertainties about how social learning is done, how it is measured, and what outcomes it can achieve, raise challenges in terms of justifying an investment into approaches that may demand changes in practice and resource allocation.[20]

We adopt the following structure. First, in the next section, we discuss the relationship between social learning and climate change adaptation. We follow this with a presentation of our method for narrowing and reviewing the case study literature on social learning. This structures our findings in terms of evidence in relation to four areas of focus that have significance for those in international development

organizations looking to support adaptation through social learning initiatives or programs. These four focus areas are: lessons learned and principles for using a social learning approach; examples of tools and approaches used; approaches to evaluating social learning; and examples of its impact. Finally, our discussion and conclusion summarizes key findings for adaptation practice, highlighting the importance of practitioners developing a shared view of how social learning tools and methods can support the change intended through projects or programs; the centrality of skilled facilitation and how this may shift the role of adaptation practitioners toward being participants in the collective learning process; and the need to attend to social difference in social learning initiatives that are intended to support equitable adaptation outcomes.

SITUATING SOCIAL LEARNING IN CLIMATE CHANGE AND DEVELOPMENT

Recent research surveying the views of development practitioners concerned with climate change adaptation suggests broad agreement that adaptation needs to move beyond a focus on information provision, and instead become embedded in processes that support learning.[18] As Box 1 illustrates, these stakeholders called for increased local participation to provide opportunities for information sharing and knowledge building, identifying that adaptation should stimulate behavioral change and socio-institutional shifts. As one respondent surveyed for the study noted, there is a need for 'tools and methodologies … that help people adapt and do things differently.'[18] The views expressed by these stakeholders resonate with a growing literature linking climate change adaptation, development, and social learning.[21–23] Many authors[24–26] highlight the contrast between the social learning paradigm and policies that focus on behavior change through regulating, informing, or educating actors.

While the social learning literature is diverse, knowledge co-creation to develop shared ways of knowing is a common theme, usually entailing a shift in power relations to bring excluded or marginalized voices into management or decision-making processes.[27–30] Periods of experimentation and reflection can support the emergence of new knowledge and ways of operating.[3,31] Here, there is overlap with work on 'innovation systems' in which diverse stakeholders, including communities, service providers, and external experts, interact to co-evolve the social, institutional, and technical components of research and development.[32] This capacity to build new knowledge, relationships, and practices in response to complex environmental challenges links social learning to climate change adaptation. Collins and Ison,[33] for example, make the conceptual case for 'adaptation as social learning' in recognition of the uncertainty, interconnectedness, and complexity that are bound up with differing understandings of risk and value inherent in adaptation decision making.

Studies of social learning reflect varying interpretations of praxis. For some, the focus is on observing existing social interactions, such as in Rist et al.'s analysis of the traditional land use system operated by indigenous communities in the Andes in terms of social learning.[34] Similarly, other authors point to the significance of informal relationships (in 'adaptive' or 'shadow' networks or spaces) that can prepare the

BOX 1

PRACTITIONER NEEDS AND PRIORITIES[18]

Practitioners working at the intersection of climate change and development have identified a need for tools and methods that enable communication across different scales and between different types of stakeholders (e.g., between farmers, NGOs, and government officers). Barriers to effective action overwhelming relate to how messages about climate change and adaptation options are constructed and disseminated. For example, there was wide consensus among survey respondents on the need to work through and with local languages, values, and cultural systems. But even at local scales the need to differentiate was identified: for example, in farming communities in India marginal and commercial farmers exist side by side yet have significantly different priorities, values, and interests. Successful communication approaches contextualized content, making use of processes to understand the perceptions and realities of local populations. Thus, for example, participatory processes were cited as successful, with radio offered as an example of a method to reach local communities that provides built-in feedback loops to co-create the messages (through users posing questions during phone-in discussions). While these insights confirm the need for shared knowledge creation processes that draw together communities and external actors, a separate survey of climate change communication initiatives suggests that only a minority of approaches (14%) offer this, while the vast majority (56%) is still rely on linear, top down processes.

ground for the emergence of new ideas, alternative policy discourses, and socio-technical transitions.[35,36] Knowledge networks, for example, are seen as a practical arrangement for enabling flows of knowledge between adaptation and development actors.[37] In this review, our interest is in purposeful, planned interventions. While we recognize that social learning is not solely the product of such interventions—and indeed may fail to emerge even when interventions have this as a goal—there is a growing toolbox of methods and approaches to support interventions and help create conditions under which social learning may emerge.[38] In this framing, we understand 'social learning approaches' as actions designed to create the conditions in which social learning is likely to occur. In turn, these learning processes can contribute to adaptive capacity by providing a way to alter practices or decision-making norms in the face of uncertainty,[39,40] enabling participants to influence vulnerability to particular shocks and stresses, or alter the resilience or transform the function of their social-ecological system.[41,42]

There are, however, important barriers faced by organizations concerned with climate change adaptation who wish to implement social learning approaches in practice (e.g., see Box 2). There is often a limited fit between existing institutional architectures, practices, and incentives and those recommended for organizations aiming to integrate social learning into their core practices. At the same time, uncertainties around both the means and ends of social learning pose challenges, first, to those needing to justify an investment of time and resources into approaches that may demand significant changes in practice; and second, to those looking to plan actions using social learning approaches to achieve particular desired outcomes. This includes aligning particular principles, tools, and approaches with the vision of change that a given social learning approach has been based upon.

REVIEW METHOD

To address some of the concerns outlined above, this review adopts a set of existing 'methodological lenses'[44] drawn from the social learning literature to extract evidence on four areas of focus for putting social learning into practice. The areas, identified through consultations with key informants[b] and through a review of the existing literature, consist of: lessons learned and principles for using a social learning approach, examples of specific tools and approaches used, approaches to evaluating social learning, and specific examples of its impact. As such, our focus areas are grounded in the literature yet have external validity, as they respond to needs identified among those concerned with adaptation programming within development organizations.

