UNIVERSITY OF HELSINKI

https://helda.helsinki.fi

Social learning for enhancing social-ecological resilience to disaster-shocks : a policy Delphi approach

Haque, C. Emdad; Berkes, Fikret; Fernández-Llamazares, Álvaro; Ross, Helen; Chapin, F. Stuart ...

2022-08-09
Emerald Publishing
http://hdl.handle.net/10138/347329
Haque, C E, Berkes, F, Fernández-Llamazares, Á, Ross, H, Chapin, F S, Doberstein, B, Reed, M G, Agrawal, N, Nayak, P K, Etkin, D, Doré, M & Hutton, D 2022, 'Social learning for enhancing social-ecological resilience to disaster-shocks : a policy Delphi approach', Disaster Prevention and Management: An International Journal, vol. 31, no. 4, pp. 335-348. https://doi.org/10.1108/DPM-03-2021-0079

Downloaded from Helda, University of Helsinki institutional repository. https://helda.helsinki.fi
This is an electronic reprint of the original article.
This reprint may differ from the original in pagination and typographic detail.
Please cite the original version.

Author's accepted manuscript of:

Haque, C.E., Berkes, F., Fernández-Llamazares, Á., Ross, H., Chapin III, F.S., Doberstein, B., Reed, M.G., Agrawal, N., Nayak, P.K., Etkin, D., Doré, M., Hutton, D. (2021) Social learning for enhancing social-ecological resilience to disaster-shocks: a policy Delphi approach. Disaster Prevention and Management. doi: 10.1108/DPM-03-2021-0079

Social learning for enhancing social-ecological resilience to disaster-shocks: A policy Delphi approach

C. Emdad Haque[a], Fikret Berkes[a], Álvaro Fernández-Llamazares[b], Helen Ross[c], Terry Chapin[d], Brent Doberstein[e], Maureen G. Reed[f], Nirupama Agrawal[g], Prateep Kumar Nayak[h], David Etkin[g], Michel Doré[i], and David Hutton[j]

[a]Natural Resources Institute, University of Manitoba, Canada
(cemdad.haque@umanitoba.ca)
[a]Natural Resources Institute, University of Manitoba, Canada
(Fikret.Berkes@umanitoba.ca)
[b]Helsinki Institute of Sustainability Science, University of Helsinki, Finland
(alvaro.fernandez-llamazares@helsinki.fi)
[c]School of Agriculture and Food Sciences, The University of Queensland, Australia
(helen.ross@uq.edu.au)
[d]International Arctic Research Center, University of Alaska Fairbanks, USA
(terry.chapin@alaska.edu)
[e]Department of Geography and Environmental Management, University of Waterloo, Canada
(bdoberst@uwaterloo.ca)
[f]School of Environment and Sustainability, University of Saskatchewan, Canada
(mgr774@mail.usask.ca)
[g] School of Administrative Studies, York University, 4700 Keele St., Canada
(nirupama@yorku.ca)
[h]School of Environment, Enterprise and Development, University of Waterloo, Canada
(pnayak@uwaterloo.ca)
[g] School of Administrative Studies, York University, 4700 Keele St., Canada
(etkin@yorku.ca)
[i]University of Quebec at Montreal, Montreal, Canada
(michel.c.dore@hotmail.ca)
[j]Public Health Services Authority, Vancouver, Canada
(david.hutton@phsa.ca)

Corresponding Author: C. Emdad Haque, Natural Resources Institute, University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2, Phone: (204) 474-8374, e-mail: cemdad.haque@umanitoba.ca

Abstract

Purpose The plethora of contributions to social learning has resulted in a wide range of interpretations, meanings and applications of social learning, both within and across disciplines. But advancing the concept and using social learning methods and tools in areas like disaster-shocks require interdisciplinary consolidation of understandings. In this context, the primary focus of this paper is on the contributions of social learning to disaster risk reduction (DRR).

Design/methodology/approach Applying a three-round policy Delphi process involving 18 purposefully selected scholars and expert-practitioners, we collected data on the meanings of social learning for two groups of professionals, DRR and social-ecological resilience. The survey instruments included questions relating to the identification of the core elements of social learning, and the prospects for enhancing social-ecological resilience.

Findings The results revealed strong agreement that i) the core elements of social learning indicate a collective, iterative and collaborative process that involves sharing/networking, changes in attitudes and knowledge, and inclusivity; ii) social learning from disasters is unique; and iii) linkages between disciplines can be built by promoting interdisciplinarity, networks and knowledge platforms; collaboration and coordination at all levels; and teaching and practising trust and respect. Social learning is useful in preparing for and responding to specific disaster events through communication; sharing experience, ideas and resources; creating synergies for collective action, and promoting resilience.

Originality/value The study provides a consensus view on the core elements of social learning and its role in DRR and resilience building. Relevant to all stages of DRR, social learning is best

characterized as a collective, iterative, collaborative process. It can be promoted by enhancing networking and interdisciplinarity.

Keywords: social learning; disaster risk reduction; social-ecological resilience; interdisciplinary integration

1. Introduction

If disasters can be seen, not as one-off events, but experiences from which to learn, then we need approaches and policies that emphasize social learning that involves multiple parties: practitioners, policy-makers, civil society representatives and communities. Such an approach is consistent with reducing vulnerabilities and building resilience. It is also essential for adaptive governance that relies on diverse, flexible, and pluralistic regimes as well as on cycles of continuous learning, to keep improving on management response in a rapidly changing, uncertain global environment (Folke *et al.*, 2005; Young, 2017). Here resilience refers to "the capacity of a system to absorb disturbances while retaining essentially the same function, structure, identity and feedbacks" (Walker *et al.*, 2004). Relevant to all stages of disaster management from risk perception to post-disaster recovery, our overall goal is to examine social learning from multi- and interdisciplinary perspectives for its potential contribution to disaster risk reduction (DRR).

