Multi-level Learning in Reducing Disaster-Risk and

Building Resilience to Cyclones in Coastal Bangladesh

By

Mahed-Ul-Islam Choudhury

A Thesis submitted to
The Faculty of Graduate Studies of the University of Manitoba
in partial fulfillment of the requirements of the degree of

DOCTOR OF PHILOSOPHY

ABSTRACT

Coastal communities in Bangladesh and around the world are at increasing risk of climate-induced disaster-shocks. In recent years, Bangladesh has been able to reduce the risk of disasters through a robust institutional intervention. It is assumed that learning from past experience has played a significant role in such risk reduction and resilience-building processes. However, how learning at multiple societal levels shapes community resilience to disaster-shocks is poorly understood. In light of this gap, the present research empirically investigates social learning at community and multiple institutional levels, and transformative learning at the individual level, from cyclonic shocks in selected coastal communities in Bangladesh. This thesis departs from the normative framing and thoughts on the relationships among learning, resilience, and DRR; it adopts a critical approach to investigate the role of learning at different levels that shapes community resilience. I followed a qualitative research approach that was supplemented by a household survey (n=240). The results revealed that the coastal communities in Bangladesh have a rich stock of indigenous and local knowledge (ILK) that helps them to generate early warnings and reduce their risk from cyclones and associated storm surges. Translation of such ILK into action often depends on the state of social memory. Formal institutional interventions often contribute to the development of negative social memory. Moreover, formal institutional interventions (e.g., NGO-led) often deny ILK a meaningful role in social learning processes. Concerning transformative learning, I further found that the relationship between transformative learning and resilience building is complex, involving multiple social-cultural-structural factors (e.g., beliefs, values, power structures), practical considerations (e.g., impact on livelihood, evacuation and relocation logistics), and cognitive factors. Regarding the multi-loop learning at multi-level institutions, loop learning is found to be different for different level of institutions and contributed differently to community resilience. Bridging organizations played critical roles in institutionalizing and scaling up social learning from episodic events as well as in innovation and knowledge management. Future efforts to build community resilience to climate-induced disaster-shocks should pay more attention to learning-based action and the feedback relationships among multiple societal levels in shaping community resilience to disaster-shocks.

ACKNOWLEDGEMENT

DEDICATION

To My Parents:

Mahfuz-Ul-Islam Choudhury

and

Hena Begum Choudhury

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CHAPTER ONE

Introduction

1.1 Background and Rationale

This thesis concerns how learning (i.e. lessons drawing) from climate change-induced shocks at multiple societal levels (i.e. individual, community, and institution) assists disaster risk reduction and in building resilience of coastal communities to disaster-shocks in Bangladesh. Below I start with the problem statement and introduction of the pertinent issues.

Tropical cyclones are one of the most threatening natural hazards that can have catastrophic consequences on human lives and properties (Estrada et al., 2015). Tropical cyclones[1] can cause damage to human lives and property in three ways: i) extremely strong winds that damage assets and other fragile infrastructure; ii) considerable volumes of rainwater that cause flooding; and iii) high waves and storm surges that wash away people and property (Murray et al., 2012). The Saffir-Simpson Scale, which is an estimate of wind-speed near the earth's surface, is applied to categorize the intensity of storms from category 1 to 5.

Recent years have witnessed an increasing number of tropical cyclones forming over the oceans. The year 2020 saw a total of 103 named storms globally, and was a record breaking North Atlantic hurricane season (NOAA, 2021). There is a growing consensus among scholars regarding the increasing intensity of, and risks induced by tropical cyclones (Edmonds et al., 2020; Ramsay, 2014). However, the risk posed by a tropical cyclone is not materialized unless it makes landfall (Camargo & Wing, 2021), and recent trend analysis suggests that tropical cyclones are more frequently moving toward the coastline and making landfall within their lifetime maximum intensity (Wang & Toumi, 2021). In recent decades, coastal communities in particular are experiencing more frequent and more intense tropical cyclones and associated storm surges and flooding than before (Bevacqua et al., 2020; Witze, 2018).

Hydrological and metrological extreme events, such as tropical cyclones, are often outcomes of climate change or global warming (Estrada et al., 2015; Singh et al., 2021; Trenberth, 2005). Tropical cyclones, including hurricanes and typhoons, typically occur when

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[1] Tropical cyclones, typhoons, and hurricanes all refer to the same weather phenomena (National Ocean Service, 2021), and are typically identified as "powerful storms generated over tropical and subtropical waters" (Murray et al., 2012; p. 502). In the North Atlantic, central North Pacific, and eastern North Pacific, such storms are called *hurricanes,* while the same disturbances are labelled *typhoons* in the Northwest Pacific and *cyclones* in the South Pacific and Indian Ocean (National Ocean Service, 2021). The transfer of heat from the ocean to the atmosphere is the primary driver for cyclone formation (Emanuel, 2003).

sea surface temperature (SST) exceeds 26°C (Henderson-Sellers et al., 1998). In this regard, Trenberth (2005) explains that due to global warming higher SSTs evaporate more water and consequently help in developing tropical storms and fueling already developed cyclones. A recent study on Cyclone Fani (2019) highlights that high SST contributed to its rapid intensification and notes that the place of formation of this cyclone, the Bay of Bengal, was close to Equator where cyclone formation is rare (Singh et al., 2021). Scientific findings previously concluded that tropical cyclones generally weaken when they reach land (Kaplan & Demaria, 1995). Recent findings suggest that due to an increased SST, storms are weakening more slowly and causing more damage after landfall (Chavas & Chen, 2020; Li & Chakraborty, 2020).

It is evident from scientific data that the present decade has included consecutive years that were the warmest on record; there is also ample evidence of extreme weather events with unusual frequency and intensity in various parts of the world. For example, the USA's National Oceanic and Atmospheric Administration (NOAA) database indicates the ten warmest years within the last 137 years (1880-2017) were recorded since 2005, and these past 15 years have also seen six catastrophic major Atlantic hurricanes (i.e. Harvey, Irma, Maria, Katrina, Sandy, and Florence) (Rahmstorf, 2017; Shuckburgh et al., 2017; Witze, 2018).

Sea level rise and the increasing intensity of storms due to global warming are resulting in severe coastal flooding and higher storm surges (Pourquié, 2018; Woodruff et al., 2013). Global warming causes sea level rise in two ways: i) melting of land-based ice and ii) the increase in volume of warmer water (Rahmstorf, 2017). The IPCC Working Group II report (2014) underscores the vulnerability of low-lying coastal regions and their risk of flooding and storm surges. This was evident during Hurricane Harvey in the USA, which brought a volume of rainwater to Texas that they have never experienced before (Rahmstorf, 2017).

Several quarters have also documented that low-lying deltas are at elevated risk from these increasingly higher and stronger storm surges due to their low elevation and generally high population density (Bevacqua et al., 2020; Edmonds et al., 2020; Noy, 2016). Developing countries are particularly vulnerable due to: i) a lack of institutional capacity, and ii) degradation of natural resources and erosion of natural protection systems (Barbier, 2014; Palmer, 2020). This implies that risks from tropical cyclones depends not only on the intensity of cyclones but also on the level of exposure, poverty, governance, and other social, cultural, institutional factors (Noy, 2016; Peduzzi et al., 2012; Zscheischler et al., 2020). This is reflected in Oliver-Smith's

(1999) assertion that disaster involves 'external variability' (i.e. biophysical phenomena or processes) and 'internal complexity' (i.e. socio-political-cultural processes).

The coastal areas of Bangladesh, identified by the IPCC (2014) as coastal cyclonic zones, are particularly vulnerable to climate change-induced disaster. Such risk is also amplified by the physical nature of the delta and estuaries of the Bay of Bengal (Haque, 1995). In Bangladesh, more than 35 million people live along the 700 km. long coastline, seven million of which are located in high disaster-risk zones (MoDMR, 2013). Low-lying coastal plains constitute 20% of the total land area in Bangladesh (Huq, 2001). It is predicted that if there is a 2°C increase in SST and 0.3 m rise in sea level, flood risk in the coastal areas of Bangladesh could increase by more than 15% while the depth of flooding could increase more than 20% within 20 km. from the coastline (Karim & Mimura, 2008). Notably, the southern coastal communities of Bangladesh are among the most vulnerable areas to coastal cyclones (IPCC, 2014).

In the past century, Bangladesh experienced 106 natural disasters (MoDMR, 2013). The most catastrophic cyclone and storm surge made landfall along the coastal area on 12th November 1970, causing the loss of approximately half a million lives and property amounting to more than US $1 billion (Sommer & Mosley, 1972). On 29th April 1991, Cyclone 2B claimed 138,868 lives and caused property losses worth more than US $2 billion (MoDMR, 2013). Since 2005, the coastal people in Bangladesh have experienced a total of eight cyclones of various magnitudes (Hossain & Mullick, 2020). The 'super-cyclone' Sidr devastated the southwestern coast on 15th November 2007, causing 3,406 deaths, injuring 55,000 people, and resulting in about US $1.7 billion damage to property (Paul, 2009).

In addition to the increased risk of climate-induced shocks (e.g., costal cyclones), Bangladesh's society, including coastal communities, has undergone rapid social-ecological transformation in recent years. The main drivers were market integration, globalization, rural to urban migration, telecommunication and new technology, climate change-induced stresses (e.g., saline intrusion), and degradation of coastal mangrove forests (Amin, 1998; Islam et al., 2018; Monirul, 2013; Saha, 2017; Sen, 2013). Such transformations sometimes undermine traditional and socially embedded institutions, such as kinship and family ties and local wisdom that historically facilitated disaster response and resilience-building processes (Mutton & Haque, 2004; Zaman, 1993). In recent years, formal institutions are increasingly taking responsibility for community-level disaster risk reduction (DRR) and resilience (Choudhury et al., 2019; Islam &

Walkerden, 2015, 2017). Overall, these drivers are resulting in complex disaster risk profiles as well as risk reduction and management strategies.

A key question arises here: How can coastal communities in general, and Bangladeshi coastal communities in particular, cope, adapt, transform, and build their resilience to the increasing risks of climate-induced disaster shocks? Coping measures imply absorbing the immediate impacts of hazards – the extent of a community's ability to absorb such shocks using existing coping responses is referred to as its absorptive capacity (Cutter et al., 2008). Inability to absorb the impacts of hazards (e.g., cyclones and storm surges) is likely to result in disasters. The United Nations International Strategy for Disaster Reduction (UNISDR) (2009, p.9) defines *disaster* as a "serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts". Hazard risks and losses and damages from the impact of disasters can be significantly reduced by taking longer-term planning and proactive actions, i.e. adaptation. *Risk* implies the potential of future extreme events and associated natural hazards to cause harm (Ferrier & Haque, 2003). Such risks always exist regardless of hazard occurrence, and are amplified by increased climatic variability and change (Haque et al., 2018). To deal with emerging and increasing risks of climate change-induced disasters, communities may require moving beyond and/or transforming customary coping and adaptation practices (Choudhury & Haque, 2016).

Resilience thinking provides an emerging perspective for analyzing and investigating communities' inherent capacities to withstand external shocks, stresses, and disturbances (Berkes & Ross, 2016; Folke, 2006, Faulkner et al., 2018). It is an overarching concept that connects various forms of human and institutional responses (i.e. coping, adaptation, and transformation) to hazards. In dealing with shocks and stresses, resilience thinking underscores the importance of adaptability or adaptive capacity – a human/social component that implies the capacity of actors to learn from experience and combine different forms of knowledge. This is considered a prerequisite for building community resilience to natural hazards (Cutter et al., 2008; Matyas & Pelling, 2015; Folke et al., 2010; Walker et al., 2004). Specifically, learning (e.g., social, experiential, and transformative learning) has been identified as one of the key principles for building resilience (Biggs et al., 2015; Gunderson, 2010; Choudhury & Haque, 2018).

In this study, *social learning* refers to the process of collective way of framing and reframing an issue through participation of different stakeholders that goes beyond individuals and becomes situated in practice across the community and institutions (Armitage et al., 2008; Reed et al., 2010) while transformative leanring implies the continuous process of reflection and critical engagement that transforms our perception and knowledge of the world, and consequently our behavior and action (Mezirow, 1978, 1997).

Moreover, resilience at the community level is shaped by drivers and processes at multiple scales and levels (Angeler et al., 2016; Berkes & Ross, 2016; Shahidullah et al., 2020). Resilience scholarship in this regard provides a valuable lens to investigate how individuals, communities, and institutions' experience of and learning from disaster shocks shape responses in dealing with disasters. In considering the fundamental linkages between learning and community resilience to nature-triggered disasters and shocks, it is critically important to ask: How does learning at multiple societal levels (i.e. individual, community, and institutional) enhance community resilience to shocks?

It is argued that experience and learning from past cyclones can contribute to the ability and willingness to take measures for risk reduction (Noy, 2016). It has been found that countries with considerable experience in dealing with past cyclones are better able to respond to and cope with recent cyclones compared with countries with no or relatively little experience (Noy, 2016). For example, since 2000 the Bangladesh coast has been struck by two severe cyclones of comparable magnitude and intensity to the 1970 and 1991 cyclones. However, human fatalities were much reduced compared to previous events (Paul, 2009). Not only have the human toll and property damage become less severe than in past disasters, recovery and rehabilitation processes also appear more robust (Paul, 2009).

This improvement is primarily claimed to be the result of institutional changes – perhaps reflecting a significant level of social learning in DRR and disaster resilience in Bangladesh (labelled by some as a 'paradigm shift') (Haque & Uddin, 2013). This makes the coastal communities of Bangladesh an interesting case to investigate how multi-level (i.e. institutional, community, and individual) learning can contribute to building resilience and reducing risks of communities to climate-induced disaster-shocks. To advance our knowledge of the role of social learning in community resilience, DRR, disaster management, and disaster resilience, I investigated the most critical and pertinent research questions (see Section 1.4.5 below)

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empirically in one of the most vulnerable areas of the world, namely, the southern coastal communities in Bangladesh.

1.2 Research Purpose and Objectives

The general purpose of this research was to understand how learning at multiple societal levels shapes community resilience to coastal cyclones and associated storm surges in Bangladesh. The specific objectives were to:

Objective 1: map the processes, outcomes, and surrogates of social learning at the local community level concerning DRR and resilience;

Objective 2: examine the processes, barriers, and outcomes of transformative learning for building community resilience to cyclones; and

Objective 3: identify and analyze the types, processes of, and barriers against social learning about DRR and resilience by multi-level (i.e. local, regional, and national) and multiple disaster management institutions (e.g. state, non-state, and community-based).

1.3 Research Approach, Methodology and Study Area

1.3.1 Philosophical Approach to the Study

Research is always guided by philosophical positions/worldviews/paradigms. Guba defines worldview as "a basic set of beliefs that guide action" (Guda, 1990, quoted in Creswell 2009, p. 6). Creswell (2009) defines a paradigm or worldview as "a general orientation about the world and the nature of research that a researcher holds" (p.6). Fundamentally, there are two types of worldviews. One argues that there is a 'world' or 'universe' that is knowable, observable, and measurable through objective human sensations, i.e. a positivistic way of knowing the world. For them, reality is singular and 'out there' (Creswell, 1994). By contrast, an interpretive paradigm sees the world as having multiple realities that are socially constructed by individuals and social groupings. All others are derivative of either interpretive (e.g., postmodern) or positivist (e.g., postpositivism) worldviews or mixtures of both (e.g., pragmatism).

Bhaskar (1998) argues that we cannot separate ontology (i.e. reality) from the knowledge (i.e. epistemology) we produce about it (i.e. epistemology). Positivism offers a segment of reality/knowledge and promotes what he calls the "epistemic fallacy" (p.27), i.e. the reduction of reality (ontology) to knowledge (epistemology). This line of criticism also applies to social constructivism, which claims that reality is socially constructed (Fletcher, 2017). To address

multiple ontologies (i.e. realities) in my interdisciplinary endeavors, philosophically I recognize the value of "epistemological pluralism", which recognizes that "in any given research context, there may be several valuable ways of knowing, and that accommodating this plurality can lead to more successful integrated study" (Miller et al. 2008, p. 1). Recognizing that learning occurs at multiple levels (i.e. multiple realities), I drew insights from different disciplinary and interdisciplinary literature.