The literature selected for this review was drawn from Rodela's 2011 systematic review of social learning in natural resource management, which included a total of 97 peer-reviewed publications.[17] This corpus was used to provide consistency in what was identified

BOX 2

TAKING A LEARNING-CENTERED APPROACH TO PROGRAM DEVELOPMENT

From the outset of the Collaborative Adaptation Research Initiative in Africa and Asia (CARIAA)[a] program in 2012, IDRC has aimed to take a learning-centered approach to program design and management. The approach, drawing on Ison et al.'s (2013) description of social learning as a governance mechanism, has been to formalize social learning (framed as an iterative form of learning review) into the program's monitoring and evaluation framework and associated planning and strategy processes. This experience has revealed the challenges institutions involved in developing research programs may face in creating an 'enabling environment' for incentivizing, capturing, and acting on learning. These include:

- Allowing considerable time and resourcing for the negotiation of a shared model of practice and governance at the outset of a partnership;
- Allowing flexibility (in grant agreements, etc.) for consortium partners to re-allocate resources among themselves in line with emerging findings and lessons;
- Establishing a distinction and independence between monitoring and evaluation for accountability and for learning purposes to avoid creating fear of reporting failure;
- Providing scope and mechanisms for program objectives, anticipated outcomes, and approaches to be revised as lessons emerge;
- Creating spaces and time for ongoing dialog that are accessible across a program with at least 200 individuals based in over 20 countries.

Addressing these challenges has meant working differently, both within IDRC as well as with the range of partners, and innovating on standard practice in terms of program governance, management, and implementation.

as 'social learning,' given the wide range of material available on learning processes that may or may not specifically identify itself as social learning. We further narrowed this by sampling from within each of Rodela's three categories of social learning research (individual, networked, and social ecological system), identifying papers that provide strong illustrative examples of social learning aligned with our four areas of enquiry. A total of 24 studies were retained.[c]

Rodela's (2011) categories of social learning research emerge from different perspectives that span a range of views on where learning takes place, and what it can prompt as outcomes. As such, recognition of these differences is essential if the application of social learning approaches in adaptation practice is to match the expectations of those in implementing organizations. The first is an *individual-centric* perspective, where learning is seen as transformative, resulting from individuals' participation in learning activities, and resulting in changes in individual behavior (also see Ref 9). We note, however, that Rodela identifies a missing link in evidence for claims that these approaches yield changes beyond the individual (a point we return to in our conclusion). The second perspective is *network-centric*, where learning is experiential and leads to changes in established practice and ways of relating among members of a common network or community. This is in line with work by Wenger[8] and others on learning in networked practice. The third of Rodela's perspectives is *systems-centric* and sees learning as a process emerging from engagement with or around social-ecological systems and resulting in more systemic transformations that improve the sustainability of these systems. These are closely related to the work on adaptive co-management of social-ecological systems (e.g., Ref 45).

Beyond these three perspectives presented by Rodela, we further structured our analysis using peer-reviewed framings extracted from within the corpus we were reviewing, for each of the four areas of focus (lessons and principles, tools and methods, evaluation, and impact). This approach to framing the review strengthens the validity (through the use of peer-reviewed framings), directs attention toward key themes raised in the literature, and responds to the concerns of some social learning theorists that the ever-expanding range of framings of social learning contributes to a lack of clarity in its theory and practice (cf. Reed et al.[12]). The framings were selected for the significance of the themes they identify for those in adaptation practice, drawing on inputs from a group of experts active in adaptation and development.[19] They are drawn from Collins and Ison's 'design heuristic for social learning'[30] (lessons and principles); Maurel et al.'s[46] typology of functions (tools and methods); Cundill and Rodela's concern with distinction between process and outcomes[2] (evaluation); and Lebel at al.'s[40] categorization of 'what is learned' (impact). These framings are explored in more detail below, and Tables 1–4 provide illustrative examples of our findings within this analytical structure. In this way, we offer a novel but grounded analysis that allows us to draw out findings of significance to practice from within the diverse literature.

FINDINGS

Lessons and Principles Derived from Social Learning Practice

This first area of focus identifies generalizable lessons learned and principles that might inform future adaptation practice. The growing body of case-study literature is rich in this regard, but findings are often buried within reports that focus on specific initiatives or processes. Beyond our categorization according to Rodela's three perspectives on social learning, we organized our findings in line with Collins and Ison's[30] 'design heuristic for social learning,' which they describe as 'a minimum set of activities necessary for a social learning system for climate change adaptation to function' (p.366). These activity sets consist of building stakeholding (i.e., convening the appropriate range of stakeholders and ensuring they are able to take part), providing facilitation, developing conducive institutions and policies, and taking into account epistemological or knowledge considerations.

As Table 1 illustrates, the reviewed literature yielded a wide range of lessons learned and principles proposed, aimed at informing future practice. These were primarily related to the process of undertaking social learning, rather than the selection of stakeholders or the wider policy or contextual issues. There is close agreement across the three social learning perspectives (individuals and systems in particular) that accounting for multiple worldviews and knowledge sources is a key principle for engagement. This reflects the centrality of developing 'shared ways of knowing' to social learning processes.[49] Building on this, establishing processes for addressing differences (in power, aims, perspectives, knowledge systems, etc.) across those participating groups was also noted as a pre-requisite. Capacity- and trust-building processes were recommended by many as a key to successful engagement, although the literature is unclear whether capacity and trust need to be built *a priori* or can be developed through the process. Ensuring that there was scope for change to follow from learning

TABLE 1 | Lessons and Principles: Illustrative Examples

	Individual	Network	System
Stakeholders and building stakeholding	Look for diverse participation but with due attention to power and standing of individuals[47,48]		Involve local resource users as they are key decision makers[49]
Facilitation and Process	Facilitators, trust building and open processes needed but participation may co-opt less powerful actors[47,48,50]	Do not try to resolve or eliminate conflict, but rather aim to learn about complex issues in an inherently conflictual environment[51]	Cross scale learning events can support dialogue, build networks, diversify experiences, and stimulate innovation[52]
Institutions and Policies	Individual learning is frustrating without avenues for institutional or policy change[47,53]	Supporting network development can enable increased dialogue and planning for change[50]	Need the ability to monitor and respond to environmental changes[52]
Knowledge considerations	Need to respect and invite multiple sources of knowledge—including local knowledge[54,53]	Integrated understanding of the social and environmental dimensions of change is crucial[55]	Need to allow for differing worldviews and different knowledge systems among stakeholders[3,56]

processes (e.g., through the existence of funding opportunities or avenues for structural change) was widely noted as being important if learning benefits are to be realized rather than frustrated.[50,54,60] Finally it was widely noted that good facilitation is necessary for ensuring successful social learning. This feature warrants further reflection as a core of good practice, and is a point we return to in the conclusions to this paper.