Social learning is a process of mutual development and sharing of knowledge through iterative reflections on experience so that new understanding can emerge. Its significance to address social and environmental challenges is increasingly recognized (e.g., Ensor and Harvey, 2015). At higher levels (e.g., national), social learning may be linked to "policy learning" where, for example, past experience with disasters leads to windows of opportunity for the introduction of new policies designed to anticipate and reduce the frequency, intensity or impacts of disasters (Moyson and Scholten, 2017; de Vries, 2017).

Building resilience helps communities to cope with and adapt to various forms of perturbations, including disaster-shocks (Haque and Etkin, 2012). We use this term to refer to unexpected and catastrophic impacts stemming primarily from nature-triggered extreme events, such as earthquakes, cyclones, and flash floods. Our focus is on extreme events that surpass

technological, socioeconomic and cultural coping capacities, which further compound, and are aggravated by, global environmental change. There is well-established evidence that the frequency, intensity and severity of extreme events globally is rapidly increasing as a result of climate change (IPCC, 2018).

However, there had been criticisms in the 1970s and 1980s of the treatment of nature-triggered extreme events as 'unusual events' by a group of scholars (Cannon, 1994). As well, Hewitt (1983) in his seminal work on interpretation of calamity challenged the notion of disasters as discrete events, as that denies the fact that disasters are outcomes of complex processes. Nonetheless, in the context of the present study which focuses on catastrophic shocks, the application of these alternative views is not feasible.

Using social learning for building resilience to disaster-shocks has policy significance, both locally and globally. Understanding the role of social learning in enhancing *coping* (i.e., immediate and direct response to an extreme event) and *adaptive capacities* (i.e., long-term strategies enabling change and transformation to deal with adverse effects) (Welle and Birkmann, 2015) to strengthen resilience to disaster-shocks (Sudmeier-Rieux, 2014) is critically important. The role of social learning in coping and adapting has been poorly researched relative to other areas (Henly-Shepard *et al.,* 2015). Many have called for systematic studies, as these issues are of considerable scholarly and practical interest for enhancing resilience (Murti and Mathez-Stiefel, 2019).

Diverse disciplinary, interdisciplinary and epistemological perspectives of social learning have been evolving, for example, in the areas of environmental management (Suškevičs *et al.,* 2018); environmental education (Krasny and Roth, 2010); social-ecological resilience (de Kraker, 2017); and community resilience (Berkes and Ross, 2013; Nirupama and Maula, 2013), as well as disaster risk reduction (O'Brien *et al.,* 2010). The plethora of contributions has generally helped

the move towards long-term planning based on learning and multistakeholder participation in these various sub-fields. However, it has also resulted in a wide range of interpretations, meanings and applications of social learning, even within individual disciplinary areas (McGreavy, 2016). Advancing the concept requires interdisciplinary consolidation of understandings and broader participation. It also requires addressing problems in dealing with power in social learning which is necessary for policy input (Brown, 2016).

In view of the limited global success in reducing disaster loss and damage in recent decades, the UN Hyogo Framework for Action 2005-2015 and the UN Sendai Framework for Disaster Risk Reduction (DRR) 2015-2030 have set specific goals for making "our communities safer and more resilient to disasters" (UNDRR, 2020, p.1). DRR evolved as an approach generally adopted by the disaster risk management community since the commencement of the International Decade for Natural Disaster Reduction in 1990, and is generally aimed at identifying, assessing and reducing the causal, and/or underlying risk factors of environmental disasters (UNISDR, 2015).

Here our primary focus is the contribution that social learning can make to DRR. First, we aim to explore and unpack the meanings of social learning for professionals in DRR and social-ecological resilience areas. The social-ecological systems (SES) framework we adopted here is concerned with the resilience of integrated, coupled systems of people and environment (Berkes *et al.*, 2003). Second, we critically analyze the prospects for the application of interdisciplinary understandings of social learning to DRR. We established an international Delphi panel of 18 DRR and social-ecological resilience experts. We asked participants the following questions, through three rounds of a Delphi feedback process to obtain increasingly refined and synthesized responses:

1) In defining social learning, what are the main elements?

2) Are experiences with learning from disaster events unique from other types of social learning?
3) What are the main challenges for interdisciplinary integration?
4) What are possible bridges or linkages that can transcend diverse research streams and foster interdisciplinary integration?

2. Methods

The Delphi method or technique was developed and applied initially by the Rand Corporation in the USA to forecast the impact of technology, based on the notion that forecasts or decisions from a structured group of experts would be more accurate than from unstructured groups (Rowe and Wright, 2001). The details of the Delphi procedures and processes are given elsewhere (Linstone and Turoff, 1975). In brief, it is an iterative process that involves experts to respond to a questionnaire in two or more rounds through which the respondents may revise their positions based on group synthesis delivered back to them. The *policy Delphi technique* is a particular variant of the conventional method that was subsequently developed. In policy Delphi process, the researcher does not advocate nor promote consensus-building among the participants; instead it offers a scope for the respondents to reassess their ratings. As Turoff (2002) suggested, this way the policy Delphi process helps "to expose the differing positions advocated and the principal pro and con arguments for those positions" (p. 82).

For the purpose and objectives of this study, we found that the policy Delphi was the most suitable method to collect the needed information, as well as to unpack the underlying views behind the debates. The method fits well with the interdisciplinary consolidation of the understandings of social learning, as required for advancing the concept for application to DRR. Since the first use of the Delphi technique by the Rand Corporation in the USA in the 1960s,

numerous studies have reiterated that the number of Delphi participants is not meant to be a representative sample of the population, rather they should represent a diverse group of experts who are knowledgeable and expert in pertinent areas (Turoff, 2002). Considering the need to include informed people representative of the diverse views of the issues under examination (Turoff, 2002), we assembled a group of 18 academics, professionals and practitioners, self-selected from a group of about twice that number initially invited.