A pragmatic research approach fits best with multiple epistemological and ontological positions as it rejects complete objectivity and subjectivity (Creswell, 2014). A pragmatic approach involves selecting methods that best fit epistemological positions (Hodgkin, 2008), and facilitates incorporating methods and approaches that are consistent with research problems, questions, and objectives. It is concerned with ensuring the outcome of research offers practical solutions to real world problems (Denscombe, 2008). Hence, in pragmatic research the research question receives primary importance (Biesta, 2015; Feilzer, 2010).

In contrast, advocates of the Transformative-Emancipatory (T-E) paradigm argue that pragmatism is weak in addressing the issues of power, inequality, and justice. As pragmatism is practice oriented, Mertens (2003) asks the question: "practical for whom and to what end?" (p.159). She posits that the goal of research is to represent the voice of marginalized people and to address the issues of power, inequality, and justice to facilitate change and transformation. The T-E paradigm argues that reality should be seen from the position of the marginalized and disadvantaged people. Community people's voice and participation are therefore critical in the production of knowledge that is likely to facilitate transformative change and their emancipation from oppression and subjugation. Moreover, parallel to resilience thinking, the T-E paradigm focuses on the *strengths* of marginalized and disadvantaged communities (which resides within the community) rather than on their *deficiencies* (Mertens, 2009, 2012).

The T-E and pragmatic paradigms together provided the guiding principles in the overall context of the present study. Shannon-Baker (2016) argues that to apply the T-E paradigm one must use a theoretical framework from the community's perspective to connect theory with data – in both the data collection and analysis phases. To apply the T-E paradigm as the guiding principle to investigate social learning at the community level and to represent their voice, I drew insights from 'critical literature' on natural disasters, resilience, and social learning (see Chapter Two and Chapter Three). The T-E paradigm includes pragmatism in the sense that research

questions and objectives dictate the choice of methods, ensuring appropriate methods of data collection are used to address research objectives and questions. In this research, data collection involved both qualitative and quantitative techniques.

1.3.2   Study Area

This thesis research involved collecting data from two main sources: i) local community people, and ii) multi-level institutions, both formal and informal. Data collected from the community level helped address my first two objectives and the third objective partially. To further address the third objective, I collected data on learning by multi-level formal and informal institutions. Field research was carried out in two *Upazila* (sub-district) level coastal communities of southern Bangladesh, from August, 2018 to January, 2019.

To collect data from the local community, I carried out an empirical investigation in the southern Barguna District of Bangladesh (Fig. 1.1), which is among the most vulnerable areas of climate change-induced disaster-risk according to IPCC scenario-building models (IPCC, 2014). Barguna District covers 1939.39 sq. km., with a total population of 892,781 (as per 2011 census). Most people here rely on agriculture and fish for their livelihoods. The district consists of six *Upazilas* and 560 villages (Bangladesh National Portal, 2021).
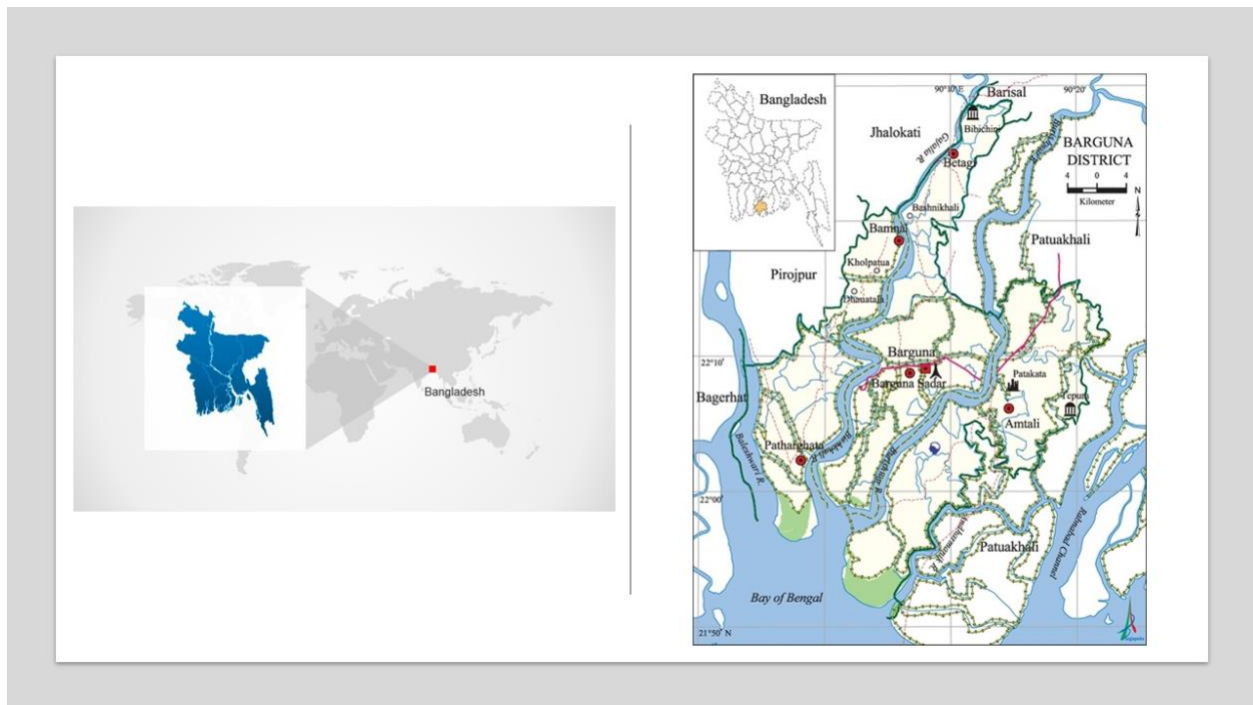
Fig. 1.1: Map of the study area

In 2007, Barguna District was severely affected by Cyclone Sidr (category 5), which claimed 1,292 lives, severely injured 16,310 people, and destroyed numerous properties and houses in the district (MoDMR, 2013). This region, along with other coastal regions, was subsequently severely affected by Cyclone Aila (2009), Cyclone Mahasen (2013), and Cyclone Komen (2015). After Cyclone Sidr, a considerable number of initiatives for preparedness, response, and recovery were taken by district and sub-district committees of government institutions, and national and international NGOs; these measures resulted in a noticeable reduction of property and human losses in subsequent cyclone events. I selected six villages from two *Upazilas*, namely Amtali and Taltali, that were severely affected by both Cyclones Sidr and Aila.

1.3.3   Methods

To address the objectives stated above, data collection involved both qualitative and quantitative techniques. For primary qualitative data collection at the community level, several techniques were adopted from the Participatory Rural Appraisal (PRA) toolbox; these included Semi-Structured Interviews (SSI), Focus Group Discussions (FGDs), Key Informants Interviews (KIIs), Oral History Interviews, and Participant Observation (PO) (Chambers, 1994). Details of the research instruments used are shown in Appendix 1. The required ethics approval for collecting primary data was obtained from the University of Manitoba Joint Research Ethics Board prior to field data collection (Appendix 2).

Table 1.1 outlines the number of PO events, FDGs, and interviews conducted to address each objective and the rationale for applying these methods. Chapter Two and Chapter Three address the first and second objectives respectively and are based on data collected from community people and their local institutions. Data collected from 'talk-based methods' included SSIs, FGDs, KIIs, and Oral History Interviews, and relevant documents from local NGOs and PO events. These helped address the first objective (Chapter Two), while SSIs, FGDs, KIIs, and household surveys helped address the second objective (Chapter Three). The third objective (Chapter Four) is based on data collected through KIIs and document reviews (see Table 1.1).

Table 1.1: Choice of methods to addresses specific objective and rationales

Method	Number	Rationale	Objectives and Chapters		
			Obj. #1 Chapter 2	Obj. #2 Chapter 3	Obj. #3 Chapter 4
Semi-Structured Interview (SSI)	50 (30 males and 20 females)	SSIs are typically "content focused", i.e. interview questions directly address research questions (Dunn, 2005). This talk-based method helped capture community members' diverse narratives on memory, experience, and learning from past major disasters.	√	√	
Focus Group Discussion (FGD)	12 (7 with males and 5 with females). Out of 7 FGDs with males, 3 were with fishers, 2 with farmers, and 2 with mixed groups.	FGDs are a helpful method in capturing collective narratives and lived experience of different groups of people (Liamputtong, 2011). FGDs helped capture people's narratives on learning and disaster experience. It was also helpful in documenting the constraints that shape action based on learning.	√	√	

Method	Number	Rationale	Objectives and Chapters		
			Obj. #1 Chapter 2	Obj. #2 Chapter 3	Obj. #3 Chapter 4
Oral History Interview	6 (4 males and 2 females) with elders (aged more than 65 years)	The oral history method provides a voice or a picture of the past from the words and memories of the respondent. The emphasis is on the experience of individuals – how individuals cope with society (Marshall & Rossman, 2010). The oral history method facilitated a deeper understanding of how disaster experience is connected with critical reflection and change in frames. Specifically, this helped understand the specific experience of individuals – how they coped with past disasters, what they learned from such events, and how this learning contributed to subsequent adaptation processes.	√		
Key Informant Interview (KII)	Community level: 5 Institutional level: 47 with individuals from various levels and types of institutions	A KI is a person who shares vital information to understand a culture. Perspectives from KIs add deeper insights into the research by working as a "translator both literally and figuratively" (Gilchrist & Williams, 1999, p.74). At the community level, KIIs helped understand community power dynamics, and at the institutional level KIIs provided valuable insights on the process, outcome, and barriers of social learning.	√	√	√

Method	Number	Rationale	Objectives and Chapters		
			Obj. #1 Chapter 2	Obj. #2 Chapter 3	Obj. #3 Chapter 4
Participant Observation (PO)	Participation in 3 social learning sessions at the community level.	PO can be conducted in both formal and informal settings. In a formal setting, this method helps answer questions such as who are the participants? and is the participatory learning space inclusive in terms of age and gender?	√	√	
Household survey	240 household surveys from 6 villages.	To supplement qualitative data by documenting socio-demographic profiles and disaster losses and damages.		√	

Method	Number	Rationale	Objectives and Chapters		
			Obj. #1 Chapter 2	Obj. #2 Chapter 3	Obj. #3 Chapter 4
Document review	Relevant documents included both academic and grey literature. The later covered 'lessons learned' documents, meeting minutes of disaster management committees, meeting minute of various administrative bodies where the issues of DRR and disaster management are discussed, government and institutional reports, booklets, progress reports, photos, and other relevant documents from various levels of institutions.	All documents are data, but not vice versa (Altheide, 1996, p. 1-38). The purpose here is to extract learning from documents as well as support qualitative interpretations. The purpose of document review was two-fold: i) to investigate the role of local institutions in social learning at the community level, and ii) to investigate social learning by multi-level institutions. For institutional learning, document analysis served two purposes: i) to extract learning from documents, and ii) to assess the capacity (i.e. financial, administrative, and technical) of state-led, multi-level institutions.	√		√

1.4 Conceptual Background

1.4.1   Learning and Community Resilience to Nature-Triggered Hazards

Learning is a multifaceted phenomenon whose study has diverse disciplinary and philosophical roots (Abeling, 2015; Winch, 1998). It is an area of investigation for educational, organizational, cultural, psychological, and environmental studies (e.g., natural resources management, climate change adaptation, and disaster management). Such diversity of disciplinary and philosophical roots contributes to the adoption of multiple definitions of learning and choice of multiple units of analyses for empirical investigations. In particular, learning implies a process of *change* in the way we orient ourselves (i.e. our thoughts, feelings, plans, and actions) toward the social, economic, cultural, biological, and physical aspects of the external world (Childs, 2011; Krasny et al., 2010).

By taking an existential philosophical standpoint, Peter Jarvis (2005) argues that learning is essentially a human attribute, which must be understood in relation to the wider society. Learning is therefore always 'situated', which implies that people chiefly learn through a process of sharing of experience, communication, and interaction within their given social, political, ecological, and cultural contexts (Cundill, Roux, et al., 2015; Wenger, 2000). People gain experience through their interaction with people and nature, which is fundamental to learning. Such learning can be longitudinal, episodic, and can emanate from direct and indirect experience. In brief, learning from this perspective involves a transformation in experience (Jarvis, 2005).

In nature-triggered disaster contexts, experience could be considered as a starting point for drawing lessons and learning. However, learning is much broader than experience, and has enduring effects on people. For instance, Cundill et al. (2015) posit that learning involves: i) "acquiring information and increasing knowledge; ii) memorizing; iii) acquiring facts, skills, and methods; iv) making sense and abstracting meaning; and v) interpreting and understanding reality in a different way by reinterpreting knowledge" (p. 178). For the purpose of my thesis research, I consider learning as a form of change in understanding, behavior, action, and/or plan, which can result from a change in and accumulation of experience, memory, and knowledge. It is both a *process* and an *outcome*.

Humans are not only victims of nature-triggered disasters, but also survivors of them. The capacity of actors to learn and combine different forms of knowledge (i.e. adaptability) is a prerequisite for building community resilience to natural hazards (Folke et al., 2010; Walker et

al., 2004). *Resilience* is understood here as the inherent capacity of communities to absorb shocks and disturbances, adapt, and transform (Berkes & Ross, 2013; Folke, 2006). Resilience thus fundamentally involves a process of change and adjustment (Choudhury & Haque, 2018; Holling, 1973; Magis, 2010), and learning facilitates such processes of change, adjustment, and transformation (Berkes & Ross, 2013; Maclean et al., 2014; Matarrita-Cascante et al., 2017; Wilson, 2012).

In considering the fundamental linkages between learning and community resilience to nature-triggered disasters and shocks, it is critically important to ask: how does learning at multiple societal levels (i.e. individual, community, and institutional) enhance community resilience to shocks? Recognizing that resilience is a multi-scalar and nested (e.g., individual, community, region) process (Angeler et al., 2016; Gunderson, 2010; Peterson et al., 1998), and concurring with O'Brien et al., (2010), I assert that "resilience building is a learning process at all levels" (p. 506).

I focused on three levels of learning, namely individual, community, and institutional (state, non-state, and community-based), and investigated the role of social learning at community and institutional levels and transformative learning at the individual level, and the effects of this learning on community resilience. I argue that different types of learning at different levels facilitate and foster diverse human responses (reactive/absorptive/coping, adaptative, and transformative) that in turn shape community resilience to cyclones and associated storm surges (Fig. 1.2).

1.4.2 Social and Transformative Learning and Human Responses to Nature-Triggered Disasters

1.4.2.1 Social Learning

Social learning has entered into the political arena as an instrument of social change. It has emerged as a counter discourse against the argument that the future is predictable through rational planning and use of resources (Muro & Jeffrey, 2008). The environmental studies literature, and specifically the natural resources management literature, has adopted social learning to facilitate adaptive management practices, and often defines this learning as an outcome of a process (often deliberative and sometimes spontaneous) where different stakeholders participate in a collective learning platform to share their experience and opinions, learn from each other, and come to a common understanding of the issue (Armitage et al., 2008;

Berkes, 2009; Pahl-Wostl et al., 2016). The climate change adaptation and the risk management literature define social learning in a similar fashion, where it is considered a necessary condition for moving up the adaptation ladder (Baird et al., 2014; Benson et al., 2016; Collins & Ison, 2009; Johannessen & Hahn, 2013; Tàbara et al., 2010).