In contrasting lessons and principles across Rodela's three different social learning perspectives, there were some important points of note. First, there is a much stronger emphasis in individual-centric approaches on the minimum set of skills required to engage effectively in social learning. This may be due to a less deliberate focus on collective change compared to network and systems-centric approaches, in which there are frequent references to the use of bridging organizations and knowledge networks. Second, the evidence suggests that using experimentation to generate learning is common to both network- and system-wide learning. These wider-scale engagements lend themselves to collective action more readily than individual-orientated approaches. Finally, network- and system-centric approaches also appear to bring a stronger focus on facilitating longer-term change at the level of processes, policies, and collective action, though this question of 'higher order change' was also raised in two individual-centric studies. These findings reinforce the need for careful consideration of the fit between the social learning perspective, the methods adopted, and the ambition for adaptation interventions in terms of initiating change in collectives or institutions.

Tools and Approaches to Support Practice

The second area of focus is on the specific tools, techniques, and approaches that can help facilitate a social learning process. These can range from facilitation and workshop approaches, to the use of specific information and communication technologies (ICTs) to support interaction. As Table 2 illustrates, the framing we have used organizes the tools and approaches by function type:[46] techniques for facilitating interaction; tools designed to elicit stakeholders' perspectives and framings on issues; knowledge management tools for documenting and storing information; and tools to simulate systems or dynamics. In some cases, tools are applicable across more than one of these functions. For adaptation practitioners, it is significant that there is evidence of a broad pool of tools for social learning on which to draw. However, we also recognize that in practice tools are engaged within 'systemic modalities'; that is, in a dynamic and emergent process that involves the practitioner, the tool or method, and the situation.[63]

What seems evident across all of these approaches and perspectives is the fundamental role played by face-to-face facilitation, in a range of forms, in creating opportunities for social learning. From specially designed conference approaches (e.g., search conferences[47]) to more traditional role playing games, direct interaction between differently positioned stakeholders remains at the center of social learning approaches. In some cases these have been supported by computer-based modeling and simulation tools (such as agent-based social simulation[57]), or

TABLE 2 | Tools and Approaches: Illustrative Examples

	Individual	Network	System
Facilitating Interaction	Role playing games[31,57]	Develop partnerships and engage in action research[58]	Participatory techniques for mentoring farmers' representatives[49]
Capturing Lessons		Framing/reframing exercise[46]	Field visits[49]
Knowledge Management	Workshops for joint knowledge production[48]	ICT-tools can be used to store, retrieve, analyze, display, and disseminate information but must be simple[46]	Combining farmer-produced resource maps of catchment areas[3]
Simulation	Agent based social simulation[57]	Future scenarios workshops[59]	

the use of ICTs for knowledge management, but the role of direct engagement has not been circumvented by these tools. Maurel et al.[46] report, for example, that despite the potential appeal of high-tech tools to support social learning processes, the majority of participants in their study noted that simpler and more accessible tools for interaction had greater impact on them. They note: 'Sometimes, a site visit or a field trip may be very helpful to complement for example a complex hydraulic modeling' (p. 9). This is likely to have a bearing on the investment of time and money required for social learning activities to take place.

In differentiating between these tools and approaches, it is unsurprising that the approaches used for systems-centric perspectives focus much more directly on human–environment interactions (e.g., through field visits or participatory mapping exercises) while individual and network-centric activities have a stronger focus on meaning-making at the individual level or between peers. These are important distinctions when considered in the context of the expected contributions or impacts of social learning interventions for adaptation. For example, if an initiative aims to use social learning to strengthen an existing network of practice, evidence drawn from our review suggests that facilitated peer-to-peer meaning-making should feature at the core of those activities.

Evaluation of Social Learning Interventions

'Despite […] calls for greater empirical rigor, efforts at empirical evaluation of social learning have been hindered by the rapidly growing literature on this topic, which is replete with contrasting assertions about the outcomes and processes that support social learning.' (Ref 2, p. 7) This assertion by Cundill and Rodela, supported by other analyses of social learning,[21,64] strikes at the heart of a great deal of the uncertainty about a systematic adoption of social learning at a larger scale. As institutions working in the context of climate and development are increasingly expected to demonstrate the rate of success and scale of impact of their interventions, a clear sense of how to do so effectively with social learning approaches is required to justify their adoption. Our review of the literature reveals that there are a number of tools that have been used to evaluate components of social learning interventions (i.e., the purposeful use of social learning). We group these in line with Cundill and Rodela's statement above, considering the evaluation of a social learning intervention's *processes* and *outcomes* (Table 3). This framing emerges from the dual role that evaluation may play in social learning interventions, as either an assessment of how an intended social learning process unfolded, or as an assessment of the types of change (at individual, network, or systemic levels) that resulted from the social learning activity in question. In so doing, the

TABLE 3 | Evaluation: Illustrative Examples

	Individual	Network	System
Process evaluation	Participant observation[47,57]	Community self-assessment and use of process indicators[51]	Participatory mapping[56]
Outcome evaluation	Pre-post questionnaires and follow up interviews[31]	Measurement of change in behavior, attitude, skills, knowledge, or condition (situation) of participants[50]	

framing also reflects and supports the understanding that the process that leads to adaptation actions can build adaptive capacity, and as such can be as important as the overall outcome.[65] It is worth noting that the fluid and iterative nature of social learning often makes it difficult to define specific start and end points for evaluation; however, in the context of the cases featured in this review—planned social learning interventions—these points were often prescribed by the interventions themselves. As such, both of these forms of assessment were evident in the literature.