We adopted a three-round policy Delphi technique, with n=16 participating in rounds 1 (generating a range of responses) and 2 (ranking responses on a three-point scale), and n=12 participating in round 3 (verifying responses). While the policy Delphi technique has traction in global change research (e.g., Coleman *et al.*, 2017), to our best knowledge, it has never been applied in the context of social learning. Extending the policy Delphi methodology, the present study was designed as a bridging platform between SES and DRR communities, and between researchers and practitioners.

Multiple write-in responses were invited to each question; potential answers were not provided. We asked the participants their perspectives on the main elements of social learning. Frequency distributions of the write-in responses of the participants were calculated to find areas of agreement. The "weighted means" in the tables were calculated by scoring "strongly agree" = 2; "agree" = 1; and "marginal or disagree" = 0. Data for the "marginal" and "disagree" responses were merged into one category for the purpose of a clear distinction between agreed vs. marginal/disagreed items.

3. Results

3.1 Main elements of social learning. There was a diverse range of responses, and the data presented in Table 1 show which elements of social learning received the highest scores based on the system summarized above. Participants "strongly agreed" that social learning is a collective, iterative, collaborative process, involves sharing and networking, and implies a change in attitude and knowledge. To a lesser extent, participants agreed that social learning is inclusive, experiential, and interdisciplinary.

[INSERT TABLE 1 NEAR HERE]

The core elements of social learning were identified by the participants in a broad, general context. They were reflective of the necessity of a collaborative, participatory process of learning with an open mind, organizationally and individually. This way, iterations of learning can improve and adapt to meet emerging needs. The delineation of these core elements of social learning helps to provide specific guidance for scholarly and practical work.

The policy Delphi method, and the Delphi method in general, is suitable for looking for consensus, in this case, the consolidation of understandings of social learning. However, the method we used also helped generate lists of "outliers" to the elements on which there seemed to be a consensus. In the case of the first question, these outlier views included "contextuality", "process", "leadership", and the availability of "platforms or venues". For two of the participants, contextuality -- particularly cultural context -- matters in social learning. A further comment was that the social learning process reveals "who is engaged, how and under what circumstances; legitimacy of the process is needed to move from instrumental to more transformative forms of learning". "Intergenerationality" as an element of social learning was included by one participant, and "social reflexivity" by another.

3.2 Is social learning from disaster events unique? There was a convergence of opinion (participants "strongly agreed") that social learning from disasters could be considered unique and different from other types of social learning. This is because disaster-shocks tend to be discrete, intense events regarding speed and severity, bring about windows of opportunity for learning and change, and are characterized by a common sharing of experiential observations.

Participants agreed that the exceptional characteristics of extreme events results in traumatic impacts, allows only limited time for deliberation, and often involves multiple sectors and requires communities to "pull together". Responses with less strong agreement included the points that learning from disaster-shocks is susceptible to fading over time, and results in "forced learning" and relatively rapid action (Table 2). Although disaster-shocks create windows of opportunity for policy change, for example, triggering climate change adaptation (Ensor and Harvey, 2015), participants generally agreed that social memory is prone to fading if time gaps are wide between event occurrences.

[INSERT TABLE 2 NEAR HERE]

Overall, there was a high degree of consensus that social learning from disasters is unique for two main reasons: First, "situated learning" from extreme, traumatic events involves a social process whereby experiential knowledge is co-constructed by multiple actors. Second, the presence of "communities of practice" in disaster management, whereby managers and practitioners often cooperate and share learning before, during, and after disasters, also makes such learning unique (Lave and Wenger, 1991).

3.3 Linkages for interdisciplinary integration. Social learning for DRR is best facilitated in an environment wherein significant interactions between disciplines occur. A large number of

responses related to this theme were received, and there was strong agreement on seven issues. Participants thought that linkages between disciplines could be built by: promoting interdisciplinarity; facilitating networks and knowledge platforms; collaboration and coordination at all levels; teaching and practising trust and respect; focusing on enabling conditions and outcomes; and bridging theory and practice. Three additional issues had a less strong agreement: using a problem-solving approach; mobilizing resources for bridging; and focusing on outcomes to promote shared learning (Fig. 1).

[INSERT FIGURE 1 NEAR HERE]

In exploring how bridges between disciplines, as well as professional communities, could be built and facilitated, results revealed a consensus around promoting and practising interdisciplinarity in academia, research and practice, with a call for developing a culture that values interdisciplinarity. Addressing the disparate courses of theoretical vs. real-world problem-solving by establishing interactive connections, communications, and feedback can play vital roles in interdisciplinary integration.

3.4 Challenges for interdisciplinary integration. Many participants suggested that social learning for DRR could be compromised by a number of common challenges to interdisciplinary integration. There were diverse opinions on this question, but participants agreed on the following seven items ("strongly agree" and "agree"): transaction costs; institutional inertia; disciplinary differences in terminology and traditions; lack of favourable context; scarcity of funding; differing worldviews; and insufficient emphasis on opportunities (Fig. 2). Many of the additional responses referred to various aspects of disciplinary barriers, such as specialized terminology; knowledge traditions; and methodological differences.

[INSERT FIGURE 2 NEAR HERE]

Participants also identified more specific barriers, with a strong agreement that high transaction costs related to time and resources required for engagement across disciplines and thematic areas. A paucity of funding was generally thought to be a barrier to meaningful knowledge-sharing and to associated processes that are equitable, transparent, and empowering. Major problems included barriers to co-production of knowledge (Armitage *et al.*, 2011), and lack of investment in interdisciplinary approaches and complexity thinking. Participants also indicated ways to overcome barriers, such as making the concept of social learning relevant to diverse social, political and other institutional actors, and creating opportunities and incentives for new generations to engage in interdisciplinary education, training and skill development.