Recently, there is a growing recognition of social learning in the hazard resilience, disaster management, and risk reduction literatures (Mian, 2014; Roosli & O'Brien, 2011; Tidball et al., 2010). In this literature it is argued that social learning is a necessary condition for adaptation or adaptive resilience (Cutter et al., 2008; Lei et al., 2014), and commonly identified features of social learning are: i) it involves collective framing and reframing of problems and issues through a process of sharing, interaction, communication, and debate; ii) such framing and reframing are undertaken through the participation of multiple and diverse stakeholders; iii) social learning processes could emerge spontaneously from within a community or could be externally driven; and iv) it is both a process and an outcome.

Social learning implies learning at the system or regime level (den Boer, 2016; Pahl-Wostl, 2009). I adopt Reed et al.,'s (2010) definition of social learning, which describes it as "a change in understanding that goes beyond the individual to become situated within wider social units or communities of practice through social interactions between actors within social networks" (Reed et al., 2010, p. 6). Social learning can be single-, double-, and triple-loop. *Single-loop learning* refers to minor adjustments made in response to mistakes; it is a routinized practice wherein assumptions are not challenged. *Double-loop learning* involves the examination of assumptions behind actions made in response to crises, and therefore constitutes 'learning for improvement'; and *triple-loop learning* involves making changes to underlying norms and values and overall governance structures, i.e. a paradigm shift in thinking and action (Argyris, 1977; de Kraker, 2017; Lee & Krasny, 2015; Medema et al., 2014; Pahl-Wostl, 2009). Löf (2010) equates single- and double-loop learning with incremental change and triple-loop learning with transformative change. I posit that single-loop learning facilitates coping responses, while double- and triple-loop learning facilitate adaptive and transformative responses respectively (Fig.1.2).

1.4.2.2 *Transformative Learning*

Literature on community resilience to environmental shocks primarily highlights the role of experiential learning (i.e. learning from past experiences and mistakes) in building resilience

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(Adger et al., 2005; Berkes, 2007; Imperiale & Vanclay, 2016). Experiential learning has played a significant role in terms of reducing the loss of human lives and damage to properties and in fostering resilience to shocks and stresses in many coastal communities (Adger et al., 2005; Berkes, 2015, p. 69-91; Cinner et al., 2018; Ferro-Azcona et al., 2019). I posit that in the context of climatic variability and uncertainty, experiential learning is necessary but insufficient to deal with climate change-induced shocks (Choudhury & Haque, 2018). Experiential learning is likely to facilitate mostly coping and adaptation, which in the long run and in the context of climatic variability may also result in maladaptation (Choudhury & Haque, 2016; Plümper, Quiroz Flores, & Neumayer, 2017) (Fig. 1.2). Action and behavior based on past experience alone may be inadequate and likely to create a false sense of security (Abreu-Santos et al., 2017).

What is required further is transformative learning, meaning the continuous process of reflection and critical engagement that transforms our perception and knowledge of the world, and consequently our behavior and action (Mezirow, 1978, 1997). For successful adaptation and resilience to climate-induced disaster-risks, a change or transformation in our *frame of reference* through critical reflection is required because often our existing beliefs, ideas, knowledge and actions are incompatible with emerging situations like climate change-induced disaster-risks. However, evidence of transformative learning in terms of reducing disaster risk is scanty (Sharpe, 2016; Tschakert et al., 2016).

I consider transformative learning as both a process (i.e. continually learning from direct and indirect experience though critical reflection, creativity, and imagination) and an outcome (i.e. a change or a transformation in individuals' frames of reference). I consider direct experience (i.e. loss and damage of property and disturbances in livelihoods from natural disasters) and indirect experience (i.e. social interaction, communication, and participation in collective learning platforms) from nature-triggered disasters and awareness of hazards as a *disorienting dilemma* that may trigger a change in or transformation of individuals' frames of reference e.g. transformation of individuals' frames of reference regarding disaster risks and appropriate responses to build community resilience to nature-induced disaster-shocks (Diduck et al., 2012; Diduck & Sinclair, 2002; Sinclair & Diduck, 2001) (Fig. 1.2).

Domain of experience   Domain of learning   Domain of response   Domain of resilience

Direct experience from disaster shocks

Individual level

Community level

Multilevel institutions

Triple-loop and transformative learning

Single- and double-loop and experiential learning

Transformative

Proactive or anticipatory measures

Reactive/absorptive/coping measures

Indirect experience from interaction and communication (e.g. formal and informal learning platforms)

Situated factors

Community resilience to nature-triggered shocks

Fig. 1.2: Learning, human responses, and community resilience linkages. Situated factors, such as livelihood practices, local knowledge, social and cultural factors (norms, beliefs, and values), institutional contexts, and power structures mediate the relationships between i) the domain of experience and the domain of learning, and ii) the domain of learning and the domain of response.

1.4.3   Community and Institutional Responses and Resilience to Natural Hazards

Community and institutional learning responses can be reactive, proactive, or transformative. A reactive, or *coping* response is a human attribute and part of adaptive capacity (Levina & Tirpak, 2006). The United Nations International Strategy for Disaster Reduction (UNISDR) (2009, p. 8) defines coping as the "ability of people, organizations, and systems, using available skills and resources, to face and manage adverse conditions, emergencies or disasters". It is then an *ex post* action – both short and medium term (Lavell et al., 2012). Coping is thus often equated with absorptive capacity or threshold, which is defined as "the ability of the community to absorb event impacts using predetermined coping responses" (Cutter et al., 2008, p. 603). The resilience of a community thus partly depends on its capacity to absorb (i.e. reactive resilience) the impact of nature-triggered hazards (Handmer & Dovers, 1996).

Adaptation is broadly defined as "the process of adjustment to actual or expected climate and its effects. […] In some natural systems, human intervention may facilitate adjustment to

expected climate and its effects" (IPCC, 2014, p.1758). The social-ecological system (SES) resilience literature emphasizes the role of institutions, self-organization, and learning for successful adaptation (Berkes, 2007; Folke et al., 2003). The climate resilience literature considers adaptation is an *ex ante*, anticipatory action where learning plays a key role (Goulden et al., 2013; Klein et al., 2015). The disaster resilience literature regards adaptation as preparedness and as part of planning for future disasters (Cutter et al., 2008; Matyas & Pelling, 2015). Adaptation is also directly related to adaptive resilience – often adaptive capacity (adaptation) is seen as part of resilience, or vice versa (Cutter et al., 2008; Gallopín, 2006; Lei et al., 2014; Zhou et al., 2010). Like the SES resilience literature, disaster resilience considers the role of improvisation and social learning as key factors for both short- and long-term adjustments (Cutter et al., 2008; Lei et al., 2014).

Transformation is a cross-cutting theme with different meanings and implications in different streams of resilience scholarship. However, one common understanding is that transformation means a rapid and fundamental change or alteration in the structure, function, and attributes of the unit under investigation (e.g., community, individual, or adaptation practice) (O'Brien, 2012; Pelling, O'Brien, & Matyas, 2015; Walker et al., 2004). The nature of adaptation discussed above broadly refers to an incremental change or adjustment, often described as an incremental adaptation (Brown, 2014; Kates et al., 2012; O'Brien, 2012). It has been claimed that an incremental change or adaptation in the context of climatic variability and change in insufficient; what is required is *transformational adaptation*, which can be both reactive or responsive and anticipatory or proactive. (Kates et al., 2012).

Coping, adaptation, and transformation imply a certain degree of change or fluctuation, but the degree of change depends on the magnitude of shocks and stresses imposed upon the community (Bene et al., 2014). In terms of the depth and speed of change, both coping and adaptation imply an incremental or a transitional change, while transformation indicates a rapid and fundamental alteration of system's (e.g., community) attributes (Hordijk et al., 2014; Termeer et al., 2017). Coping is mostly a reactive, short- and medium-term response, whereas adaptation is a more proactive, anticipatory, and longer-term response to reduce future harms. Transformation can be either reactive or proactive (Kates et al., 2012).

Some have raised concerns regarding both the normative framing of and connection drawn between learning and resilience (Boyd et al., 2014; Cote & Nightingale, 2011; Cundill,

Leitch, et al., 2015; Maclean et al., 2017; Tschakert & Dietrich, 2010). First, regarding resilience, questions such as "resilience for whom?" and "who defines resilience for whom?" are critically important (Cretney, 2014; Gaillard, 2010). Failure to addresses asymmetrical power structures may undermine the resilience-building process (Grove, 2014; Jordan, 2019). Second, learning from indirect experience through participation and interaction in collective learning platforms has raised concerns. Often such participatory learning spaces are imbued with power, which consequently shapes learning outcomes (Rist et al., 2007; Tschakert & Dietrich, 2010). Cundill et al., (2015) argue that lack of attention to unequal power structures, inability to document the trade-offs between learning and resilience, and failure to address the appropriate level and scale may undermine learning for building resilience. I posit that as learning processes and outcomes (i.e. learning translated into action for building resilience) depend on the social context, it is therefore important to understand how learning takes place within local social, cultural, and institutional contexts and how this shapes resilience outcomes (Fig. 1.2).

Lastly, learning from direct experience of disaster is not always positive. Negative learning from past disaster experience may develop false sense of assumption regarding future events (Abreu-Santos et al., 2017; Plümper et al., 2017). Operationalizing learning for research entails multiple challenges. In this regard, Armitage et al. (2008) have highlighted the 'paradox of learning', and have documented five thematic areas where there is often confusion regarding learning: i) "definitions of learning; ii) learning goals and expectations; iii) mechanisms by which learning takes place; iv) questions regarding who is involved in the process of learning; and v) the risks and ethical ambiguities faced by different actors expected to willingly participate in a learning process, whether formal or informal" (p.86-98).

1.4.4 Multi-level Learning and Place-Based Community Resilience to Disaster-Shocks

For the purpose of my research, I focused on a place-based community as resilience applies best to such communities (Berkes & Ross, 2013). I define *place-based community* as a group of people living in a delineated geographical area and dependent on local ecosystem services for livelihoods, and who are likely to be affected by environmental hazards specific to that locality (e.g., cyclones and associated storm surges in the coastal areas) (Choudhury & Haque, 2018; Shahidullah, Choudhury, & Haque, 2020). A *community* is composed of people with multiple and often competing interests, livelihoods, and ideologies. Place and place-based communities are a focus of multiple disciplinary and interdisciplinary environment-related studies, such as

natural resources management (Berkes & Seixas, 2005), environmental risks and hazards (Zhou et al., 2010), sociology (Gieryn, 2000), anthropology (Barnes et al., 2013), and geography (Cretney & Bond, 2017; Cutter, Ash, & Emrich, 2014); therefore, I felt that focusing on a place-based community would help to better explain the situated aspects of learning and understand the dynamics of learning and community resilience to disaster-shocks.

However, place-based communities are not isolated entities. The resilience of local communities is shaped by drivers at multiple scales and levels (Berkes & Ross, 2016; Shahidullah et al., 2020). Managing disasters at the local level requires attention to multiple levels of analysis as well as interactions with other scales (e.g., spatial and temporal). Learning and change at one level is likely to shape learning and change at other levels. It is therefore necessary to understand learning at multiple, interconnected levels to understand coastal community resilience to cyclones and associated storm surges.

Empirical evidence suggests that individuals' cognition and worldviews are important determinants of system or community-level learning and change (Johannessen & Hahn, 2013), and institutional-level learning and change also shape these processes at the community level (Liu et al., 2007). To understand this interconnection among different levels in the context of coastal communities of Bangladesh, I consider the community as the point of entry. From there I look downward (i.e. the individual level) and upward (i.e. institutional levels) (Angeler et al., 2016; Berkes & Ross, 2016) (Fig. 1.3). This also helps focus on specific social-cultural and institutional contexts and consider a multiplicity of relationships.
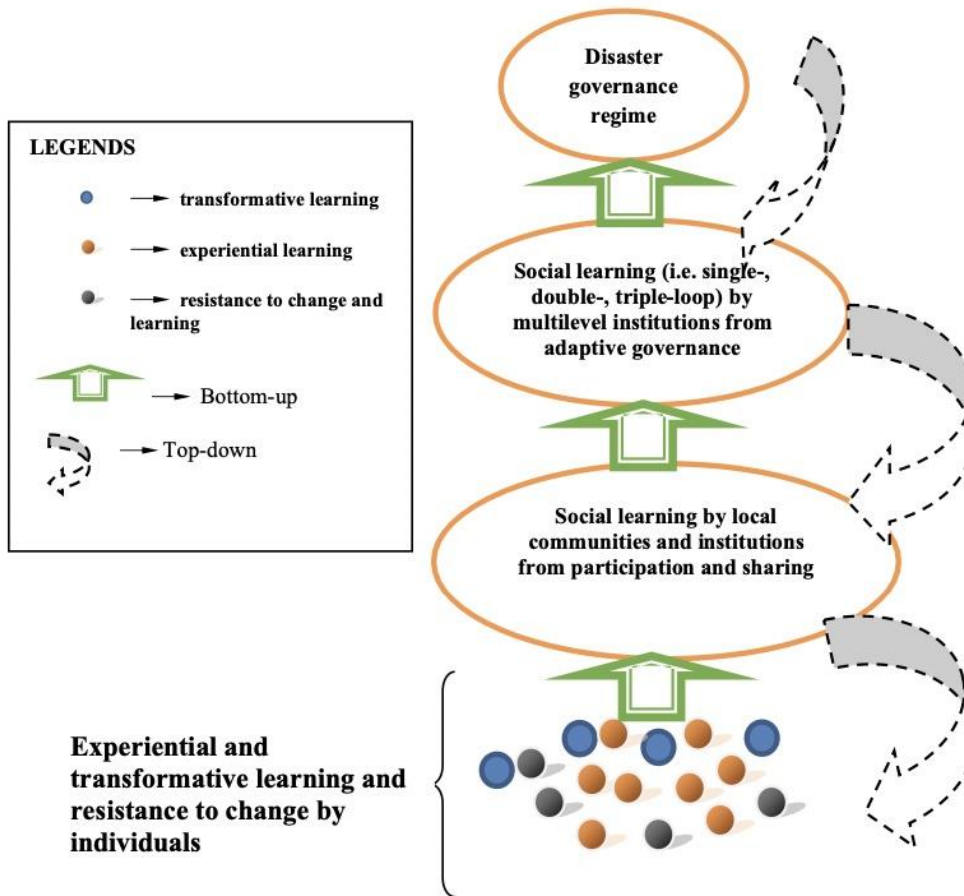
Fig. 1.3: Interconnection among multiple societal levels of learning

The key research questions I seek to answer here are: i) Can DRR benefit from community resilience, local and traditional knowledge, and social memory? ii) How do community people learn collectively? iii) Is social learning by community people a top-down process (i.e. mostly shaped by learning at higher level institutions)? iv) To what extent does social learning at the community level shape institutional learning and activities? v) To what extent do formal institutions take local lessons into account in social learning processes? vi) What kinds of individual-level learning and change are required to enhance resilience at the community level to disaster-shocks? vii) What are the factors that facilitate or constrain learning from shocks and taking action for resilience at the individual level? viii) What kind of institutional linkages and support can help DRR in coastal communities? and ix) How is multi-loop social learning at multiple institutional levels connected, what are the feedback loops among levels and learning loops, and how does this in turn shape community resilience to disaster-risks?

Chapter Two of this thesis addresses questions i-v, Chapter Three deals with questions vi and vii, and Chapter Four addresses the final two questions.

1.5   Significance of the Research

This thesis contributes to DRR and community resilience scholarship. The community and disaster resilience scholarship widely recognizes the importance of learning at multiple levels (Berkes & Ross, 2016; Choudhury & Haque, 2018; Cundill, et al., 2015; Cutter et al., 2008; Gunderson, 2010). It is also acknowledged that disaster events and/or conditions open 'windows of opportunity' for learning, change, and improvement (Birkmann et al., 2010; Davidsson, 2020; Olsson et al., 2006). However, limited attention has thus far been paid to how learning at multiple societal levels from episodic events, such as disaster-shocks, shapes risk reduction efforts and resilience to climate-induced disaster-shocks at the community level.