Immediately notable in our analysis is the relative scarcity of evaluation tools for social learning in system-oriented approaches. While Lebel et al.[40] discuss the role that social learning can play in establishing monitoring and evaluation criteria for assessing progress on adaptiveness, they note that 'the extent of critical empirical analysis on effectiveness of different learning processes is still relatively modest. Further case study work, especially that which documents and assesses changes over time is needed.' (p. 349) Reflecting on the body of literature reviewed for this study, we postulate two possible reasons for this absence. The first is that, as social learning processes in this framing are often embedded in other processes such as adaptive governance or environmental co-management, they may not be evaluated as stand-alone activities. Thus, as in the case of Lebel et al. above, the evaluation focus is the overall adaptiveness in a social-ecological system, with limited reflection on the contribution that social learning has made to this end state. Second, a lack of reported evaluations may be as a result of the relatively recent emergence of this specific framing of learning in resource management and responses to climate change. Similar observations have been made with regard to the relatively limited range of evaluation approaches specific to climate change adaptation.[66] It is also notable that the majority of examples identified in the literature on individual- and network-centric social learning draw on classical instruments such as surveys, interviews, and self-assessment. However, novel evaluation approaches such as discourse analysis[48] and psychologists' evaluations[57] also featured in individual-centric approaches.

In differentiating the use of evaluation approaches for both process and outcome across the three social learning perspectives, the importance of identifying the anticipated locus of learning or change becomes clear. The use of psychological assessments, discourse analysis, and participant observation for individual-centric perspectives, compared with community-self assessment in network-centric approaches, or participatory mapping in systems-centric approaches relate closely to the theories of change that underlie them. As such, these findings further reinforce the fact that for organizations wishing to undertake social learning approaches for adaptation it is important to clarify which vision of change is presumed or sought from social learning, in this case so that appropriately aligned evaluation approaches can be identified.

Evidence of Impact

The final area of focus considers the ultimate impacts of social learning approaches. Here we have focused as closely as possible on specific impacts noted in case descriptions from the literature review, looking to identify direct changes as a result of social learning exercises.

In the broader social learning literature, there is conflicting evidence on what changes and outcomes can be expected from social learning processes. For example, there appears to be wide consensus that social learning can have a significant impact on how participants comprehend their and others' positions around a common issue, leading to changed understanding. Yet Muro and Jeffrey[64] note that this may be a case of less powerful actors adopting the positions of more powerful actors during a particular exchange. Elsewhere, Lebel et al.[40] recount how, in Vietnam, evidence of learning that challenged assumptions and transformed worldviews and values ('double loop' and 'triple loop' learning) failed to yield changes in dominant water governance structures. Despite a shift to a more consultative system of decision making, the new social learning institutions operated as alternative platforms, away from the highly politicized, transboundary governance context within which a development model tied to large-scale infrastructure and macro-economic goals remained intact. With regard to the contribution of social learning to decision-making processes related to resource governance and adaptation, Cundill and Rodela[2] suggest that 'empirical testing of the extent to which social learning improves decision making, under what conditions, and for whom, must be a central theme in future research into the role of social learning in natural resource management.' (p. 11).

Despite the shortcomings highlighted above, there are a range of influences and outcomes attributed to social learning in the literature reviewed. We have organized these using a categorization drawn from Lebel et al.[40] on 'what is learned' through social learning processes. They identify three categories of learning: cognitive learning (factual knowledge), normative learning (changes in norms, values, and belief systems), and relational learning (building of

TABLE 4 | Impacts: Illustrative Examples

	Individual	Network	System
Cognitive	Participants' attitudes toward a communal resource (canals) shifted[31]	Change in participants' understanding of farmers as merely recipients of knowledge and technology, to active agents with the capacity to learn and collaborate[60]	Farmers rebuilding professional identities on the basis of a new relationship to the resources they use[61]
Normative	Municipality allocated new budget for maintenance of shared resource[31]	Improved natural resource management plans[51]	Redesign of fencing to cross legal boundaries of property ownership[40]
Relational	Participants focus on solutions that respect a plurality of interests and worldviews[53]	Improved collective planning processes[51]	Cancelation of new dam building based on inputs from indigenous communities[62]

trust, appreciation of others' worldviews, etc.), which can then lead to outcomes that include changes to practice, values, institutions, or systems. Illustrative examples of our findings are found in Table 4.

Evidence of impact is evenly distributed across Lebel et al.'s three categories of learning, with examples of learning processes leading to changes in systems (e.g., budgeting[31]) and practices (e.g., natural resource management practices[59]). The evidence drawn from the 24 cases also supports the view that moving impacts from the level of the individual (awareness raising, shifts in individual values, etc.) to more collective or system-wide impacts presents increasing challenges as established values, protocols, and relationships are brought under scrutiny.[40] However, these higher-order changes seem to offer concrete impacts on how resources are managed[51,61] and how collective decision making functions.[62] Pelling et al. suggest that adaptation needs to extend beyond awareness raising and behavior change in relation to climate change impacts, to encompass incremental and transformative shifts in institutions, practices, and power relations.[67] For organizations concerned with supporting adaptation, these findings suggest that planning for actions across this spectrum is realistic, but at the same time that social learning approaches do not dissolve the challenge of supporting transformative adaptation.

DISCUSSION AND CONCLUSION

At a time when the evidence base on social learning continues to grow, this review has sought to look *within* the current practice of social learning to better understand what is emerging—in terms of lessons, tools, approaches, and impacts—from this practice. Our view is that this can contribute to a further collective reflection on current practice and, in particular, offers concrete lessons for those in development organizations seeking to use social learning approaches in support of climate change adaptation. In addition to the particular findings in relation to adaptation practice identified above, we draw attention to three central issues that emerge from our review of practice for those looking to implement social learning as part of an adaptation initiative.