4. Discussion

Despite the existence of many definitions of social learning and lack of agreement in the literature we found a consensus about the main elements of social learning, as involving collaborative and collective processes, with scope for continuous refinement and adaptation through iterations. The social learning process needs to be inclusive of all the major actors, including Indigenous peoples and other marginalized groups (Dyball and Keen, 2012). There was also a consensus on the need for interdisciplinary integration to deal with complex systems and to address complex issues and problems (Holland, 2013). In this respect, many professional networks and communities-of-practice have successfully established mechanisms of interdisciplinary communication and knowledge-sharing (e.g., Resilience Alliance's workbook for practitioners) (Resilience Alliance, 2010; Reed *et al.*, 2014).

However, consensus in these areas is not sufficient by itself to assure inclusivity. Although our study did not directly address this issue, it is known that the inclusion of all major actors, including Indigenous peoples and other marginalized groups, is difficult, and that there are issues

of power in social learning (Grove, 2013; Brown 2016). For example, involving Indigenous peoples in social learning for disaster management in Taiwan has a long history. The recognition of Indigenous rights and concerns only occurred after Typhoon Morakot of 2009, a major disaster that disproportionally impacted Indigenous communities. A collaborative learning environment was made possible through legislative support, institutional transitioning and multilevel disaster governance (Berkes *et al.*, 2021).

Considering that our results clearly recognize the unique nature of social learning for DRR, further explorations should be made regarding *what* and *how* social learning methodology can be adapted. Social learning about SES resilience in the context of stresses and shocks is very relevant for DRR purposes. The literature on riverine SES and the floodplain communities in the Ganges-Brahmaputra (Haque, 1988; Islam *et al.,* 2018) and coastal SES (Adger *et al.,* 2005; Nayak, 2017) offer evidence of various strategies. Formulation of these coping and adaptation strategies was possible through communicative and transformative learning (Mezirow, 1995) regarding floods, cyclones, tsunami and other hazards.

The present study makes original contributions to four critical areas. First, findings reinforce the notion that approaching DRR through social learning, using an SES framework, can help build resilience. This, we argue, is a key requirement for disaster preparedness and resilience, given the context of uncertainty related to accelerating global change and the suddenness of most disaster events. Disaster-shocks, including the COVID-19 pandemic, affect poor people and marginalized communities disproportionately (Lambert and Scott, 2019). Since the concepts of SES resilience underscore the interrelationships between ecosystems and society (Young, 2017) , there is common ground between DRR and SES resilience, whereby the underlying factors of resilience are rooted in the interface between nature and society.

Second, addressing DRR and building disaster resilience requires the capacity for continuous, contextualized learning by individuals, groups and society. Iterative learning involves adjusting responses to uncertainty and complexity over time (Folke *et al.,* 2005). The present study extends the argument for social learning across knowledge systems, including community knowledge (Choudhury *et al.,* 2021) and for the co-production of knowledge, that is, using multiple kinds of knowledge together to innovate problem-solving (Armitage *et al.,* 2011). However, given that social learning is a political process and has a power dimension, we call for policies that foster pluralism in social learning. The object would be to create processes to engage with different peoples' local knowledge, social learning, and narrative ways of knowing, including those of Indigenous peoples and other marginalized communities (Lejano *et al*. 2021). Such knowledge-making can shape and improve DRR decision-making and, in turn, be shaped by it, enriching and broadening the practice of DRR.

Third, the results provide a strong indication of the importance of trust and respect-building, and collaboration at all levels and among diverse groups, including disadvantaged groups. In Futures Studies, for example, there have been significant and urgent calls for tools and approaches for scenarios that embrace Indigenous conceptualizations and understandings of values, well-being, and human-nature relationships, and how these are embedded and reflected in culture and governance systems. However, there has been limited use of Indigenous and local knowledge in visioning transformative pathways (Lam *et al.,* 2020), highlighting the need for fostering constructive and respectful collaborations between diverse knowledge systems (Tengö *et al.,* 2017).

Fourth, to ensure that all possible options are placed on the table, the conventional policy Delphi, collects data from a selection of topic-specific experts iteratively (Delbecq *et al.,* 1975).

Extending this methodology, we innovatively applied policy Delphi to function as a bridging platform between SES and DRR communities, as well as between research and practitioner communities. To the best of our knowledge, the use of policy Delphi as a bridging platform between such diverse groups is a novel contribution in interdisciplinary studies on human dimensions of global environmental change.

The findings of our Delphi research have several policy and planning implications. Policy shifts may follow windows of opportunity and may be hastened by a "focusing event", a sudden, exceptional experience that, because of how it leads to harm or exposes the prospect for great devastation, is perceived as the impetus for policy change (Gerlak *et al.,* 2018). Opportunity for policy shifts is created mainly because of the convergence of the problem stream, the political stream and the policy stream during and immediately after a disaster, albeit for a limited period of time (Cairney *et al.,* 2016).

Participants referred to the ability of disaster events to reveal and promote learning about societal weaknesses, such as inaccurate risk perceptions (Agrawal *et al.*, 2020) leading to development approval in a floodplain. Such events also provide an immediate opportunity to use social learning to build resilience, while there is political will, new funding sources for recovery, and an unusual coalescence of actors who all want to see the recovery effort succeed. Recognizing this opportunity and its time constraint, and then seizing the opportunity by facilitating policy deliberation and action is important (Walker *et al.,* 2020). As well, creating space for the agency to enable bottom-up transformation is essential (Westley *et al.,* 2013). Social learning developed in a post-disaster period is often applied seemingly overnight in a process that planning theorists refer to as "knowledge to action" (Friedmann, 1987; Gerlak *et al.,* 2018).

Policy Delphi participants further identified the ability of disasters to create "forced learning", whereby societies are forced to confront and learn from often hidden issues (e.g. climate change altering the nature of flooding), and this learning then creates opportunities to save future lives. Multiple levels may be involved – the homeowners affected by the disaster, the insurance companies, and the state/provincial or federal governments that step in to provide disaster relief. High profile disasters force policy learning, as policy makers are compelled to change course in order to address the knowledge gained from the disaster.