This thesis therefore is the first known research that investigates the role of learning at multiple societal levels in shaping community resilience and reducing risks of climate-induced shocks. The main contribution of this thesis is broadly two-fold: i) it demonstrates how learning at individual, community, and multiple institutional levels shapes community resilience and risk reduction; and ii) how such learning at multiple societal levels feeds back to one another and to community resilience to disaster-shocks. To contribute to understanding of the processes and attributes of community resilience to cyclones and associate storm surges, this thesis departs from the normative framing and thoughts on the relationships among learning, resilience, and DRR and adopts a critical approach to investigate the role of learning at different levels that shapes community resilience. Chapter Two draws insights from a biopolitical lens on social learning and resilience to investigate how power-knowledge-institution matrix shape social learning process and consequently resilience outcome. Chapter Two draws insights from the sociological and anthropological scholarships on risks, coping, and adaptation; it also examines the processes and barriers of transformative learning for building resilience. Chapter Three brings political and power aspects of governance into discussion to examine the learning outcomes and resilience.

Findings and recommendation from this study have practical and policy implications for coastal communities, disaster practitioners, and policy makers. It is also widely acknowledged that coastal communities are among the most vulnerable dwellers to climate change-induced shocks in Bangladesh and elsewhere. This thesis documents and demonstrates the role of

learning in enhancing resilience of coastal communities to cyclone-induced shocks. Policy makers and practitioners in Bangladesh widely recognize that the country has gained considerable experience and achieved noticeable success in dealing with disasters, especially in reducing mortality and morbidity from disasters. There is no detailed study to date on how different forms of learning at different levels contributed to such successes. Therefore, findings and recommendations from this research could improve both disaster management practice and disaster management policies.

1.6 Contributions of Authors

This thesis is written and organized in the 'sandwich' form, i.e. a collection of manuscripts. These manuscripts are either already published or have been submitted to peer-reviewed journals for publication. Footnotes indicate the status of publications. Three manuscripts (from Chapters Two to Four) based on my findings are multi-authored; therefore, I use the pronoun we throughout these three chapters.

I have collected, analyzed, and interpreted both primary (both qualitative and quantitative) and secondary data (i.e. documents, maps, and photos). I wrote the first draft of all chapters and revised them multiple times after receiving input from co-authors before submission. In the case of published manuscripts, I also took the lead in revising manuscripts after receiving comments from journal editors and peer reviewers.

1.7. Chapter Connection and Organization of the Thesis

This thesis is organized under five chapters. Chapter One highlights the context and rationale of this study, describes its purpose, objectives, and overarching conceptual framing, and provides a brief overview of the methodology used. This introduction is followed by three main chapters presenting and discussing findings: Chapters Two, Three, and Four are based on empirical data and address objectives one, two, and three, respectively. Each chapter has specific lines of argument and presents distinct sets of data to support them.

This thesis places community resilience at the center of its discussion. All of the chapters based on findings directly contribute to the community resilience scholarships, but each from a different conceptual standpoint. Chapter Two highlights the social learning process at the community level and its effects on community resilience, while Chapter Three documents learning and change at individual levels and their resilience outcomes. Chapter Four takes an

institutionalist approach (i.e. adaptive governance) to learning, documents learning at multiple institutional levels, and underscores the effects of such learning on community resilience. The final chapter provides discussion and conclusions that connect the results chapters and demonstrate how learning at multiple societal levels feedback to one another and impacts community resilience to shocks. This chapter also elaborates the policy implications of and my own reflections on this PhD research project.

References

Abeling, T. (2015). *Can we learn to be resilient? Institutional constraints for social learning in heatwave risk management in London* [Doctoral thesis, King's College London]. Collection at UNU. https://collections.unu.edu/view/UNU:5606

Abreu-Santos, I., Vasconcelos, L., & Pires, I. (2017). Learning from risk: lessons from L'Aquila and Japan / *Aprender del riesgo: lecciones de L'Aquila y Japón*. *Psyecology*, *8*(1), 107–147. https://doi.org/10.1080/21711976.2016.1267854

Adger, W. N., Hughes, T. P., Folke, C., Carpenter, S. R., & Rockström, J. (2005). Social-ecological resilience to coastal disasters. *Science*, *309*(5737), 1036–1039. https://doi.org/10.1126/science.1112122

Altheide, D.L. (1996). *Qualitative media analysis* (Ser.38). Sage.

Amin, S. (1998). Family structure and change in rural Bangladesh. *Population Studies*, *52*(2), 201–213. https://doi.org/10.1080/0032472031000150376

Angeler, D. G., Allen, C. R., Garmestani, A. S., Gunderson, L. H., & Linkov, I. (2016). Panarchy use in environmental science for risk and resilience planning. *Environment Systems and Decisions*, *36*(3), 225–228. https://doi.org/10.1007/s10669-016-9605-6

Argyris, C. (1977). Double loop learning in organizations. *Harvard Business Review*, *55*(5), 115–125.

Armitage, D., Marschke, M., & Plummer, R. (2008). Adaptive co-management and the paradox of learning. *Global Environmental Change*, *18*(1), 86–98. https://doi.org/10.1016/j.gloenvcha.2007.07.002

Baird, J., Plummer, R., Haug, C., & Huitema, D. (2014). Learning effects of interactive decision-making processes for climate change adaptation. *Global Environmental Change*, *27*(1), 51–63. https://doi.org/10.1016/j.gloenvcha.2014.04.019

Barbier, E. B. (2014). A global strategy for protecting vulnerable coastal populations. *Science*, *345*(6202), 1250–1251. https://doi.org/10.1126/science.1254629

Bangladesh National Portal (2021, March15). *Barguna district.* http://www.barguna.gov.bd

Barnes, J., Dove, M., Lahsen, M., Mathews, A., McElwee, P., McIntosh, R., Moore, F., O'Reilly, J., Orlove, B., Puri, R., Weiss, H., & Yager, K. (2013). Contribution of anthropology to the study of climate change. *Nature Climate Change*, *3*(6), 541–544. https://doi.org/10.1038/nclimate1775

Bene, C., Newsham, A., Davies, M., Ulrichs, M., & Godfrey-Wood, R. (2014). Review article: resilience, poverty and development. *Journal of International Development*, *26*, 598–623. https://doi.org/10.1002/jid.2992

Benson, D., Lorenzoni, I., & Cook, H. (2016). Evaluating social learning in England flood risk management: an "individual-community interaction" perspective. *Environmental Science and Policy*, *55*(2), 326–334. https://doi.org/10.1016/j.envsci.2015.05.013

Berkes, F. (2007). Understanding uncertainty and reducing vulnerability: lessons from resilience thinking. *Natural Hazards*, *41*(2), 283–295. https://doi.org/10.1007/s11069-006-9036-7

Berkes, F. (2009). Evolution of co-management: role of knowledge generation, bridging organizations and social learning. *Journal of Environmental Management*, *90*(5), 1692–1702. https://doi.org/10.1016/j.jenvman.2008.12.001

Berkes, F. (2015). *Coasts for people : Interdisciplinary approaches to coastal and marine resource managemen*. Routledge.

Berkes, F., & Ross, H. (2013). Community resilience: toward an integrated approach. *Society and Natural Resources*, *26*(1), 5–20. https://doi.org/10.1080/08941920.2012.736605

Berkes, F., & Ross, H. (2016). Panarchy and community resilience: sustainability science and policy implications. *Environmental Science and Policy*, *61*, 185–193. https://doi.org/10.1016/j.envsci.2016.04.004

Berkes, F., & Seixas, C. S. (2005). Building resilience in lagoon social-ecological systems: a local-level perspective. *Ecosystems*, *8*, 967–974. https://doi.org/10.1007/s10021-005-0140-4

Bevacqua, E., Vousdoukas, M. I., Zappa, G., Hodges, K., Shepherd, T. G., Maraun, D., Mentaschi, L., & Feyen, L. (2020). More meteorological events that drive compound coastal flooding are projected under climate change. *Communications Earth & Environment*, *1*. https://doi.org/10.1038/s43247-020-00044-z

Bhaskar, R. (1998). Philosophy and scientific realism, In M. Archer, R. Bhaskar, A. Collier, T. Lawson, & A. Norrie (Eds). *Critical realism: Essential readings* (pp. 16-47). Routledge.

Biesta, G. (2015). Pragmatism and the philosophical foundations of mixed methods research. In A. Tashakkori & C. Teddlie (Eds.), *Mixed methods in social & behavioural research* (pp. 95–118). Sage. https://doi.org/http://dx.doi.org/10.4135/9781506335193

Biggs, R., Schlüter, M., & Schoon, M. L. (2015). *Principles for building resilience: Sustaining ecosystem services in social-ecological systems.* Cambridge University Press.

Birkmann, J., Buckle, P., Jaeger, J., Pelling, M., Setiadi, N., Garschagen, M., Fernando, N., & Kropp, J. (2010). Extreme events and disasters: a window of opportunity for change? Analysis of organizational, institutional and political changes, formal and informal responses after mega-disasters. *Natural Hazards*, *55*, 637–655. https://doi.org/10.1007/s11069-008-9319-2

Boyd, E., Ensor, J., Broto, V. C., & Juhola, S. (2014). Environmentalities of urban climate governance in Maputo, Mozambique. *Global Environmental Change*, *26*, 140–151. https://doi.org/10.1016/j.gloenvcha.2014.03.012

Brown, K. (2014). Global environmental change I: a social turn for resilience? *Progress in Human Geography*, *38*(1), 107–117. https://doi.org/10.1177/0309132513498837

Camargo, S. J., & Wing, A. A. (2021). Increased tropical cyclone risk to coasts. *Science*, *371*(6528), 458–459. https://doi.org/10.1126/science.abg3651

Chambers, R. (1994). Participatory rural appraisal (PRA): analysis of experience. *World Development*, *22*(9), 1253–1268. https://doi.org/10.1016/0305-750X(94)90003-5

Chavas, D., & Chen, J. (2020). Hurricanes last longer on land in a warming world. *Nature*, *587*, 200–201.

Childs, A. (2011). Environmental learning: insights from research into the student experience. *Journal of Environmental Studies*, *17*(3), 429–431. https://doi.org/10.1080/13504622.2010.548157

Choudhury, M-U-I, Uddin, M. S., & Haque, C. E. (2019). "Nature brings us extreme events, some people cause us prolonged sufferings": the role of good governance in building community resilience to natural disasters in Bangladesh. *Journal of Environmental Planning and Management*, *62*(10), 1761–1781.

https://doi.org/10.1080/09640568.2018.1513833

Choudhury, M-U-I., & Emdad, C. E. (2018). Interpretations of resilience and change and the catalytic roles of media: a case of Canadian daily newspaper discourse on natural disasters. *Environmental Management*, *61*(2), 236–248. https://doi.org/10.1007/s00267-017-0980-7

Choudhury, M-U-I., & Haque, C. E. (2016). "We are more scared of the power elites than the floods": adaptive capacity and resilience of wetland community to flash flood disasters in Bangladesh. *International Journal of Disaster Risk Reduction*, *19*, 145–158. https://doi.org/10.1016/j.ijdrr.2016.08.004

Cinner, J. E., Adger, W. N., Allison, E. H., Barnes, M. L., Brown, K., Cohen, P. J., Gelcich, S., Hicks, C. C., Hughes, T. P., Lau, J., Marshall, N. A., & Morrison, T. H. (2018). Building adaptive capacity to climate change in tropical coastal communities. *Nature Climate Change*, *8*(2), 117–123. https://doi.org/10.1038/s41558-017-0065-x

Collins, K., & Ison, R. (2009). Jumping off Arnstein's ladder: social learning as a new policy paradigm for climate change adaptation. *Environmental Policy and Governance*, *19*(6), 358–373. https://doi.org/10.1002/eet.523

Cote, M., & Nightingale, A. J. (2011). Resilience thinking meets social theory: situating social change in socio-ecological systems (SES) research. *Progress in Human Geography*, *36*(4), 475–489. https://doi.org/10.1177/0309132511425708

Cretney, R. (2014). Resilience for whom? Emerging critical geographies of socio-ecological resilience. *Geography Compass*, *8*(9), 627–640. https://doi.org/10.1111/gec3.12154

Cretney, R. M., & Bond, S. (2017). Shifting relationships to place: a relational place-based perspective on SES resilience. *Urban Geography*, *38*(1), 8–24. https://doi.org/10.1080/02723638.2016.1139865

Creswell, J.W. (2014). *Qualitative inquiry and research design: Choosing among five approaches* (3rd ed.). Sage.

Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches.* Sage.

Creswell, J. W. (1994). *Research design: Qualitative and quantitative approaches*. Sage.

Cundill, G., Leitch, A. M., Schultz, L., Armitage, D., & Peterson, G. (2015). Principle 5 – Encourage learning. In R. Biggs, M. Schluter, & M. L. Schoon (Eds.), *Principles for building resilience: Sustaining ecosystem services in social-ecological systems*

(pp. 174-200). Cambridge University Press.
https://doi.org/10.1017/CBO9781316014240.008

Cundill, G., Roux, D. J., & Parker, J. N. (2015). Nurturing communities of practice for transdisciplinary research. *Ecology and Society*, *20*(2), 22. https://doi.org/10.5751/ES-07580-200222

Cutter, S. L., Ash, K. D., & Emrich, C. T. (2014). The geographies of community disaster resilience. *Global Environmental Change*, *29*(6), 65–77. https://doi.org/10.1016/j.gloenvcha.2014.08.005

Cutter, S. L., Barnes, L., Berry, M., Burton, C., Evans, E., Tate, E., & Webb, J. (2008). A place-based model for understanding community resilience to natural disasters. *Global Environmental Change*, *18*(4), 598–606. https://doi.org/10.1016/j.gloenvcha.2008.07.013

Davidsson, Å. (2020). Disasters as an opportunity for improved environmental conditions. *International Journal of Disaster Risk Reduction*, *48*, 101590. https://doi.org/10.1016/j.ijdrr.2020.101590

de Kraker, J. (2017). Social learning for resilience in social–ecological systems. *Current Opinion in Environmental Sustainability*, *28*, 100–107. https://doi.org/10.1016/j.cosust.2017.09.002

den Boer, J. (2016). *Drawing lessons from learning - a reflection on enabling conditions for social learning in multi-level flood risk governance arrangements*. [Master thesis, Utrecht University]. Utrecht University Repository. https://dspace.library.uu.nl/handle/1874/344187

Denscombe, M. (2008). Communities of practice: a research paradigm for the mixed methods approach. *Journal of Mixed Methods Research*, *2*(3), 270–283. https://doi.org/10.1177/1558689808316807

Diduck, A., & Sinclair, A. J. (2002). Public involvement in environmental assessment: the case of the nonparticipant. *Environmental Management*, *29*(4), 578–588. https://doi.org/10.1007/s00267-001-0028-9

Diduck, A., Sinclair, A. J., Hostetler, G., & Fitzpatrick, P. (2012). Transformative learning theory, public involvement, and natural resource and environmental management. *Journal of Environmental Planning and Management*, *55*(10), 1311–1330. https://doi.org/10.1080/09640568.2011.645718

Dunn, K. (2005). Interviewing, in Hay (Eds.) *Qualitative research methods in human geography* (2nd ed., pp. 79-93). Oxford University Press.