Developing a Shared Vision for Change

By drawing attention to the influence of how social learning is framed on eventual impacts, this review underscores the importance of designing social learning for adaptation around a clear vision of change. Explicitly and collectively articulating this vision—that is, identifying the level at which social learning change is anticipated and the expected pathway (and associated mechanisms) for promoting that change—will be key within development organizations looking to adopt social learning approaches in their practice. In particular, the desired learning must be situated within a broader set of assumptions about how change is expected to unfold. There must also be recognition that reflection and sense-making are iterative and often complex, requiring facilitation that is able to address incommensurable worldviews and inequality in power relations (as we will discuss below). Facing these realities means making difficult choices within development organizations, as they demand trade-offs against alternative development approaches that require very different human resource and financial investments.

We argue that the decision on the emphasis and locus of efforts to promote social learning should be

informed by a shared vision of the role the organization sees itself playing in effecting broader change. This process of collective sense-making is essential to initiating a well-conceived social learning process and should, in turn, inform the framing of a social learning approach, the tools used, approaches to evaluation, and the outcomes that can be expected. Collective analysis of assumptions can serve to identify areas where dominant institutional practices or norms may conflict with the model of social learning that is envisioned (e.g., see Box 2). Ison et al.[14] note that the language through which social learning is framed (as performance, governance, action, etc.) both reveals and conceals the assumptions and epistemic positions of those wishing to apply the concept. This, they argue, calls upon practitioners to clearly articulate the ways in which they choose to use the term. In particular, we highlight the significance of ambitions for individual versus network or system level change. If adaptation demands the co-evolution of human social systems and the environment, as Collins and Ison suggest,[33] then, we would argue, changes must be sought at the level of management practices and institutions. Evidence that individual-centric framings of social learning can achieve this is currently lacking.[17]

Facilitation

What emerges clearly from this review is that facilitation approaches designed to build trust, address power imbalances, and bridge diverging aims and interests are critical to the success of planned social learning activities. While we have highlighted a range of tools and techniques that have been used, the vast majority of these still depend on adept facilitators who are able to work across a range of different actors. Recent findings continue to take this discussion forward. For example, Bos et al.[68] observe that facilitation may need to be distributed among a network of actors working for change within a socio-technical system (in this case, the Australian water sector). At the same time, overarching and centralized facilitation by those arranging the experiment remained a necessary 'dedicated engine,' providing practical support and a shared sense of focus. As Colvin et al.[69] note, the significance of the skill-set embedded in experienced and expert facilitators 'cannot be over-emphasised' (p. 768).

Initiatives that are intended to support those engaged in facilitation for social learning are emerging, including frameworks for those working in action research for adaptation[15] and tools for managers of organizations.[70] These are likely to prove valuable as those looking to initiate social learning for adaptation face challenging questions: Who will the facilitators be? To what extent is there a clear understanding of what makes for good facilitation in different settings? How should a facilitator's role be integrated into the research processes? For many development organizations, answering these questions will require an investment in time and effort. It may also require a shift in the skills of front line staff, from technical specialists toward knowledgeable and responsive facilitators. For those in research-led development organizations, the reviewed literature highlights how the research process itself is altered by social learning, with researchers becoming stakeholders and facilitators,[3] shifting from 'researcher to practitioner, toward collective and collaborative decision making and, ultimately, social learning' (Ref 55, p. 566). While this may require a significant change in perspective for some,[71] researchers may in fact be well placed to convene multiple stakeholders and provide feedback to aid learning,[68] and support the emergence of documented social learning processes and outcomes (cf. Ref 61). This is an important gap: the lack of a consistent and systematic documentation is frequently cited in the literature and was confirmed in our review, with the majority of current case-based documentation based on ex-post analysis rather than active documentation of processes as they unfold.[71] If development organizations concerned with adaptation programming are to adopt social learning approaches, with associated risks and costs, then such documentation will prove vital.

Social Differentiation

In the majority of the literature reviewed, the focus is on social learning interventions initiated by outside organizations. This is particularly true for the individual-centric and network-centric social learning, while systems-centric learning appears to have a stronger recognition of the role endogenous processes play in shaping adaptation and environmental management (such as indigenous land use systems in the Andes[34]). Thus, there may be opportunities for drawing on the literature from social-ecological systems to, first, inform planning on integrating endogenous processes into social learning strategies, and second, to see what these processes offer to other social learning initiatives. The former reflects findings in the adaptation literature which draws attention to the significance of building on local institutions to ensure effective adaptation and to enhance the capacity of local actors to adapt.[72] However, in both contexts the risk of reinforcing unequal power relations needs

to be acknowledged and addressed, albeit in differing ways. The need for attention to power relations has been frequently noted, with recent work revealing how opportunities for supporting adaptation through social learning can be tied up with patterns of differentiation embedded in complex socio-technical, political, and economic structures.[73] Thus, numerous cases underscored the role that capacity building has to play at the outset of social learning process to ensure there is more equitable participation.

Ensuring effective participation in the face of inequitable power relations remains an issue for adaptation and development practitioners.[65] Worryingly, it has similarly been highlighted that the role of power in shaping learning is poorly appreciated.[74] Simply working with 'less powerful' or marginalized actors to engage them in learning processes will not fully address issues of power. As noted above, 'successful' social learning that leads to consensus between socially differentiated actors does not necessarily lead to equitable outcomes if this search for consensus undermines those who are less powerful.[64] In such cases, accommodating difference may be a more appropriate goal. Ultimately, unless those who sit in positions of power are called upon to re-consider the primacy of their own ways of knowing and acting, learning will remain partial. This suggests that those engaged in using social learning approaches to support adaptation need to examine how the social and political context determines patterns of power, authority, and accountability, and as such reflects findings on the causes of marginalization from adaptation resources.[75] What was not evident in the literature we reviewed was close attention to the role that gender plays in shaping social learning processes. This is a significant gap, in particular for social learning approaches in the context of climate change, where the significance of gender has been repeatedly highlighted.[76] It is encouraging to note that this has been acknowledged in more recent studies.[27]