An example from Canada was the devastating 2013 flood in southern Alberta, which led to a new understanding of the high risk of living in floodplains. The flood revealed to residents that pre-flood human activity such as deforestation, river diversion, and home building altered the environment and created flood risk (Haney and McDonald-Harker, 2017). The Alberta Floodway Relocation Program was created just weeks after floodwaters subsided (Government of Alberta, 2013) when the risks of floodways became too obvious to ignore. In turn, at the national level, the Federal Government developed a visionary strategy document in 2019 which built on lessons learned in the 2013 Alberta floods (Public Safety Canada, 2019).

Participants emphasized the importance of social learning to create synergies for collective action and to identify effective coping strategies. Interdisciplinary sharing of experience appears particularly important for this process. For example, in March 2020, when the number of COVID-19 fatalities in Italy surpassed that reported by China, the Italian Red Cross turned to Chinese experience and social learning to control the epidemic. Subsequently, Chinese medical workers, along with tons of medical equipment, helped Italian communities at the height of their coronavirus outbreak (DW, 2020). Also relevant, historians brought forth aspects of social learning derived

from the Spanish flu of a century ago, for example, about implementing social distancing policies in St. Louis, USA (Strochlic and Champine, 2020).

5. Conclusion

There is increasing recognition that disaster management requires a holistic approach and preparedness through pre-disaster planning. Disasters are not one-off events but experiences from which to learn. Building resilience for the "next" disaster can benefit from social learning, especially if this learning involves multiple parties including communities (Lejano *et al*. 2021). This is not easy to achieve but may become increasingly important as rapid climate change, and other global change, requires continuous learning with all stakeholders on board, to develop resilience to disasters.

Here we have examined social learning for its potential contribution to disaster risk reduction (DRR). Advancing the concept of social learning requires a consolidation of interdisciplinary understandings. Using a policy Delphi approach, we found agreement that i) social learning is characterized by a collective, iterative and collaborative process that involves sharing experiences, changes in attitude and knowledge, and inclusivity; ii) social learning from disasters is unique; and iii) linkages between disciplines can be built through interdisciplinarity, networking, collaboration and coordination, and building trust and respect among all the parties.

Social learning is not a panacea. Implementing social learning require multiple changes, some of them systemic, about how DRR is carried out. Politics of knowledge and power relations in social learning are major impediments. Some of the participants suggested additional notes of caution. For example, regarding the first question, "at a certain point these elements [of social learning] conflate the descriptive characteristics of social learning as a social-psychological

process with a normative judgment on the benefits or value of social learning… Social learning has some elements which are necessary and sufficient for the spread of behavioural changes, and some which are desirable for the spread of moral or ethical social behaviours, but there is no perfect overlap between these two categories".

Nevertheless, social learning can provide crucial guidance for preparing for disaster-shocks in the future by enhancing anticipatory capacity and enabling reflexivity. The evolution of cyclone shelters in Bangladesh (Haque and Uddin, 2013) and India (Nirupama, 2013) from a single-purpose, rarely-used buildings to multi-purpose every-day use (i.e., elementary school *cum* community-training center *cum* disaster shelter) unit is a result of the guidance provided by social learning to prepare for future events. We call for further scholarly and policy attention to how social learning can guide societies to prevent, mitigate, prepare for, and cope with and adapt to similar disaster-shocks, as well as to strengthen social-ecological resilience in the face of an increasingly uncertain and complex global environment.

References

Adger, W.N., Hughes, T.P., Folke, C., Carpenter, S.R., Rockstörm, J. (2005), "Social-ecological resilience to coastal disasters", *Science,* Vol. 309, pp. 1036-1039. doi:10.1126/science.1112122

Agrawal, N., Elliott, M., Simonovic, S.P. (2020), "Risk and resilience: A case study of perception versus reality for flood management", *Water,* Vol. 12, No. 5, p. 1254. Online: https://doi.org/10.3390/w12051254

Armitage, D., Berkes, F., Dale, A., Kocho-Schellenberg, E., Patton, E. (2011), "Co-management and co-production of knowledge: Learning to adapt in Canada's Arctic", *Global Environmental Change*, Vol. 21, pp. 995-1004.

Berkes, F., Colding, J., Folke, C. (eds.) (2003), *Navigating Social-Ecological Systems: Building Resilience for Complexity and Change,* Cambridge University Press, Cambridge, UK.

Berkes, F., Ross, H. (2013), "Community resilience: Toward an integrated approach", *Society and Natural Resources*, Vol. 26, No. 1, pp 5-20.

Berkes, F., Tsai, H.-M., Bayrak M.M. and Lin, Y.-R. (2021), "Indigenous resilience to disasters in Taiwan and beyond", *Sustainability*, Vol. 13, No. 2435, pp. 1-17. https://doi.org/10.3390/su13052435

Brown, K. (2016), *Resilience, Development and Global Change*, Routledge, London, UK.

Cairney, P., Zahariadis, N. (2016), "Multiple stream approach: a flexible metaphor presents an opportunity to operationalize agenda setting processes". In *Handbook of Public Policy Agenda Setting*. N. Zahariadis, (ed.), pp. 87-105. Edward Edger, Glos, UK.

Cannon, T. (1994), "Vulnerability analysis and the explanation of 'Natural' disasters. In Ann Varley (ed.), *Disasters, Development and Environment*, pp. 13- 30. John Wiley and Sons Ltd., London, U.K.

Choudhury, M-U-I, Haque, C.E., Nishat, A., Byrne, S. (2021), "Social learning for building community resilience to cyclones: role of ingigenous and local knowledge, power, and institutions in coastal Bangladesh", *Ecology and Society*, Vol. 26, No. 1, p.5. Online: https://doi.org/10.5751/ES-12107-260105

Coleman. S., Hurley, S., Koliba, C., Zia, A. (2017), "Crowdsourced Delphis: Designing solutions to complex environmental problems with broad stakeholder participation", *Global Environmental Change*, Vol. 45, pp. 111-123.

de Kraker, J. (2017), "Social learning for resilience in social-ecological systems", *Current Opinion in Environmental Sustainability*, Vol. 28, pp. 100-107.