Edmonds, D. A., Caldwell, R. L., Brondizio, E. S., & Siani, S. M. O. (2020). Coastal flooding will disproportionately impact people on river deltas. *Nature Communications*, *11*(1), 1–8. https://doi.org/10.1038/s41467-020-18531-4

Emanuel, K. (2003). Tropical cyclones. *Annual Review of Earth and Planetary Sciences*, *31*, 75–104. https://doi.org/10.1146/annurev.earth.31.100901.141259

Estrada, F., Botzen, W. J. W., & Tol, R. S. J. (2015). Economic losses from US hurricanes consistent with an influence from climate change. *Nature Geoscience*, *8*(11), 880–884. https://doi.org/10.1038/ngeo2560

Faulkner, L., Brown, K., & Quinn, T. (2018). Analyzing community resilience as an emergent property of dynamic social-ecological systems. *Ecology and Society*, *23*(1), 24. https://doi.org/10.5751/ES-09784-230124

Feilzer, M. Y. (2010). Doing mixed methods research pragmatically: implications for the rediscovery of pragmatism as a research paradigm. *Journal of Mixed Methods Research*, *4*(1), 6–16. https://doi.org/10.1177/1558689809349691

Ferro-Azcona, H., Espinoza-Tenorio, A., Calderón-Contreras, R., Ramenzoni, V. C., Gómez País, M. de las M., & Mesa-Jurado, M. A. (2019). Adaptive capacity and social-ecological resilience of coastal areas: a systematic review. *Ocean & Coastal Management*, *173*, 36–51. https://doi.org/10.1016/j.ocecoaman.2019.01.005

Fletcher, A. J. (2017). Applying critical realism in qualitative research: methodology meets method. *International Journal of Social Research Methodology*, *20*(2), 181–194. https://doi.org/10.1080/13645579.2016.1144401

Folke, C. (2006). Resilience: the emergence of a perspective for social-ecological systems analyses. *Global Environmental Change*, *16*(3), 253–267. https://doi.org/10.1016/j.gloenvcha.2006.04.002

Folke, C., Carpenter, S. R., Walker, B., Scheffer, M., Chapin, T., & Rockstrom, J. (2010). Resilience thinking: integrating resilience, adapatability, and transformability. *Ecology and Society*, *15*(4), 20. http://www.ecologyandsociety.org/vol15/iss4/art20/

Folke, C., Colding, J., & Berkes, F. (2003). Synthesis: building resilience and adaptive capacity in social–ecological systems. In F. Berkes, J. Colding, & C. Folke (Eds.), *Navigating social–ecological systems: Building resilience for complexity and change* (pp. 352–387). Cambridge University Press. https://doi.org/10.1017/CBO9780511541957.020

Gaillard, J. C. (2010). Vulnerability, capacity and resilience: perspectives for climate and

    development policy. *Journal of International Development*, *22*(2), 218–232.

    https://doi.org/10.1002/jid.1675

Gallopín, G. C. (2006). Linkages between vulnerability, resilience, and adaptive capacity. *Global*

    Environmental Change, *16*(3), 293–303. https://doi.org/10.1016/j.gloenvcha.2006.02.004

Gilchrist, V.J. and Williams, R. J. (1999). Key informant interviews. In B.F. Crabtree & W.L.

    Miller (Eds.), *Doing qualitative research*, (2nd ed., pp 71-88). Sage.

Gieryn, T. F. (2000). A space for place in sociology. *Annual Review of Sociology*, *26*(1), 463–

    496. https://doi.org/10.1146/annurev.soc.26.1.463

Goulden, M. C., Adger, W. N., Allison, E. H., & Conway, D. (2013). Limits to resilience from

    livelihood diversification and social capital in lake social-ecological ystems. *Annals of the*

    Association of American Geographers, *103*(4), 906–924.

    https://doi.org/10.1080/00045608.2013.765771

Grove, K. J. (2014). Adaptation machines and the parasitic politics of life in Jamaican disaster

    resilience. *Antipode*, *46*(3), 611–628. https://doi.org/10.1111/anti.12066

Gunderson, L. (2010). Ecological and human community resilience to natural disasters. *Ecology*

    and Society, *15*(2), 18. http://www.ecologyandsociety.org/vol15/iss2/art18/

Handmer, J. W., & Dovers, S. R. (1996). A typology of resilience: rethinking institutions for

    sustainable development. *Organization and Environment*, *9*(4), 482–511.

    https://doi.org/10.1177/108602669600900403

Haque, C. E. (1995). Climatic hazards warning process in Bangladesh: experience of, and

    lessons from, the 1991 April cyclone. *Environmental Management*, *19*(5), 719–734.

    https://doi.org/10.1007/BF02471954

Haque, C. E., & 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 J. Tiefenbacher (Eds.), *Approaches to examining the implementations of*

hazards, emergency and disasters (pp. 33–54). InTechOpen. https://doi.

org/https://doi.org/10.5772/54973

Henderson-Sellers, A., Zhang, H., Berz, G., Emanuel, K., Gray, W., Landsea, C., Holland, G.,

    Lighthill, J., Shieh, S. L., Webster, P., & McGuffie, K. (1998). Tropical cyclones and global

    climate change: a post-IPCC assessment. *Bulletin of the American Meteorological Society*,

79(1), 19–38. https://doi.org/10.1175/1520-0477(1998)079<0019:TCAGCC>2.0.CO;2

Hodgkin, S. (2008). Telling it all: a story of women's social capital using a mixed methods approach. *Journal of Mixed Methods Research*, *2*(4), 296–316. https://doi.org/10.1177/1558689808321641

Holling, C. S. (1973). Resilience and stability of ecological systems. *Annual Review of Ecology and Systematics.*, *4*, 1–23. https://doi.org/10.1146/annurev.es.04.110173.000245

Hordijk, M., Sara, L. M., & Sutherland, C. (2014). Resilience, transition or transformation? A comparative analysis of changing water governance systems in four southern cities. *Environment and Urbanization*, *26*(1), 130–146. https://doi.org/10.1177/0956247813519044

Hossain, I., & Mullick, A. R. (2020). Cyclone and Bangladesh: a historical and environmental overview from 1582 to 2020. *International Medical Journal*, *25*(6), 2595–2614. https://www.seronijihou.com/article/cyclone-and-bangladesh-a-historical-and-environmental-overview-from-1582-to-2020

Huq, S. (2001). Climate change and Bangladesh. *Science*, *294*(5547), 1617. https://doi.org/10.1126/science.294.5547.1617

Mutton, D., & Haque, C. E. (2004). Human vulnerability, dislocation and resettlement: adaptation processes of river-bank erosion-induced displacees in Bangladesh. *Disasters*, *28*(1), 41–62. https://doi.org/10.1111/j.0361-3666.2004.00242.x

Imperiale, A. J., & Vanclay, F. (2016). Experiencing local community resilience in action: learning from post-disaster communities. *Journal of Rural Studies*, *47*, 204–219. https://doi.org/10.1016/j.jrurstud.2016.08.002

IPCC. (2014). Climate Change 2014: Impacts, Adaptation, and Vulnerability Part A: global and sectoral aspects. In C. B. Field, V. R. Barros, D. J. Dokken, K. J. Mach, M. D. Mastrandrea, T. E. Bilir, M. Chatterjee, K. L. Ebi, Y. O. Estrada, R. C. Genova, B. Girma, E. S. Kissel, A. N. Levy, S. MacCracken, P. R. Mastrandrea, & L. L. White (Eds.). *Working group II contribution to the fifth assessment report of the Intergovernmental Panel on Climate Change*. Cambridge University Press. https://doi.org/www.cambridge.org/9781107641655

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, *28*, 531–538. https://doi.org/10.1016/j.ijdrr.2017.12.017

Islam, R., & Walkerden, G. (2015). How do links between households and NGOs promote disaster resilience and recovery?: a case study of linking social networks on the Bangladeshi coast. *Natural Hazards*, *78*(3), 1707–1727. https://doi.org/10.1007/s11069-015-1797-4

Islam, R., & Walkerden, G. (2017). Social networks and challenges in government disaster policies: a case study from Bangladesh. *International Journal of Disaster Risk Reduction*, *22*, 325–334. https://doi.org/10.1016/j.ijdrr.2017.02.011

Jarvis, P. (2005). Towards a philosophy of human learning: an existentialist perspective. In P. Jarvis & S. Parker (Eds.), *Human learning. An holistic approach* (pp. 1–15). Routledge. https://doi.org/10.4324/9780203463321

Johannessen, Å., & Hahn, T. (2013). Social learning towards a more adaptive paradigm? Reducing flood risk in Kristianstad municipality, Sweden. *Global Environmental Change*, *23*(1), 372–381. https://doi.org/10.1016/j.gloenvcha.2012.07.009

Jordan, J. C. (2019). Deconstructing resilience: why gender and power matter in responding to climate stress in Bangladesh. *Climate and Development*, *11*(2),167-179. https://doi.org/10.1080/17565529.2018.1442790

Karim, M. F., & Mimura, N. (2008). Impacts of climate change and sea-level rise on cyclonic storm surge floods in Bangladesh. *Global environmental change*, *18*(3), 490-500. doi:10.1016/j.gloenvcha.2008.05.002

Kaplan, J., & Demaria, M. (1995). A simple empirical model for predicting the decay of tropical cyclone winds after landfall. *Journal of Applied Meteorology*, *34*(11), 2499–2512. https://doi.org/10.1175/1520-0450(1995)034<2499:ASEMFP>2.0.CO;2

Kates, R. W., Travis, W. R., & Wilbanks, T. J. (2012). Transformational adaptation when incremental adaptations to climate change are insufficient. *Proceedings of the National Academy of Sciences*, *109*(19), 7156–7161. https://doi.org/10.1073/pnas.1115521109

Klein, R. J. T., Midgley, G. F., Preston, B. L., Alam, M., Berkhout, F. G. H., Dow, K., Shaw, M. R., Gitay, H., Thurlow, J., Buob, S., & Thomas, A. (2014). Adaptation opportunities, constraints, and limits. In C. B. Field, V. R. Barros, D. J. Dokken, K. J. Mach, M. D. Mastrandrea, T. E. Bilir, M. Chatterjee, K. L. Ebi, Y. O. Estrada, R. C. Genova, B. Girma, E. S. Kissel, A. N. Levy, S. MacCracken, P. R. Mastrandrea, & L. L. White (Eds.). *Climate Change 2014: Impacts, Adaptation and Vulnerability: Part A: Global and Sectoral*

Aspects.Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (pp. 899–944). Cambridge University Press. https://doi.org/10.1017/CBO9781107415379.021

Krasny, M. E., Lundholm, C., & Plummer, R. (2010). Resilience in social-ecological systems: the roles of learning and education. *Environmental Education Research*, *16*(5–6), 463–474. https://doi.org/10.1080/13504622.2010.505416

Lavell, A., Oppenheimer, M., Diop, C., Hess, J., Lempert, R., Li, J., Muir-Wood, R., Myeong, S., Moser, S., Takeuchi, K., Cardona, O. D., Hallegatte, S., Lemos, M., Little, C., Lotsch, A., & Weber, E. (2012). Climate change: new dimensions in disaster risk, exposure, vulnerability, and resilience. In Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (Eds.). *Managing the risks of extreme events and disasters to advance climate change adaptation: Special report of the Intergovernmental Panel on Climate Change* (pp. 25-64). Cambridge University Press. https://doi.org/10.1017/CBO9781139177245.004

Lee, E., & Krasny, M. E. (2015). The role of social learning for social-ecological systems in Korean village groves restoration. *Ecology and Society*, *20*(1).42 https://doi.org/10.5751/ES-07289-200142

Lei, Y., Wang, J., Yue, Y., Zhou, H., & Yin, W. (2014). Rethinking the relationships of vulnerability, resilience, and adaptation from a disaster risk perspective. *Natural Hazards*, *70*(1), 609–627. https://doi.org/10.1007/s11069-013-0831-7

Levina, E., & Tirpak, D. (2006). *Adaptation to climate change: key terms*. http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=COM/ENV/EPOC/IEA/SLT(2006)1&docLanguage=En

Li, L., & Chakraborty, P. (2020). Slower decay of landfalling hurricanes in a warming world. *Nature*, *587*(7833). https://doi.org/10.1038/s41586-020-2867-7

Liamputtong, P. (2011). Focus group methodology: theory and ethics. In *Focus group methodolgy: Principles and practice* (pp. 15–30). Sage. https://doi.org/http://dx.doi.org/10.4135/9781473957657

Liu, J., Dietz, T., Carpenter, S. R., Alberti, M., Folke, C., Moran, E., Pell, A. N., Deadman, P., Kratz, T., Lubchenco, J., Ostrom, E., Ouyang, Z., Provencher, W., Redman, C. L.,

Schneider, S. H., & Taylor, W. W. (2007). Complexity of coupled human and natural systems. *Science*, *317*(5844), 1513–1516. https://doi.org/10.1126/science.1144004

Löf, A. (2010). Exploring adaptability through learning layers and learning loops. *Environmental Education Research*, *16*(5–6), 529–543. https://doi.org/10.1080/13504622.2010.505429

Maclean, K., Cuthill, M., & Ross, H. (2014). Six attributes of social resilience. *Journal of Environmental Planning and Management*, *57*(1), 144–156. https://doi.org/10.1080/09640568.2013.763774

Maclean, K., Ross, H., Cuthill, M., & Witt, B. (2017). Converging disciplinary understandings of social aspects of resilience. *Journal of Environmental Planning and Management*, *60*(3), 519–537. https://doi.org/10.1080/09640568.2016.1162706

Magis, K. (2010). Community resilience: an indicator of social sustainability. *Society and Natural Resources*, *23*(5), 401–416. https://doi.org/10.1080/08941920903305674

Marshall, C., & Rossman, G. B. (2010). *Designing qualitative research*. Sage.

Matarrita-Cascante, D., Trejos, B., Qin, H., Joo, D., & Debner, S. (2017). Conceptualizing community resilience: revisiting conceptual distinctions. *Community Development*, *48*(1), 105–123. https://doi.org/10.1080/15575330.2016.1248458

Matyas, D., & Pelling, M. (2015). Positioning resilience for 2015: the role of resistance, incremental adjustment and transformation in disaster risk management policy. *Disasters*, *39*(s1), s1–s18. https://doi.org/10.1111/disa.12107

Medema, W., Wals, A., & Adamowski, J. (2014). Multi-loop social learning for sustainable land and water governance: towards a research agenda on the potential of virtual learning platforms. *NJAS - Wageningen Journal of Life Sciences*, *69*(6), 23–38. https://doi.org/10.1016/j.njas.2014.03.003

Mertens, D. M. (2003). Mixed methods and the politics of human research: the transformative-emancipatory perspective. In A. Tashakkori & C. Teddlie (Eds.), *Handbook of mixed method social & behavioral research* (pp. 135-164). Sage.

Mertens, D. M. (2009). *Transformative research and evaluation*. Guilford Press.

Mertens, D. M. (2012). Transformative mixed methods: addressing inequities. *American Behavioral Scientist*, *56*(6), 802–813. https://doi.org/10.1177/0002764211433797

Mezirow, J. (1978). Perspective transformation. *Adult Education Quarterly*, *28*(2), 100–110. https://doi.org/10.1177/074171367802800202

Mezirow, J. (1997). Transformative learning: theory to practice. *New Directions for Adult and Continuing Education*, *1997*(74), 5–12. https://doi.org/10.1002/ace.7401

Mian, S. (2014). Pakistan's flood challenges: an assessment through the lens of learning and adaptive governance. *Environmental Policy and Governance*, *24*(6), 423–438. https://doi.org/10.1002/eet.1659

Miller, T., Baird, T., Littlefield, C., Kofinas, G., Chapin III, F., & Redman, C. (2008). Epistemological pluralism regoranizing interdisciplinary research. *Ecology & Society*, *13*(2),46. https://www.ecologyandsociety.org/vol13/iss2/art46/

MoDMR. (2013). *Bangladesh: towards resilient post 2015*. Gobal Platform for Disaster Risk Reduction, Geneva, Geneva, Switzerland.