NOTES

[a] The Collaborative Adaptation Research Initiative in Africa and Asia (CARIAA) program is a joint initiative between Canada's International Development Research Centre (IDRC) and the UK Department for International Development (DFID). CARIAA aims to generate new research findings, and promote the use of these findings in policy and practice through four transdisciplinary research consortia collaborating on a 7-year program of action.[43]

[b] The consultations with key informants were initiated in May 2012 at a CCAFS-hosted 'Workshop on Communications and Social Learning in Climate Change' in Addis Ababa, Ethiopia. The first objective of this event was to 'identify and prioritize issues where further understanding and research is needed to ensure more robust and successful social learning and communication strategies and interventions on adaptation, mitigation and risk at the local level.' Documentation of this event and a full list of participants are available at: http://ccsl.wikispaces.com/Agenda.

[c] For a detailed documentation of the evidence drawn from the 24 studies, see Harvey et al.,[19] within which a full list of the 24 papers can be found on page 36 and 37.

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REFERENCES

1. Turnpenny J, Lorenzoni I, Jones M. Noisy and definitely not normal: responding to wicked issues in the environment, energy and health. *Environ Sci Policy* 2009, 12:347–358. doi:10.1016/j.envsci.2009.01.004.
2. Cundill G, Rodela R. A review of assertions about the processes and outcomes of social learning in natural resource management. *J Environ Manag* 2012, 113:7–14. doi:10.1016/j.jenvman.2012.08.021.

3. Ison R, Roling N, Watson D. Challenges to science and society in the sustainable management and use of water: investigating the role of social learning. *Environ Sci Policy* 2007, 10:499–511. doi:10.1016/j.envsci.2007.02.008.
4. Roling N. Beyond the aggregation of individual preferences: moving from multiple to distributed cognition in resource dilemmas. In: Leeuwis C, Pyburn R, eds. *Wheelbarrows Full of Frogs*. Assen, the Netherlands: Koninklijke Van Gorcum BV; 2002, 25–48.
5. Lonsdale KG, Gawith MJ, Johnstone K, Street RB, West CC, Brown AD. *Attributes of Well-Adapting Organisations*. London, UK: UK Climate Impacts Programme; 2010.
6. Bandura A. *Social Learning Theory*. Toronto, Canada: Prentice Hall; 1977.
7. Argyris C, Schon D. *Organizational Learning: Creating, Retaining and Transferring Knowledge*. Norwell, MA: Kluwer Academic Publishers; 1978.
8. Wenger E. *Communities of Practice*. Cambridge, UK: Cambridge University Press; 1999.
9. Mezirow J. *Transformative Dimensions of Adult Learning*. San Francisco, CA: Jossey-Bass Publishers; 1991.
10. Freire P. *Pedagogy of the Oppressed*. New York: Seabury; 1970.
11. Lave J, Wenger E. *Situated Learning*. Cambridge, UK: Cambridge University Press; 1991.
12. Reed MS, Evely AC, Cundill G, Fazey I, Glass J, Laing A, Newig J, Parrish B, Prell C, Raymond C, et al. What is social learning? *Ecol Soc* 2010, 15:r1.
13. Weick KE, Sutcliffe KM, Obstfeld D. Organizing and the process of sensemaking. *Organ Sci* 2005, 16:409–421. doi:10.1287/orsc.1050.0133.
14. Ison R, Blackmore C, Iaquinto BL. Towards systemic and adaptive governance: exploring the revealing and concealing aspects of contemporary social-learning metaphors. *Ecol Econ* 2013, 87:34–42. doi:10.1016/j.ecolecon.2012.12.016.
15. Cundill G, Lotz-Sisitka H, Mukute M, Belay M, Shackleton S, Kulundu I. A reflection on the use of case studies as a methodology for social learning research in sub Saharan Africa. *NJAS-Wagen J Life Sci* 2014, 69:39–47. doi:10.1016/j.njas.2013.04.001.
16. Gonsalves J. *A New Relevance and Better Prospects for Wider Uptake of Social Learning within CGIAR*. Copenhagen, Denmark: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS); 2013.
17. Rodela R. Social learning and natural resource management: the emergence of three research perspectives. *Ecol Soc* 2011, 16:30.
18. Harvey B, Ensor J, Carlile L, Garside B, Patterson Z, Næss LO. *Climate Change Communication and Social Learning: Review and Strategy Development for CCAFS*. Copenhagen, Denmark: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS); 2012.
19. Harvey B, Ensor J, Garside B, Woodend J, Næss LO, Carlile L. *Social Learning in Practice: A Review of Lessons, Impacts and Tools for Climate Change*. Copenhagen, Denmark: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS); 2013.
20. Harvey B, Carlile L, Ensor J, Garside B, Patterson Z. Understanding context in learning-centred approaches to climate change communication. *IDS Bull* 2012, 43:31–37. doi:10.1111/j.1759-5436.2012.00360.x.
21. Kristjanson P, Harvey B, Van Epp M, Thornton PK. Social learning and sustainable development. *Nat Clim Chang* 2014, 4:5–7. doi:10.1038/nclimate2080.
22. Cundill G, Shackleton S, Sisitka L, Ntshudu M, Lotz-Sisitka H, Kulundu I, Hamer N. *Social Learning for Adaptation: A Descriptive Handbook for Practitioners and Action Researchers*. IDRC/Rhodes University/Ruliv; 2014.
23. Bardsley DK. Navigating the Roles of the Social Learning Researcher: a critical analysis of a learning approach to guide climate change adaptation. *Aust Geogr* 2014, 46:33–50. doi:10.1080/00049182.2014.953736.
24. Capra F. Forward. In: Wals AEJ, ed. *Social Learning Towards a Sustainable World: Principles, Perspectives, and Praxis*. Wageningen, the Netherlands: Wageningen Academic Pub; 2007, 13–15.
25. Folke C. Freshwater for resilience: a shift in thinking. *Philos Trans Roy Soc B Biol Sci* 2003, 358:2027–2036. doi:10.1098/rstb.2003.1385.
26. Brunner RD, Lynch B. *Adaptive Governance and Climate Change*. Chicago, IL: American Meteorological Society/University of Chicago Press; 2010.
27. Shaw A, Kristjanson P. A catalyst toward sustainability? exploring social learning and social differentiation approaches with the agricultural poor. *Sustainability* 2014, 6:2685–2717. doi:10.3390/su6052685.
28. Armitage D, Berkes F, Dale A, Kocho-Schellenberg E, Patton E. Co-management and the co-production of knowledge: Learning to adapt in Canada's Arctic. *Glob Environ Chang* 2011, 21:995–1004. doi:10.1016/j.gloenvcha.2011.04.006.
29. Van Bommel S, Röling N, Aarts N, Turnhout E. Social learning for solving complex problems: a promising solution or wishful thinking? A case study of multi-actor negotiation for the integrated management and sustainable use of the Drentsche Aa area in the Netherlands. *Environ Policy Govern* 2009, 19:400–412. doi:10.1002/eet.526.
30. Collins K, Ison R. Jumping off Arnstein's ladder: social learning as a new policy paradigm for climate change adaptation. *Environ Policy Govern* 2009, 19:358–373. doi:10.1002/eet.523.
31. Ducrot R. Gaming across scale in peri-urban water management: contribution from two experiences in