Delbecq, A.L., Van de Ven A.H., Gustafson, D.H. (1975), *Group Techniques for Program Planning: A Guide to Nominal Group and Delphi Processes*, Scott, Foresman, Glenview, IL, USA.

de Vries, D.H. (2017), "Temporal vulnerability and the post-disaster 'window of opportunity to woo:' a case study of an African-American floodplain neighborhood after Hurricane Floyd in North Carolina", *Human Ecology: An Interdisciplinary Journal*, Vol. 45, No. 4, pp. 437–448. https://doi.org/10.1007/s10745-017-9915-4

DW (2020), "COVID-19: China steps in to help Italy battle the virus", DW Top Stories, March 24, 2020. Accessed 31 March 2020. https://www.dw.com/en/covid-19-china-steps-in-to-help-italy-battle-the-virus/a-52901560.

Dyball, R. and Keen, M. (eds.) (2012), *Social Learning in Environmental Management: Towards a Sustainable Future.* Taylor and Francis, London, UK.

Ensor, J. and Harvey, B. (2015), "Social learning and climate change adaptation: evidence from international development and practice", *WIRES Climate Change,* Vol. 6, pp. 509-522.

Folke, C., Hahn, T., Olsson, P., Norberg, J. (2005), "Adaptive governance of social-ecological systems", *Annual Review of Environment and Resources,* Vol. 30, pp 441-473.

Friedmann, J. (1987), *Planning in the Public Domain: From Knowledge to Action,* Princeton University Press, Princeton, NJ, USA.

Gerlak, A.K., Heikkila, T., Smolinski, S.L., Huitema, D., Armitage, D. (2018), "Learning our way out of environmental policy problems: A review of the scholarship", *Policy Science,* Vol. 51, pp. 335-371.

Government of Alberta (2013), "Government of Alberta Flood Recovery Plan". Flood Recovery Task Force. Government of Alberta, Edmonton, AB, Canada. Online: https://www.alberta.ca/assets/documents/2013-GoA-Flood-Recovery-Plan.pdf

Grove, K. (2013), "Hidden transcripts of resilience: power and politics in Jamaican disaster management", *Resilience: International Policies, Practices and Discourses,* Vol. 1, No. 2, pp. 146-153.

Haney, T.J. and McDonald-Harker, C. (2017), "The river is not the same any more": Environmental risk and uncertainty in the aftermath of the High River, Alberta, flood", *Social Currents,* Vol. 4, No. 6, pp. 594-612.

Haque, C.E. (1988), "Human adjustments to river bank erosion hazard in the Jamuna floodplain, Bangladesh", *Human Ecology,* Vol. 16, No. 4, pp. 421-427.

Haque, C.E. and Etkin, D. (eds.) (2012), *Disaster Risk and Vulnerability: Mitigation through Mobilizing Communities and Partnerships.* McGill and Queen's University Press, Montreal, Canada.

Haque, C.E. and Uddin, M.S. (2013), "Disaster management discourse in Bangladesh: A shift from post-event response to the preparedness and mitigation approach through institutional partnerships", In Tiefenbacher J (ed). *Approaches to Disaster Management: Examining the Implications of Hazards, Emergencies and Disasters* (pp. 33–44). IntechOpen, London, UK.

Henly-Shepard, S., Gray, S.A., Cox, L.J. (2015), "The use of participatory modeling to promotes social learning and facilitate community disaster planning", *Environmental Science and and Policy,* Vol. 45, pp. 209-122.

Hewitt, K. (1983), *Interpretations of Calamity from the Viewpoint of Human Ecology.* Allen and Unwin.

Holland, D. (2013), *Integrating Knowledge Through Interdisciplinary Research: Problems of Theory and Practice*, Routledge, London, UK.

IPCC. (2018), Summary for Policymakers of IPCC Special Report on Global Warming of 1.5ºC approved by governments. https://www.ipcc.ch/2018/10/08/summary-for-policymakers-of-ipcc-special-report-on-global-warming-of-1-5c-approved-by-governments/

Islam, M.R., Ingham, V., Hicks, J., Kelly, E. (2018), "From coping to adaptation: Flooding and the role of local knowledge in Bangladesh", *International Journal of Disaster Risk Reduction*, Vol. 28, pp. 531-538.

Krasny, M.E. and Roth, W.M. (2010), "Environmental education for social-ecological system resilience: A perspective from activity theory", *Environmental Education Research*, Vol. 1, Nos. 5-6, pp. 545-558.

Lam, D., Hinz, E., Lang, D., Tengö, M., von Wehrden, H., Martín-López, B. (2020), "Indigenous and local knowledge in sustainability transformations research: a literature review", *Ecology and Society*, Vol. 25, No. 1, p. 3. Online: https://doi.org/10.5751/ES-11305-250103

Lambert, S. and Scott, J.C. (2019), "International Disaster Risk Reduction strategies and indigenous peoples", *International Indigenous Policy Journal*, Vol. 10, No. 2, pp. 1-21.

Lave, J. and Wenger, E. (1991), *Situated Learning: Legitimate Peripheral Participation*, Cambridge University Press, Cambridge, UK.

Lejano, R., Haque, C.E., Berkes, F. (2021), "Co-production of risk knowledge and improvement of risk communication: A three-legged stool". *International Journal of Disaster Risk Reduction* 64, Article 102508. https://doi.org/10.1016/j.ijdrr.2021.102508

Linestone, H.A. and Turoff, M. (Eds.) (1975), *The Delphi Method: Techniques and Applications*, Addison-Wesley, London, UK.

McGreavy, B. (2016), "Resilience as discourse", *Environmental Communication*, Vol. 10, No. 1, pp. 104-121.

Mezirow, J. (1995), "Transformative theory of adult learning", In: Welton M (ed). *In Defense of the Lifeworld: Critical Perspectives on Adult Learning.* Pp. 37-90. State University of New York Press, USA.