Monirul, K. (2013). Social changes in contemporary Bangladesh. *Journal of the Asiatic Society of Bangladesh*, *58*(2), 263–276. http://www.asiaticsociety.org.bd/journal/04MonirulIKhan.pdf

Muro, M., & Jeffrey, P. (2008). A critical review of the theory and application of social learning in participatory natural resource management processes. *Journal of Environmental Planning and Management*, *51*(3), 325–344. https://doi.org/10.1080/09640560801977190

Murray, V., G. McBean, M. Bhatt, S. Borsch, T.S. Cheong, W.F. Erian, S. Llosa, F. Nadim, M. Nunez, R. Oyun, and A.G. Suarez. (2012). Case studies. In Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (Eds.). *Managing the risks of extreme   events and disasters to advance climate change adaptation: Special report of the Intergovernmental Panel on Climate Change* (pp. 487-542). Cambridge University Press. https://doi.org/10.1017/CBO9781139177245.004

NOAA (2021, March 15). *National Centers for Environmental Information, State of the Climate: Tropical Cyclones for Annual 2020*, published online January 2021, https://www.ncdc.noaa.gov/sotc/tropical-cyclones/202013.

National Ocean Service, National Oceanic and Administrative Administration (2021, May 15). *What is the difference between a hurricane and a typhoon?* https://oceanservice.noaa.gov/facts/cyclone.html

Noy, I. (2016). The socio-economics of cyclones. *Nature Climate Change*, *6*(4), 343–345. https://doi.org/10.1038/nclimate2975

O'Brien, G., O'Keefe, P., Gadema, Z., & Swords, J. (2010). Approaching disaster management through social learning. *Disaster Prevention and Management: An International Journal*, *19*(4), 498–508. https://doi.org/10.1108/09653561011070402

O'Brien, K. (2012). Global environmental change II. *Progress in Human Geography*, *36*(5), 667–676. https://doi.org/10.1177/0309132511425767

Oliver-Smith, A. (1999). "What is a disaster?": Anthropological perspectives on a persistent question. In A. Oliver-Smith & S. Hoffman (Eds.), *The angry earth: Disaster in anthropological perspective* (2nd ed., pp. 18–34). Roudledge.

Olsson, P., Gunderson, L. H., Carpenter, S. R., Ryan, P., Lebel, L., Folke, C., & Holling, C. S. (2006). Shooting the rapids: navigating transitions to adaptive governance of social-ecological systems. *Ecology & Society*, *11*(1), 18. http://www.ecologyandsociety.org/vol11/iss1/art18

Pahl-Wostl, C. (2009). A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes. *Global Environmental Change*, *19*(3), 354–365. https://doi.org/10.1016/j.gloenvcha.2009.06.001

Pahl-Wostl, C., Craps, M., Dewulf, A., Mostert, E., Tabara, D., Taillieu, T., Pahl-Wostl, C., Taillieu, T., Tabara, D., Mostert, E., & Craps, M. (2016). Social learning and water resources management. *Ecology and Society*, *12*(2), 5. https://doi.org/10.5751/es-02037-120205

Palmer, T. (2020). Resilience in the developing world benefits everyone. *Nature Climate Change*, *10*(9), 794–795. https://doi.org/10.1038/s41558-020-0888-8

Paul, B. K. (2009). Why relatively fewer people died? The case of Bangladesh's Cyclone Sidr. *Natural Hazards*, *50*(2), 289–304. https://doi.org/10.1007/s11069-008-9340-5

Peduzzi, P., Chatenoux, B., Dao, H., De Bono, A., Herold, C., Kossin, J., Mouton, F., & Nordbeck, O. (2012). Global trends in tropical cyclone risk. *Nature Climate Change*, *2*(4), 289–294. https://doi.org/10.1038/nclimate1410

Pelling, M., O'Brien, K., & Matyas, D. (2015). Adaptation and transformation. *Climatic Change*, *133*(1), 113–127. https://doi.org/10.1007/s10584-014-1303-0

Peterson, G., Craig, A. R., & Holling, C. S. (1998). Ecological resilience, biodiversity, and scale. *Ecosystems*, *1*(1), 6–18.

Plümper, T., Quiroz Flores, A., & Neumayer, E. (2017). The double-edged sword of learning

from disasters: mortality in the Tohoku tsunami. *Global Environmental Change*, *44*, 49–56. https://doi.org/10.1016/j.gloenvcha.2017.03.002

Pourquié, O. (2018). Tropical cyclones are becoming sluggish. *Nature*, *558*(7708), 36–37. https://doi.org/10.1038/d41586-018-05303-w

Rahmstorf, S. (2017). Rising hazard of storm-surge flooding. *Proceedings of the National Academy of Sciences*, *114*(45), 201715895. https://doi.org/10.1073/pnas.1715895114

Ramsay, H. (2014). Shifting storms. *Nature*, *509*(7500), 290-291.

Reed, M. S., Evely, A. C., Cundill, G., Fazey, I., Glass, J., Laing, A., Newig, J., Parrish, B., Prell, C., Raymond, C., & Stringer, L. C. (2010). What is social learning? *Ecology and Society*, *15*(4), r1. https://doi.org/10.5751/ES-03564-1504r01

Rist, S., Chidambaranathan, M., Escobar, C., Wiesmann, U., & Zimmermann, A. (2007). Moving from sustainable management to sustainable governance of natural resources: the role of social learning processes in rural India, Bolivia and Mali. *Journal of Rural Studies*, *23*(1), 23–37. https://doi.org/10.1016/j.jrurstud.2006.02.006

Roosli, R., & O'Brien, G. (2011). Social learning in managing disasters in Malaysia. *Disaster Prevention and Management: An International Journal*, *20*(4), 386–397. https://doi.org/10.1108/09653561111161716

Saha, S. K. (2017). Cyclone Aila, livelihood stress, and migration: empirical evidence from coastal Bangladesh. *Disasters*, *41*(3), 505–526. https://doi.org/10.1111/disa.12214

Sen, A. (2013). What's happening in Bangladesh? *The Lancet*, *382*(9909), 1966–1968. https://doi.org/10.1016/S0140-6736(13)62162-5

Shahidullah, A. K. M., Choudhury, M-U-I., & Haque, C.E. (2020). Ecosystem changes and community wellbeing: social-ecological innovations in enhancing resilience of wetlands communities in Bangladesh. *Local Environment*, *25*(11–12), 967–984. https://doi.org/10.1080/13549839.2020.1849077

Sharpe, J. (2016). Understanding and unlocking transformative learning as a method for enabling behaviour change for adaptation and resilience to disaster threats. *International journal of disaster risk reduction*, *17*, 213-219. https://doi.org/10.1016/j.ijdrr.2016.04.014

Shannon-Baker, P. (2016). Making paradigms meaningful in mixed methods research. *Journal of Mixed Methods Research*, *10*(4), 319–334. https://doi.org/10.1177/1558689815575861

Shuckburgh, E., Mitchell, D., & Stott, P. (2017). Hurricanes Harvey, Irma and Maria: how

natural were these 'natural disasters'? *Weather*, *72*(11), 353–354.
https://doi.org/10.1002/wea.3190

Sinclair, A. J., & Diduck, A. P. (2001). Public involvement in EA in Canada: a transformative
learning perspective. *Environmental Impact Assessment Review*, *21*(2), 113–136.
https://doi.org/10.1016/S0195-9255(00)00076-7

Singh, V. K., Roxy, M. K., & Deshpande, M. (2021). Role of warm ocean conditions and the
MJO in the genesis and intensification of extremely severe cyclone Fani. *Scientific Reports*,
11(1), 1–10. https://doi.org/10.1038/s41598-021-82680-9

Sommer, A., & Mosley, W. (1972). East Bengal Cyclone of November, 1970: epidemiological
approach to disaster assessment. *The Lancet*, *299*(7759), 1030–1036.
https://doi.org/10.1016/S0140-6736(72)91218-4

Tàbara, J. D., Dai, X., Jia, G., McEvoy, D., Neufeldt, H., Serra, A., Werners, S., & West, J. J.
(2010). The climate learning ladder. A pragmatic procedure to support climate adaptation.
Environmental Policy and Governance, *20*(1), 1–11. https://doi.org/10.1002/eet.530

Termeer, C. J. A. M., Dewulf, A., & Biesbroek, G. R. (2017). Transformational change:
governance interventions for climate change adaptation from a continuous change
perspective. *Journal of Environmental Planning and Management*, *60*(4), 558–576.
https://doi.org/10.1080/09640568.2016.1168288

Tidball, K. G., Krasny, M. E., Svendsen, E., Campbell, L., & Helphand, K. (2010). Stewardship,
learning, and memory in disaster resilience. *Environmental Education Research*, *16*(5–6),
591–609. https://doi.org/10.1080/13504622.2010.505437

Trenberth, K. (2005). Uncertainty in hurricanes and global warming. *Science*, *308*, 1753–1754.
https://doi.org/10.1126/science.1112551

Tschakert, P., & Dietrich, K. A. (2010). Anticipatory learning for climate change adaptation and
resilience. *Ecology and Society*, *15*(2), 11.
http://www.ecologyandsociety.org/vol15/iss2/art11/

UNISDR. (2009). UNISDR terminology on disaster risk reduction, Geneva, Switzerland.
https://www.undrr.org/publication/2009-unisdr-terminology-disaster-risk-reduction

Walker, B., Holling, C. S., Carpenter, S. R., & Kinzig, A. (2004). Resilience, adaptability and
transformability in social–ecological systems. *Ecology and Society*, *9*(2), 5.
http://www.ecologyandsociety.org/vol9/iss2/art5/

Wang, S., & Toumi, R. (2021). Recent migration of tropical cyclones toward coasts. *Science*, *371*(6528), 514–517. https://doi.org/10.1126/science.abb9038

Wenger, E. (2000). Communities of practice and social learning systems. *Organization*, *7*(2), 225–246. https://doi.org/10.1177/135050840072002

Wilson, G. A. (2012). Community resilience, globalization, and transitional pathways of decision-making. *Geoforum*, *43*(6), 1218–1231. https://doi.org/10.1016/j.geoforum.2012.03.008

Winch, C. (1998). *The philosophy of human learning*. EBSCO Publishing.

Witze, A. (2018). Why extreme rains are gaining strength as the climate warms. *Nature*, *563*(7732), 458–460. https://doi.org/10.1038/d41586-018-07447-1

Woodruff, J. D., Irish, J. L., & Camargo, S. J. (2013). Coastal flooding by tropical cyclones and sea-level rise. *Nature*, *504*(7478), 44–52. https://doi.org/10.1038/nature12855

Zaman, M. Q. (1993). Rivers of life: living with floods in Bangladesh. *Asian Survey*, *33*(10), 985–996. https://doi.org/10.2307/2645097

Zhou, H., Wang, J., Wan, J., & Jia, H. (2010). Resilience to natural hazards: a geographic perspective. *Natural Hazards*, *53*(1), 21–41. https://doi.org/10.1007/s11069-009-9407-y

Zscheischler, J., Martius, O., Westra, S., Bevacqua, E., Raymond, C., Horton, R. M., van den Hurk, B., AghaKouchak, A., Jézéquel, A., Mahecha, M. D., Maraun, D., Ramos, A. M., Ridder, N. N., Thiery, W., & Vignotto, E. (2020). A typology of compound weather and climate events. *Nature Reviews Earth & Environment*, *1*(7), 333–347. https://doi.org/10.1038/s43017-020-0060-z

CHAPTER TWO

Social Learning for Building Community Resilience to Cyclones: Role of Indigenous and Local Knowledge, Power, and Institutions in Coastal Bangladesh[2]

Abstract

Despite wide recognition of the role of social learning in building community resilience, few studies have thus far analyzed how the power–knowledge–institution matrix shapes social learning processes that in turn foster resilience outcomes. Drawing insights from the biopolitical lens of resilience, we take a critical stance on programmatic interventions for community resilience and social learning, arguing that local knowledge, beliefs, practices, and social memory (SM) are crucial elements in social learning processes for building community resilience to shocks and stresses. In addition, we explore how technologies shape social learning processes and build or strengthen community resilience. Our research, conducted in cyclone-prone coastal zones of Bangladesh, adopts a transformative interpretive framework (TIF) and a community-based participatory approach to empirical investigation. Findings of our research provide evidence that formal institutions frequently exclude indigenous and local knowledge (ILK) from social learning processes, and often subjugate communities to notions of resilience, as defined by nonlocals, that perceive people as subjects of institutional power and objects of scientific knowledge, rather than as active agents. We further found that local communities are able to obtain early warnings of cyclones through ILK of environmental phenomena, such as changing water temperature and animal behavior. Despite an abundance of ILK regarding past cyclones, the 2007 Cyclone Sidr was a surprising event to many and caused considerable loss of life and property. Much of this unpreparedness stemmed from an overall SM deficit—a key to translating knowledge into action. We recommend strengthening efforts to bridge scientific–technical knowledge and ILK to ensure effective social-learning-led resilience outcomes are achieved.

2.1 Introduction

The enhancement of community resilience to emerging risks, such as climate-change-induced extreme weather events, is an issue that has received a great deal of attention in both academic and policy domains (Cutter et al., 2008; Haque, Choudhury, & Sikder, 2018). Recognizing that resilience is often socially and politically differentiated, for the purpose of the present study, we broadly defined "resilience" as the (inherent) ability of a community to withstand external shocks and disruptions (Berkes & Ross, 2013; Faulkner, Brown, & Quinn, 2018; Folke, Carpenter, Walker, Scheffer, Chapin, & Rockstrom, 2010). This fundamentally depends upon the community members' capacity and opportunity for learning from crises and combining different forms of knowledge in order to effectively prepare for and respond to future crises (i.e., social learning) (Adger, Hughes, Folke, Carpenter, & Rockstrom, 2005; Berkes, 2007; Folke, Colding, & Berkes, 2003; Pahl-Wostl, 2009). With this basic relationship in mind, we investigated risk reduction and community resilience to nature-triggered extreme events (NTEE) and associated disasters through a social learning lens, and posit that indigenous and local knowledge (ILK) is vital to the social learning process and for enhancing resilience to NTEE.

Numerous recent studies have rightly elaborated the problematic nature of normative framings of resilience (Brown, 2016; Christensen & Krogman, 2012; Cote & Nightingale, 2011; Fabinyi et al., 2014) and the fact that resilience has frequently been found to be socially (e.g., gender), politically (e.g., power), and culturally (e.g., local knowledge) differentiated (Brown, 2016; Grove, 2014a, 2014b; Jordan, 2019; Pelling, 2011). As the normative usage of resilience may obscure its relationship with vulnerability, facilitating social learning and building resilience require an understanding of these dynamics (Cannon & Müller-Mahn, 2010; Carr, 2019; Gaillard, 2010). In this regard, some critical social theorists appropriately assert that resilience is essentially progressive and political as it envisions people as active agents who have control over their own destiny, rather than as passive subjects and victims (Barrios, 2016; Evans & Reid, 2014; Grove, 2013a, 2013b). Support for this human agency perspective has also been registered in some applied community resilience scholarship, e.g., focusing on identifying, building, and nurturing local strengths (Berkes & Ross, 2013; Brown & Westaway, 2011; Faulkner et al., 2018). In this paper, we posit that an inter- and transdisciplinary engagement with the work of these critical social theorists and applied, pragmatically oriented scholars helps to better understand the process of resilience on the ground.

As a mechanism for sharing and developing common understandings, social learning for building resilience often involves external deliberative processes (Armitage et al., 2008; Pahl-Wostl, 2006), and several authors have raised concerns regarding who defines resilience—and for whom (Cretney, 2014; MacKinnon & Derickson, 2013). They assert that if external deliberation (e.g., by formal institutions) does not meaningfully include local voices, knowledge, and memory, these processes are likely to subjugate people to the power of institutions and scientific–technical forms of knowledge (Adger et al., 2001; Bulley, 2013; Grove, 2014b). Here, unpacking the relational matrix of power, knowledge, and the institutional context is essential for understanding the role of social learning in building community resilience, which is often ignored in the social learning discourse.