Bolivia and Brazil. *Int J Sust Dev World Ecol* 2009, 16:240–252. doi:10.1080/13504500903017260.

32. Ngwenya H, Hagmann J. Making innovation systems work in practice: experiences in integrating innovation, social learning and knowledge in innovation platforms. *Knowl Manag Dev J* 2011, 7:109–124. doi:10.1080/19474199.2011.593867.
33. Collins K, Ison R. Editorial: living with environmental change: adaptation as social learning. Collins K, Ison R, eds. *Environ Policy Govern* 2009, 19:351–357. doi:10.1002/eet.520.
34. Rist S, Burgoa FD, Wiesmann U. The role of social learning processes in the emergence and development of Aymara land use systems. *Mt Res Dev* 2003, 23:263–270. doi:10.1659/0276-4741(2003)023[0263:TROSLP]2.0.CO, 2.
35. Pahl-Wostl C. A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes. *Glob Environ Chang* 2009, 19:354–365. doi:10.1016/j.gloenvcha.2009.06.001.
36. Pelling M, High C, Dearing J, Smith D. Shadow spaces for social learning: a relational understanding of adaptive capacity to climate change within organisations. *Environ Plann A* 2008, 40:867–884. doi:10.1068/a39148.
37. Harvey B, Fisher C. Mobilising knowledge for climate change adaptation in Africa: reflecting on the adaptive management of knowledge networks. *Knowl Manag Dev J* 2013, 9:37–56.
38. Tschakert P, Dietrich KA. Anticipatory learning for climate change adaptation and resilience. *Ecol Soc* 2010, 15:11.
39. Armitage D, Marschke M, Plummer R. Adaptive co-management and the paradox of learning. *Glob Environ Chang* 2008, 18:86–98. doi:10.1016/j.gloenvcha.2007.07.002.
40. Lebel L, Grothmann T, Siebenhüner B. The role of social learning in adaptiveness: insights from water management. *Int Environ Agreements* 2010, 10:333–353. doi:10.1007/s10784-010-9142-6.
41. Engle NL. Adaptive capacity and its assessment. *Glob Environ Chang* 2011, 21:647–656. doi:10.1016/j.gloenvcha.2011.01.019.
42. Nelson DR, Adger WN, Brown K. Adaptation to environmental change: contributions of a resilience framework. *Annu Rev Environ Resourc* 2007, 32:395–419. doi:10.1146/annurev.energy.32.051807.090348.
43. de Souza K, Kituyi E, Harvey B, Leone M, Murali KS, Ford JD. Vulnerability to climate change in three hot spots in Africa and Asia: key issues for policy-relevant adaptation and resilience-building research. *Reg Environ Chang* 2015, 15:747–753.
44. Wals AEJ, Rodela R. Social learning towards sustainability: problematic, perspectives and promise. *NJAS-Wagen J Life Sci* 2014, 69:1–3. doi:10.1016/j.njas.2014.04.001.
45. Folke C, Hahn T, Olsson P, Norberg J. Adaptive governance of social-ecological systems. *Annu Rev Environ Resourc* 2005, 30:441–473. doi:10.1146/annurev.energy.30.050504.144511.
46. Maurel P, Craps M, Cernesson F, Raymond R, Valkering P, Ferrand N. Concepts and methods for analysing the role of information and communication tools (IC-tools) in social learning processes for River Basin Management. *Environ Model Softw* 2007, 22:630–639. doi:10.1016/j.envsoft.2005.12.016.
47. Schusler TM, Daniel JD, Pfeffer MJ. Social learning for collaborative natural resource management. *Soc Nat Resour* 2003, 16:309–326. doi:10.1080/08941920390178874.
48. Rist S, Chiddambaranathan M, Escobar C, Wiesmann U. "It was hard to come to mutual understanding … "—the multidimensionality of social learning processes concerned with sustainable natural resource use in India, Africa and Latin America. *Syst Pract Action Res* 2006, 19:219–237. doi:10.1007/s11213-006-9014-8.
49. Sanginga PC, Kamugisha RN, Martin AM. Strengthening social capital for adaptive governance of natural resources: a participatory learning and action research for bylaws reforms in Uganda. *Soc Nat Resour* 2010, 23:695–710. doi:10.1080/08941920802653513.
50. Kuper M, Dionnet M, Hammani A, Bekkar Y, Garin P, Bluemling B. Supporting the shift from state water to community water: lessons from a social learning approach to designing joint irrigation projects in Morocco. *Ecol Soc* 2009, 14:19.
51. Daniels SE, Walker GB. Collaborative learning: Improving public deliberation in ecosystem-based management. *Environ Impact Assess Rev* 1996, 16:71–102.
52. Olsson P, Folke C, Berkes F. Adaptive comanagement for building resilience in social ecological systems. *Environ Manag* 2004, 34:75–90. doi:10.1007/s00267-003-0101-7.
53. Zanetell BA. Legislating community-based management: lessons from the Venezuelan freshwater fishery. *J Int Wildlife Law Policy* 2001, 4:279–294. doi:10.1080/13880290109353991.
54. Blackmore C. What kinds of knowledge, knowing and learning are required for addressing resource dilemmas? a theoretical overview. *Environ Sci Policy* 2007, 10:512–525. doi:10.1016/j.envsci.2007.02.007.
55. Mahanty S, Stacey N, Holland P, Wright A, Menzies S. Learning to learn: designing monitoring plans in the Pacific Islands International Waters Project. *Ocean Coast Manage* 2007, 50:392–410. doi:10.1016/j.ocecoaman.2006.09.004.
56. Shackleton CM, Cundill G, Knight AT. Beyond just research: experiences from southern Africa in developing social learning partnerships for resource