Moyson, S., Scholten, P., Weible, C.M. (2017), "Policy learning and policy change: Theorizing their relations from different perspectives", *Policy and Society*, Vol. 36, No. 2, pp. 161-177.

Murti, R., Mathez-Stiefel, S-L. (2019), "Social learning approaches for ecosystem-based disaster risk reduction", *International Journal of Disaster Risk Reduction*, Vol. 33, pp. 433-440.

Nayak, P.K. (2017), "Fisher communities in transition: Understanding change from a livelihood perspective in Chilika Lagoon, India", *Maritime Studies*, Vol. 16, No. 13, pp. 1-33. Online: https://doi.org/10.1186/s40152-017-0067-3

Nirupama, N. (2013), "Vertical evacuation during cyclones: Suitable for developing countries", *Natural Hazards,* Vol. 69, pp. 1137-1142.

Nirupama, N. and Maula, A. (2013), "Engaging public for building resilient communities to reduce disaster impact", *Natural Hazards,* Vol. 66, pp. 51-59.

O'Brien, G., O'Keefe, P., Gadema, Z. and Swords, J. (2010), "Approaching disaster management through social learning", *Disaster Prevention and Management,* Vol. 19, No. 4, pp. 498-508.

Public Safety Canada. (2019), "Emergency Management Strategy for Canada: Toward a Resilient 2030", Public Safety Canada, Ottawa, Canada. 32 p. Online: https://www.preventionweb.net/english/policies/v.php?id=63622&cid=qzsvcpft

Reed, M.G., Godmaire, H., Abernethy, P., Guertin, M-A. (2014), "Building a community of practice for sustainability: Strengthening learning and collective action of Canadian Biosphere Reserves through a national partnership". *Journal of Environmental Management,* Vol. 145, pp. 230-239.

Resilience Alliance (2010), Assessing Resilience in Social-ecological Systems: Workbook for Practitioners. Version 2.0. (2010). Online: https://www.resalliance.org/files/ResilienceAssessmentV2_2.pdf

Rowe, G. and Wright, G. (2001), "Expert opnions in forecasting: Role of the Delphi technique", In Armstrong, J.S. (ed.), *Principles of Forecasting: A Handbook of Researchers and Practitioners,* pp. 125-144. Kluwer Acadecmic Publishers, Norwell, MA, USA.

Strochlic, N. and Champine, R.D. (2020), "How some cities 'flattened the curve' during the 1918 flu pandemic", *National Geographic,* March 27, 2020.

Sudmeier-Rieux, K.I. (2014), "Resilience – an emerging paradigm of danger or of hope", *Disaster Prevention and Management,* Vol. 23, No. 1, pp. 67-80.

Suškevičs, M. Hahn, T., Rodela, R., Macura, B., Pahn-Wostl, C. (2018), "Learning for social-ecological change: a qualitative review of outcomes across empirical literature in natural resource management", *Journal of Environmental Planning and Management,* Vol. 61, No. 7, pp. 1085-1112. DOI:10.1080/09640568.2017.1339594

Tengö, M., Hill, R., Malmer, P., Raymond, C.M., Spierenburg, M., Danielsen, F., Elmqvist, T., Folke, C. (2017), "Weaving knowledge systems in IPBES, CBD and beyond—lessons learned for sustainability", *Current Opinion on Environmental Sustainability,* Vols. 26-27, pp. 17-25. doi:10.1016/j.cosust.2016.12.005.\

Turoff, M. (2002), "The policy Delphi", In Linstone H, Turoff M (Eds) *The Delphi Method: Techniques and Applications.* Pp. 80-96. IS, New Jersey Institute of Technology, Newark, NJ, USA.

UNDRR (2020), “What is Sendai Framework for Disaster Risk Reduction?”, Online https://www.undrr.org/implementing-sendai-framework/what-sf (Accessed September 15, 2020).

UNISDR (2015), “From a reactive to proactive than people cantered approach to DRR”, Online: https://www.undrr.org/publication/reactive-proactive-then-people-centered-approach-disaster-risk-reduction) [Accessed September 18, 2020].

Walker, B., Holling, C.S., Carpenter, S.R., Kinzig, A. (2004), “Resilience, adaptability and transformability in social-ecological systems”, *Ecology and Society*, Vol. 9, No. 2, p. 5.

Walker, H.M., Reed, M.G., Fletcher, A.J. (2020), “Applying intersectionality to climate hazards: A theoretically informed study of wildfire in northern Saskatchewan”, *Climate Policy,* Online: doi.org/10.1080/14693062.2020.1824892

Welle, T. and Birkmann, J. (2015), “The World Risk Index – An approach to assess rick and vulnerability on a global scale”, *Journal of Extreme Events,* Vol. 2, No. 1, 1550003, pp. 1-34.