Understanding tensions and differentials in power and knowledge is central to comprehending and explaining the "everyday forms of resilience" that are discursively produced and reproduced through social learning processes (Boyd, Ensor, Broto, & Juhola, 2014; Brown, 2016; Pelling, 2011). Recognizing the plurality of approaches to knowledge, our intent is to explore diverse meanings and possibilities for alternative forms of resilience (Bonilla, 2020; Grove, 2013a, 2018; Pugh, 2013). In this study, by taking a critical stance on programmatic interventions for community resilience and social learning, we argue that local knowledge, beliefs, practices, and social memory (SM) are critical elements of social learning processes for building community resilience to NTEE, such as cyclones and associated storm surges. As well, we assert that it is important to examine how these elements are being applied in power relations and how technologies play out in such social learning processes.

In our investigation, we consider ILK as a point of convergence between social learning and community resilience scholarship, and further link these fields to that of disaster resilience. We document and analyze the effects of various dimensions of ILK in reducing risks and building resilience to NTEE, the interplay between ILK and SM in shaping resilience, and the role of community-based institutions in replenishing SM and in the social learning process. We then present a critical stance on social learning and resilience to interrogate the role of external formal institutions in this process. In so doing, we aim to demonstrate, with empirical evidence, how formal institutions exclude ILK, and thus how social learning activities that promote more inclusive ILK can improve outcomes and facilitate alternative practices of resilience.

2.2 Conceptual Considerations

2.2.1 Indigenous and Local Knowledge, Social Learning, and Community Resilience to Nature-Triggered Extreme Events

The capacity of actors to learn and to combine different forms of knowledge (i.e., adaptability) is a prerequisite for building resilience (Folke et al., 2003; 2010). Various forms of learning and its outcomes are conceptualized in resilience literature, such as incremental, episodic, transformative, and social learning (Berkes, 2007; Gunderson, 2010; Holling, 2004; Pelling, 2011). We posit that, from a resilience perspective, learning implies system-oriented learning, i.e., social learning (Berkes, 2007; Pahl-Wostl, 2009), which can be incremental (single- and double-loop) or transformative (triple-loop). We consider social learning a useful lens to interrogate the connection between ILK and community resilience and have adopted Reed et al.'s (2010, p. 6) view of social learning as "a change in understanding that goes beyond the individual to become situated within wider social units or communities of practice through social interactions between actors within social networks."

Social learning has diverse meanings, applications, connotations, and acquisition processes, and often involves individual-, network-, and system-centric approaches (Rodela, 2011, 2013). In the climate-induced disaster risk and resilience context, it can be considered a process (deliberative and/or spontaneous) wherein different stakeholders participate in a collective learning platform to share their experiences and opinions, learn from each other, and come to a common understanding of the issues that contribute to adaptive resilience (Baird et al., 2014; Cutter et al., 2008; Johannessen & Hahn, 2013). Social interactions and networks are thus central to the social learning process. However, it is also essential to critically examine such a normative conceptualization of social learning by investigating how power–knowledge plays out within institutional contexts that in turn shape social learning processes and resilience outcomes (cf. Armitage et al., 2008; Boyd et al., 2014; Ensor & Harvey, 2015; Reed et al., 2010).

Despite a wide array of literature underscoring the importance and utility of ILK for building community resilience to shocks and stresses (Gómez-Baggethun, Corbera, & Reyes-García, 2013; Gómez-Baggethun, Reyes-García, Olsson, & Montes, 2012; Kelman, Mercer, & Gaillard, 2012; Thomalla & Larsen, 2010), the incorporation of local voice in the social learning process that is embedded in the idea of ILK has thus far been poorly studied (Briggs & Sharp, 2004). Social learning must build on local strengths (e.g., ILK and SM) as these represent vital

inner capacities or capital of a community (Magis, 2010). Hooli (2016) extends this notion by asserting that achieving resilience among the poorest requires the incorporation of their knowledge and learning. Studies of social learning processes that focus on the implications of the inclusion and/or exclusion of local knowledge for building community resilience are nonetheless scant in the literature.

It is difficult to operationalize social learning in the case of episodic events like NTEEs. In natural disaster research literature, learning and knowledge are often used interchangeably (Pfister, 2009), but social learning can be both a "process" through which knowledge is acquired and produced or an "outcome" in and of itself (Armitage et al., 2008; Pahl-Wostl, 2006; Pfister, 2009). For the purposes of this study, we consider ILK (including SM of disasters) as a surrogate of social learning. Indigenous and local knowledge is fundamentally social in character as it is situated within wider social entities or communities of practice. It is gained through a process of continuous accumulation from empirical observation and trial and error, transmitted from one generation to the next, and embedded within local institutions and practices (Berkes, 2018; Dekens, 2007; Trogrlić et al., 2019).

Indigenous and local knowledge reflects communities' inner strengths, which have the potential to improve preparedness as well as to reduce risk and enhance community resilience to NTEE (Berkes, 2007; Kelman et al., 2012). It is a source of community resilience and adaptive capacity (Boillat & Berkes, 2013; Gómez-Baggethun et al., 2013). Supporting and enhancing local strengths is also a key to community-based risk reduction (Choudhury et al., 2019; Thomalla & Larsen, 2010). However, ILK is often narrowly defined in disaster risk reduction (DRR) and resilience literature, where the focus is primarily on acquired knowledge, ignoring social institutions, power relations, beliefs, practices, memory, and worldviews. In this respect, it is useful to draw insights from Berkes' (2018) framework for traditional ecological knowledge, which defines a "knowledge–practice–belief complex" consisting of "a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmissions, about the relationship of living beings (including humans) with one another and with their environment" (Berkes, 2018, p. 8).

Analogous to Berkes' (2018) four interrelated levels of analysis, we offer a framework to investigate the function of ILK in DRR and resilience (Fig. 2.1). Indigenous and local knowledge is the first level of analysis and is at the core of this framework. Whereas Berkes (2018)

developed his framework in the context of natural resources management and was largely concerned with the ecological aspects of ILK (e.g., species identification and behavior), our work focuses on disaster risk and community resilience. We expand this level by drawing insights from Acharya and Prakash's (2019) six dimensions of ILK (including ecological) that are relevant to DRR and resilience: (i) ecological (nonhuman behavior); (ii) phenomenological (anticipation of a probable disaster based on memory); (iii) sea/riverine; (iv) meteorological; (v) celestial; and (vi) official (information received from external institutions and electronic and print media). These dimensions of ILK often interact to provide early warning before the onset of disasters, which is likely to facilitate actions to prepare, reduce risks, and enhance resilience (Trogrlić et al., 2019). The phenomenological dimension includes SM, which has special significance for DRR and resilience (see section on SM below). The official dimension indicates that people often proactively integrate their own knowledge and experience with external knowledge and modern technologies (Hilhorst, Baart, Haar, & Leeftink, 2015).
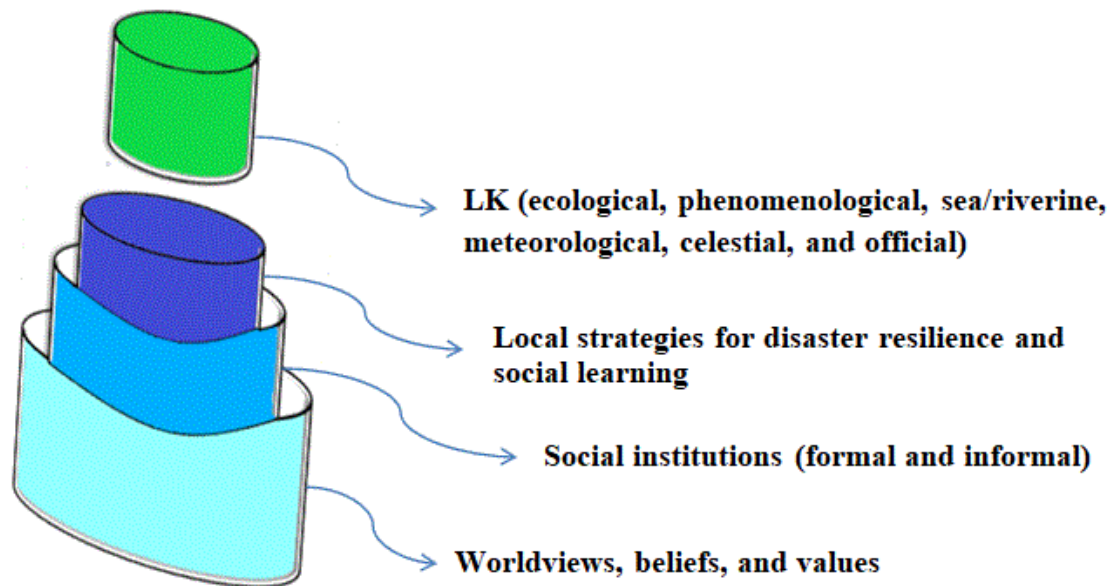
Fig. 2.1: Nested levels of analysis in ILK for DRR and resilience [after Berkes, 2018].

In the second level of analysis, people perform local resilience practices based on existing knowledge and memory. At this level, social learning often emerges from people's direct encounters with risks and catastrophic events. The third level of analysis involves formal and informal social institutions, which profoundly affect performance regarding DRR and

community resilience (see section on institutions below). The fourth level of analysis concerns worldviews, belief, and values, which shape people's attitudes and responses to NTEE. Risk reduction and resilience to NTEE are a function of worldviews, belief, and values (Fig. 2.1), and these may be altered by exposure to NTEE and disaster risks (Oliver-Smith, 2002).

Two aspects of this framework are noteworthy here: ILK as a "knowledge–practice–belief complex" is not static but rather a dynamic process that involves trial and error and the integration of new ideas and knowledge; and the four interrelated levels are not hierarchical, but rather are linked under a single nested framework with strong reciprocal relationships. Although all levels of analysis are important, for the purposes of this study, we focus on the ILK and the role of social institutions in reducing risk and building and/or strengthening community resilience.

2.2.2 Social Memory and Community Resilience to Nature-Triggered Extreme Events

Social memory is an "arena in which captured experience with change and successful adaptations, embedded in a deeper level of values, is actualized through community debate and decision making processes into appropriate strategies for dealing with ongoing change" (Folke etal., 2005, p. 453; see also Hewer & Kut, 2010; Beilin & Wilkinson, 2015). However, SM has diverse meanings and connotations (Olick, 2016). We consider SM specifically in relation to NTEE and disaster shocks and its role in DRR and community resilience building.

Social memory is essential to a community's capacity to respond to shocks and it is a source of renewal and self-organization (Berkes, 2007); it is argued that communities with higher SM tend to be more resilient (Folke et al., 2005). Human responses and resilience strategies in the face of disaster are shaped by the presence or absence of SM, as it is required for translating knowledge into action (i.e., the link between the first and second levels of our framework). However, SM has two major drawbacks: it tends to fade away with the passage of time, and it may provide a false sense of confidence.

Longer intervals between events tend to make SM less reliable. Intangible SM in the form of narratives and oral history is likely to fade away quickly if not renewed by recent disaster experience or vigorous institutional efforts. It is likely to be held by people who directly experienced past events, typically elders (Berkes & Folke, 2002), and in the absence of a renewal mechanism, "only half of the population remembers the most intensive and extensive natural processes after ten years, and only a tenth after forty years" (Komac, 2009, p. 206). Furthermore,

because SM is based on past experience, it can provide overoptimistic and inaccurate expectations regarding the likely extremes of climate-change-induced events, and lead to surprises when future events exceed all prior experiences.

2.2.3 Institutions, Social Learning, and Resilience Building

The third level in Fig. 1 comprises social institutions—the formal and informal rules, regulations, and social norms governing a community (Ostrom, 2008)—that can play a decisive role in nurturing, replenishing, and sharing SM both horizontally (actor to actor) and vertically (generation to generation). Socially embedded informal institutions play a critical role in generating and disseminating social learning and in the "memorialization" process (Rumbach & Foley, 2014; Tidball et al., 2010). Formal institutions are increasingly taking responsibility for reducing disaster risks and building resilience to NTEE by creating collective learning platforms and promoting new scientific knowledge and ideas. In light of this trend, a vital question that has emerged is: do formal institutions take local voices, learning, ILK, and SM into consideration in the social learning process, or is the social learning process mostly top-down? Taking a critical stance on the role of formal institutions in social learning and resilience-building processes, we examine to what extent institutions shape the pathways of resilience (Wilson, 2014).

Critical scholars argue that "resilience" is a contested concept with multiple meanings, interpretations, and political and ethical implications (Bonilla, 2020; Grove, 2013a, 2018; Pugh, 2013). Addressing the question of "who" defines "resilience" and for "whom," MacKinnon and Derickson (2013) have noted that nonlocals (e.g., external donors and development agencies) often define community resilience, whereas the voices of the communities themselves are silenced. Understanding tensions and differentials in power and knowledge in such processes is central to comprehending and explaining the alternative meanings of resilience (Boyd et al., 2014; Brown, 2016; Pelling, 2011). In discussing the relationship between power and knowledge, Foucault ([1980], 2005) explains that through exercises of institutional power and the exclusionary processes involved, one form of knowledge becomes "truth" and others are rejected. Such processes may take place at local levels where locally relevant knowledge may be excluded by the power of prevailing institutions (Agrawal, 2005).

However, for Foucault, power is not always oppressive and constraining but can also be productive, giving rise to new forms of interest, desire, capacity, and behavior. Such a conceptualization of power views individuals as active agents rather than passive subjects

(Foucault [1978], 2005). The Foucauldian notion asserts that "the truth of resilience is not 'out there', objectively waiting to be discovered," but rather that the conceptualization and definitions of resilience are constructed through power relations. Thus, "critical research on resilience has shown that resilience initiatives create subjects with particular kinds of desires and capacities" (Anonymous reviewer, 3 July 2020, *personal communication*). Foucault argues that "where there is power there is resistance;" people are not merely victims of hegemonic norms, but rather strategically cope with the discursively produced and reproduced social domination (Cleaver, 2007; Grove, 2013a). Therefore, resistance is not always an overtly manifested act, but rather an expression of hidden, unconventional, and strategic positions (Brown, 2016). Foucault's biopolitical analysis of power is also relevant in explaining the shift of the regimes of power, knowledge, and technologies beyond the state apparatus (e.g., toward NGOs) (see Grove 2014*b*). Biopolitics signals a "problem space" (i.e., hazards and disaster risks are governmental concerns) and a topological analysis of power "that examines how existing techniques and technologies of power are redeployed and recombined in diverse assemblies of biopolitical government" (Collier, 2009, p. 79).

In recent years, a redeployment of power and authority has taken place both globally and locally, wherein state roles and responsibilities for disaster management have been delegated to local authorities according to what is commonly termed the "subsidiarity principle" (Melo Zurita, Cook, Harms, & March, 2015; Melo Zurita et al., 2018). Such delegation has frequently been performed by the state through partnering with NGOs and other civil society organizations (Choudhury et al. 2019). This approach assumes that local institutions, by virtue of being embedded in the community and building social capital and trust, are better equipped to deal with local shocks and stresses (Melo Zurita et al. 2018). Notably, these subsidiarity principle-based approaches often sidestep fundamental questions regarding how people are governed through decentralization processes and what effects such processes have upon peoples' vulnerabilities. From a biopolitical perspective, community-based disaster resilience programming is alleged to become the technology of biopower. The intimate operation of power to promote so-called experts' notions of resilience, which Agrawal (2005) describes as "intimate institutions," is also illustrated by this perspective.

Thus, a biopolitical reading of resilience is concerned with the techniques that produce knowledge to naturalize risks and uncertainties and to intervene in the lives of communities to

help them cope and adapt to such changes (Chandler, 2018, 2019). Evans and Reid (2013) explain that, in such analyses, resilience operates through the ontology of vulnerability, which Chandler (2019) termed "ontopolitics." Therefore, following biopolitical rationalities, the intent of resilience technologies is to make subjects resilient so that they have the capacity to adapt and to exploit situations of uncertainty in the face of a multiplicity of threats (Evans & Reid, 2013; Hill & Larner, 2017). The biopolitical interpretation considers agents as active and having control over their own lives, and criticizes traditional interpretations of resilience for considering (resilient) subjects as powerless and lacking agency and for ascribing any vulnerabilities to disasters to deficiencies in the subjects' abilities rather than flaws in existing disaster management systems (Bockstael, 2017).