conservation initiatives. *Biotropica* 2009, 41:563–570. doi:10.1111/j.1744-7429.2009.00559.x.

57. Pahl Wostl C, Hare M. Processes of social learning in integrated resources management. *J Comm Appl Social Psychol* 2004, 14:193–206. doi:10.1002/casp.774.
58. Frost P, Campbell B, Medina G, Usongo L. Landscape-scale approaches for integrated natural resource management in tropical forest landscapes. *Ecol Soc* 2006, 11:30.
59. Brown HCP, Buck LE, Lassoie JP. Governance and social learning in the management of non-wood forest products in community forests in Cameroon. *Int J Agri Resour Govern Ecol* 2008, 7:256. doi:10.1504/IJARGE.2008.018329.
60. Kroma MM. Organic farmer networks: facilitating learning and innovation for sustainable agriculture. *J Sustain Agric* 2006, 28:5–28.
61. Steyaert P, Barzman M, Billaud J-P, Brivesd H, Huberte B, Ollivierf G, Rocheg B. The role of knowledge and research in facilitating social learning among stakeholders in natural resources management in the French Atlantic coastal wetlands. *Environ Sci Policy* 2007, 10:537–550. doi:10.1016/j.envsci.2007.01.012.
62. Plummer R. Sharing the management of a river corridor: a case study of the comanagement process. *Soc Nat Resour* 2006, 19:709–721. doi:10.1080/08941920600801132.
63. Ison R, Collins K, Colvin J, Jiggins J, Roggero PP, Seddaiu G, Steyaert P, Toderi M, Zanolla C. Sustainable catchment managing in a climate changing world: new integrative modalities for connecting policy makers, scientists and other stakeholders. *Water Resour Manage* 2011, 25:3977–3992. doi:10.1007/s11269-011-9880-4.
64. Muro M, Jeffrey P. A critical review of the theory and application of social learning in participatory natural resource management processes. *J Environ Plan Manag* 2008, 51:325–344. doi:10.1080/09640560801977190.
65. Dodman D, Mitlin D. Challenges for community-based adaptation: discovering the potential for transformation. *J Int Dev* 2011, 25:640–659. doi:10.1002/jid.1772.
66. Spearman M, McGray H. *Making Adaptation Count: Concepts and Options for Monitoring and Evaluation of Climate Change Adaptation*. Washington DC: World Resources Institute; 2011.
67. Pelling M, O'Brien K, Matyas D. Adaptation and transformation. *Clim Chang* 2014. doi:10.1007/s10584-014-1303-0.
68. Bos JJ, Brown RR, Farrelly MA. A design framework for creating social learning situations. *Glob Environ Chang* 2013, 23:398–412. doi:10.1016/j.gloenvcha.2012.12.003.
69. Colvin J, Blackmore C, Chimbuya S, Collins K, Dent M, Goss J, Ison R, Roggero PP, Seddaiu G. In search of systemic innovation for sustainable development: a design praxis emerging from a decade of social learning inquiry. *Res Policy* 2014, 43:760–771.
70. Gray DE. Facilitating management learning: developing critical reflection through reflective tools. *Manag Learn* 2007, 38:495–517. doi:10.1177/1350507607083204.
71. Rodela R, Cundill G, Wals AEJ. An analysis of the methodological underpinnings of social learning research in natural resource management. *Ecol Econ* 2012, 77:16–26. doi:10.1016/j.ecolecon.2012.02.032.
72. Agrawal A. Local institutions and adaptation to climate change. In: Mearns R, Norton A, eds. *Social Dimensions of Climate Change: Equity and Vulnerability in a Warming World*. Washington DC: World Bank; 2010, 173–198.
73. Boyd E, Ensor J, Broto VC, Juhola S. Environmentalities of urban climate governance in Maputo, Mozambique. *Glob Environ Chang* 2014, 26:140–151. doi:10.1016/j.gloenvcha.2014.03.012.
74. Crona BI, Parker JN. Learning in support of governance: theories, methods, and a framework to assess how bridging organizations contribute to adaptive resource governance. *Ecol Soc* 2012, 17:32.
75. Ensor JE, Park SE, Hoddy ET, Ratner BD. A rights-based perspective on adaptive capacity. *Glob Environ Chang* 2015, 31:38–49. doi:10.1016/j.gloenvcha.2014.12.005.
76. Terry G. *Climate Change and Gender Justice*. Rugby, UK: Practical Action Publishing; 2009.

FURTHER READING/RESOURCES

Mezirow J. *Learning as Transformation: Critical Perspectives on a Theory in Progress*. San Francisco, CA: Jossey-Bass Publishers; 2000.

Wals AEJ, ed. *Social Learning Towards a Sustainable World: Principles, Perspectives, and Praxis*. Wageningen, the Netherlands: Wageningen Academic Pub; 2007.