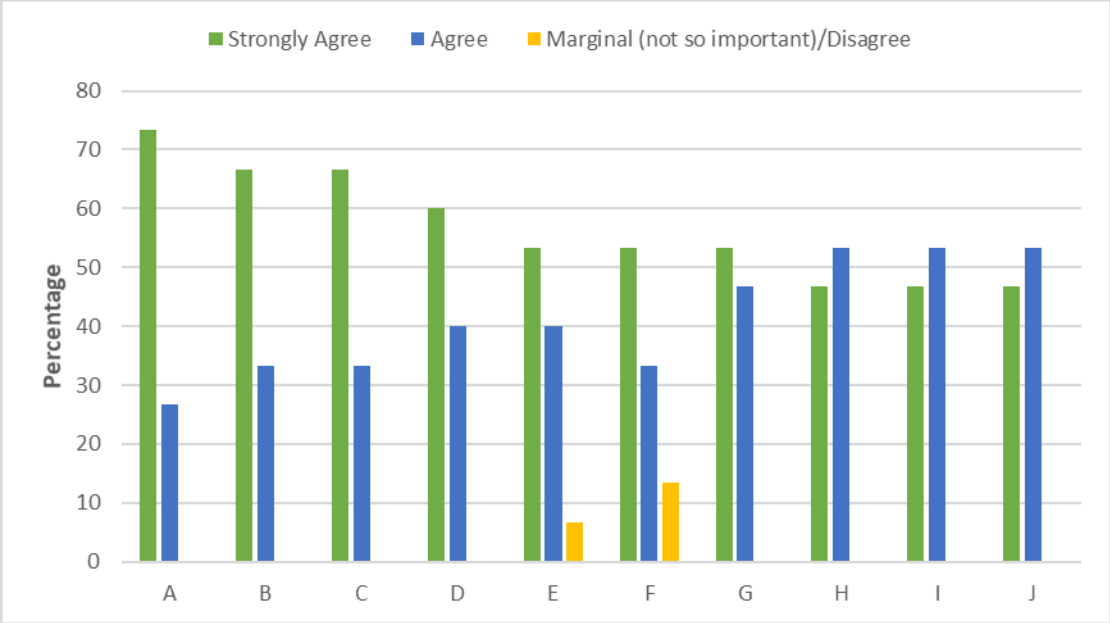
Westley, F.R., Tjornbo, O, Schultz, L., Olsson, P., Folke, C., Crona, B., Bodin, Ö. (2013), “A theory of transformative agency in linked social-ecological systems”, *Ecology and Society,* Vol. 18, No. 3, p. 27. Online: doi:10.5751/ES-05072-180327.

Young, O.R. (2017), *Governing Complex Systems: Social Capital for the Anthropocene,* MIT Press, Cambridge, MA, USA.

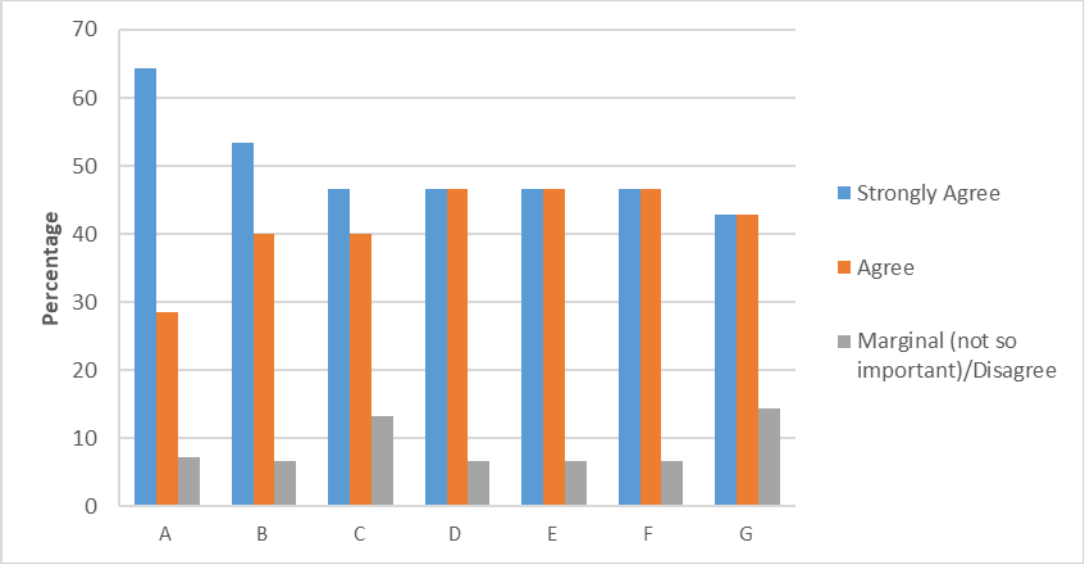
FIGURE CAPTIONS

Figure 1: Major elements in defining social learning (n=16).

Figure 2: Challenges for interdisciplinary integration.



A. Promote interdisciplinarity at all levels
B. Promote networks and collaborative knowledge platforms
C. Promote collaboration and coordination
D. Teaching and practising trust and respect
E. Focus on enabling conditions
F. Focus on outcomes
G. Bridging theory and practice
H. Education for a new generation of students
I. Using a problem-solving approach
J. Mobilize resources for linking and bridging



A. Transaction costs
B. Institutional inertia
C. Disciplinary differences in terminology and traditions
D. Lack of favourable context
E. Scarcity of funding
F. Insufficient emphasis on opportunities

TABLE CAPTIONS

Table 1: The main elements in defining social learning in the disaster-shock context (n=16).

Table 2: Why the experience and learning from disaster events are unique from other types of social learning (n=16).

Table 1: The main elements in defining social learning in the disaster-shock context (n=16).

Elements	Weighted mean
It is a collective (between people; between organizations) and a multilevel process	1.94
Iterative/on-going process; cumulative and dynamic, changing over time	1.75
Sharing/networking (e.g., experience, knowledge, learning, values)	1.69
Collaboration/collaborative processes; trust; respect; patience	1.63
Involving change (e.g., attitude, behaviour); proactive; new ideas; innovation	1.63
Characterized by the inclusivity of stakeholders	1.44
Experiential, including direct observation and experience	1.44
Interdisciplinary; involving diverse perspectives	1.38

Table 2: Why the experience and learning from disaster events are unique from other types of social learning (n=16).

Reasons	Weighted means
Disasters are discrete events/shocks; acute events	1.69
More intense events regarding speed, intensity and severity	1.63
Brings about windows of opportunity through reflection; incremental and/or transformative; allows consideration of alternative views	1.50
Based on shared experiential ("real world", directly felt) observations	1.44
Larger-scale traumatic impact; depends on speed, intensity and severity; social context important	1.38
Allows limited time for deliberation; time-sensitive decisions	1.38
Often require individuals, sectors, communities to "pull together"	1.38
Disaster learning necessarily involves multiple sectors	1.31
Social memory and learning are susceptible to fading, if events not close together	1.00
"Forced learning" does not leave any choice; and disaster learning is characterized by a "difference between life and death"	1.00