In the social learning process, ILK should therefore be considered in its own right for encouraging the local and indigenous peoples to pursue their own notion of resilience. As Barrios (2016: 35) argues, "[d]efinitions of resilience, recovery, and "rebuilding better," must not only be polyvocal, but must also foreground the voices of people and communities who directly bear the brunt of disasters," otherwise resilience-building processes may instead enhance vulnerability. In addition, in building resilience, the goal should be to provide resources to people and enable them to make their own choices, rather than implementing interventionist strategies (Evans & Reid, 2014; Kevin & Jonathan, 2015).

2.3 Study Area and Methodology

We conducted our study in the southern coastal zone of Bangladesh (Barguna district), which is ranked by Intergovernmental Panel on Climate Change (IPCC) models as among the most vulnerable areas (IPCC, 2014). Over the last half century, recurrent severe tropical cyclones, originating in the Bay of Bengal, have made landfall into this region. Following the devastating human toll (approximately half a million fatalities) of Cyclone Bhola (11 November 1970), a 3–5 m elevated earthen dike system was developed to protect the coastal region, particularly from cyclone-associated storm surges. In recent years, Barguna district was most severely affected by Cyclone Sidr in 2007, which claimed 1292 lives, injured 16,310 people, and destroyed a great deal of property and infrastructure (Government of Bangladesh (GoB) 2008). Cyclones Aila (2009), Mahasen (2013), and Komen (2015) have subsequently devastated the district. We carried out our field investigation from August 2018 to January 2019 in two *Upazilas* (subdistricts) of Barguna district, namely Amtali and Taltali, covering six

villages—two from Amatali (Baliatali and Gupkhali) and four from Taltali (Nidrarchar, Idupara, Tatulbaria, and Nolbonia) (Fig. 2.2).
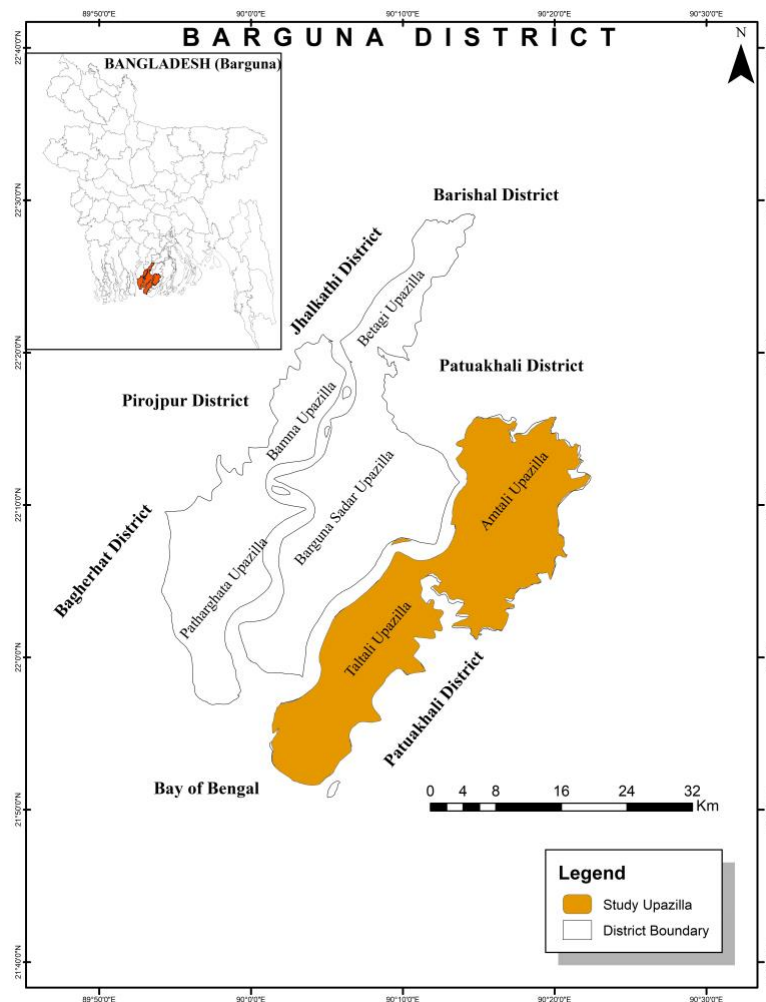
Fig. 2.2: Study area

We adopted a transformative interpretive framework (TIF) (Creswell, 2013; Mertens, 2007) in studying social learning processes for building community resilience to coastal cyclones and associated risks. The TIF framework acknowledges that knowledge and its production within a society are value-laden—that is, they reflect power asymmetry and shape social relationships. Therefore, the intent of knowledge production must be to change the lives of people and the institutions they live in (Creswell, 2014; Mertens, 2010). Community voices and participation are critical to the production of knowledge that is likely to facilitate transformative change and coping with oppression and subjugation (Mertens, 2012; Thiessen & Byrne, 2017). Parallel to resilience thinking, this paradigm focuses on the "strengths" within marginalized and

disadvantaged communities rather than their "deficiencies" (Brown & Westaway, 2011; Mertens, 2009).

Our empirical investigation followed a community-based participatory approach. This is a transformative change approach to research that aims to unshackle people from oppressive-hegemonic power structures (Jacobson & Rugeley, 2007), and in turn, facilitate change in the lives of participants as well as "the institutions in which they live and work" (Creswell, 2007, p. 21). Our primary data collection involved techniques drawn from the participatory rural appraisal (PRA) toolbox, with a four-tier study design (Choudhury & Haque, 2016). Before commencing fieldwork, the first author recruited a local field assistant who worked as a gatekeeper and translator of local dialects. Prior to collecting the data, several informal visits to the communities with the field assistant helped build rapport with community members. Appropriate verbal or written consent was obtained from each participant, following our protocol as approved by the University of Manitoba's (Canada) Joint-Faculty Research Ethics Board.

Considering the scope and objectives, the selection of respondents in the empirical investigation was made purposefully. We first conducted 50 semi-structured interviews with community members who had firsthand experience with Cyclone Sidr. This talk-based method helped capture community members' diverse narratives on memory, experience, and learning from past major NTEE and associated disasters. We interviewed adult and elderly male and female members (30 males and 20 females). Interviews ranged from 30 to 90 minutes. The interviews included exploring: experiences of past major disasters; coping and adaptation strategies; what was learned from disaster experience; actions and roles performed by local formal institutions; application of learning to later events; and how early warnings (EWs) were formulated based on ILK prior to the disaster event.

In the second stage, we conducted 11 focus group discussion (FGD) sessions involving diverse occupational groups from six villages. Focus group discussions enabled capturing people's narratives on learning and experience with NTEE and disasters. We conducted six FGDs with males (two with farmers, three with fishermen, and one with a mixed group) and five with females. These diverse FGDs were organized in order to capture diverse dimensions of ILK, more recurrent features, and outliers. Community members interact with surrounding environments differently for livelihood due to their varied occupation and gender positions. Therefore, differential experiences and exposures to risks allow people to generate ILK on

multiple and varied dimensions. For example, fishers are more capable of observing and documenting the maritime and riverine dimensions of ILK than farmers, who concentrate more on terrestrial dimensions.

In the third stage, we collected six oral histories (four males and two females) from elders (aged more than 65 years) who had experience of catastrophic cyclones before Cyclone Sidr (2007). This method made space for a "voice" or a "picture" of the past from the words and memories of the respondents. The main purpose of this investigation was to unpack the function of memory and elders' knowledge in building and maintaining resilience. The duration of these conversations ranged from 75 to 105 minutes.

In the final stage, we conducted five key informant interviews (KIIs) with representatives from community-based local institutions (e.g., local press club) to understand their roles in the memorializing and social learning process. The local press clubs in Amtali and Barguna shared images and news reports that highlighted their roles in this process.

Because formal institutions from outside the community profoundly shape the social learning and resilience building process, we conducted six KIIs with NGO personnel to understand how they carry out DRR and resilience projects at the local level. We also collected project documents to examine how external institutions view resilience and DRR. The first author participated as a "participant observer" in three social learning sessions organized by local NGOs to disseminate knowledge on DRR and resilience. Sample questions included in the observation protocol were: who participates in the platform (i.e., gender and age); do NGO-facilitated platforms take ILK and memory into account; do they disseminate and incorporate only scientific–technical knowledge in local programming or are other forms of knowledge included?

2.4 Findings and Analysis

2.4.1 Dimensions of Indigenous and Local Knowledge, Early Warning, Disaster Risk Reduction, and Resilience

From the point of view of social learning, DRR, and resilience, we focused on two aspects of ILK: triangulation of ILK, and the possession and use of ILK within the community. Regarding the first aspect, we categorized local early warnings (EWs) for DRR and resilience under the six dimensions of ILK (Table 2.1). Often the role of ILK in DRR and disaster resilience is overromanticized, and its validity is not examined. We tried to triangulate some of the ILK-

informed EWs against two other knowledge types: in relation to the onset of a particular cyclone disaster event (i.e., Sidr), and against established scientific explanations of pertinent phenomena[i]. The most common and widely reported local cyclone EW feature is the direction and rotation of blowing wind. Wind from the southeast or east (*pubal batas*) pushes water surges toward the locality (Table 2.1, iv (a)), whereas wind from the southwest or west causes surges to recede (Table 2.1, iv (d)). Community members repeatedly reported that prior to the landfall of Cyclone Sidr, an easterly wind (*pubal batas*) was blowing for about 24 h, and continued until the water surge receded: "During Sidr, *pubal batas* was blowing, as soon as wind started moving to west then water started to retreat. We start to worry when *pubal batas* blows because it increases water [as storm surge]." People also reported that a few days before the landfall of Cyclone Sidr, the weather remained hot and humid (Table 2.1, ii (b)). Often people draw inferences combining multiple dimensions. For example, fishermen observed a change in the behavior of Churi (*Eupleurogrammus muticus*) and Loittia (*Harpadon nehereus*) fish, accompanied by a change in color and temperature of the ocean surface (Table 2.1), whereupon they attempted to return to shore ahead of the impending storm.

Table 2.1: Dimensions of LK and EW to reduce the risk of coastal cyclones and storm surges

Dimensions of LK	LK as EW signs and signals
i) Ecological (non-human behavior)	a. Ants stay together and climb to higher places b. Leafs of *Mantha* tree get curled c. Cows start starvation d. Seabirds and ducks start moving toward the shore** e. Churi (*Eupleurogrammus muticus)* and Loittia fish (*Harpadon nehereus)* start moving and jumping quickly in the sea*** f. Mosquitoes stick into the body of cows and goats g. Flying insects are less visible at night. They seem to be in a rush. h. *Guyalla* birds fly out to sea i. Livestock such as ducks and hens become reluctant to enter their shelters j. Small black birds start flying over the sea
ii) Phenomenological (feeling and anticipation	a. Elders sense an impending disaster based on past experience and memory **

Dimensions of LK	LK as EW signs and signals
of a probable disaster from past memory)	b. Unbearably hot and humid weather for several days
iii) Sea/riverine (behavior and observation of river and sea)	a. Change in the color of seawater ** b. Warm seawater ** c. Water whirls and more vapors in the sea surface air d. Unusual patterns of water movement and flow in the sea e. Sea becomes darker f. Elevated water levels in the adjacent rivers
iv) Meteorological (related to wind movement, cloud, and temperature)	a. Wind from the south-east or east (locally known as *Eshan Kun* or *pubal* wind*)* brings water surges *** b. Hot and humid weather brings bad weather c. Wind from the west brings rain** d. Wind from the south-west is followed by recession of surge water *** e. When *juba* (high spring tide) combines with an easterly wind
v) celestial (condition of sky and moon)	a. Lunar day and month and associated high and low tides *** b. Lightning in the north/ north-east means strong wind and floods (this gives 10-12 hours of warning) ** c. Lightning in the south-west means only rain d. If there is no thunder and lightning and if weather becomes silent (*gombir*) then there is the possibility of storm e. Lightning during the onset of storm reduces its intensity
vi) Official (i.e. information received by external institutions, electronic and print media)	a. Warning signals from radio, TV, and mobile phones ** b. Calls from family members and relatives c. Warning signals received from CPP (Cyclone Preparedness Program) volunteers
*** Most widely reported by community people ** Moderately reported	

Source: Field data, 2018

People in coastal Bangladesh often triangulate their own observations with cyclone EWs from official sources (e.g., Bangladesh Meteorological Department) and take measures to reduce risk from the potential cyclone's impact. One elder explained that Signal Numbers One, Two, and Three from official sources are "normal" but Signals above Number Seven are considered "dangerous" locally. Explaining the use of multiple sources of EW, one FGD member stated:

> *If the sky gets cloudy and pubal batas* [easterly wind] *blows, we assume that the weather will become bad soon. Then we check radio announcements* [broadcasts] *and use SMS services in mobile for weather information. If we hear Signal Number One, we start sailing toward the shore thinking that it may become worse soon.*

Established scientific evidence matches some of the EW features and signs most widely reported and applied by the local people. Our primary intention here is not to validate ILK with scientific knowledge or to nullify; rather, it is to triangulate ILK from various pertinent sources.

The first sign used by fishers to predict impending cyclones is a significant increase in sea surface temperature (SST). In the scientific literature, the relationship between cyclogenesis and SST is well established, with cyclonic activity generally occurring when the SST exceeds 26°C (Henderson-Sellers et al., 1998; Trenberth, 2005). As the SST increases, the intensity of cyclonic storms is likely to increase as such storms are fueled by water vapor (Khan, Singh, & Rahman, 2000; Kossin, 2017). During the tropical storm Nargis (2008), which eventually made its landfall in Myanmar causing the death of more than 130,000 people, the SST of the Bay of Bengal was recorded to be over 30°C (Maneesha et al., 2012).

Scientific evidence also supports fishers' observation that the color of the sea changes prior to cyclones, as increasing water temperature triggers an increase in phytoplankton, whose pigment in turn absorbs sunlight and further raises the SST (Hernandez, Jouanno, Echevin, & Aumont, 2017; Zhao & Wang, 2018). It must be noted that this relationship may not always be linear due to other intervening variables at different temporal and spatial scales (Dunstan et al., 2018).

The second major sign used by local communities to gauge the onset and intensity of cyclonic storms is wind direction. Specifically, an easterly wind (*pubal batash*) brings storm surges and tidal flooding—a relationship confirmed by meteorological research (Wicks & Atkinson, 2017). A third major sign observed by fishers is the behavior of coastal fish species (e.g., *Eupleurogrammus muticus* and *Harpadon nehereus*) in response to rising SST. Secor et al.

(2019) and Spampinato et al. (2014) observed such a change in the behavior of fish species during tropical cyclones, although they did not specifically link this behavioral change to SST.

The possession and use of different dimensions of ILK within the community is helpful in understanding the interaction between social learning, DRR, and community resilience. We examined how the structural location of individuals shapes the possession of different dimensions of ILK by documenting the structural locations of community members according to occupation, gender, and age. These groups of people were not mutually exclusive and often overlapped (Table 2.2). For example, fishers and farmers are all male and belong to both adult and elderly age groups. Our findings indicate that specific groups hold certain dimensions of ILK more than others (Table 2.2). For example, ecological dimensions were most widely reported by fishers (who are mostly male), whereas the major determinant for reporting the phenomenological dimension (i.e., SM) was age and experience (both male and female). Persons above 50 years old have experienced past disasters firsthand and acquired knowledge through observation and intergenerational knowledge transfer. Fishers' direct interactions with the sea and rivers made them the major holders of the sea/riverine ILK dimension. Meteorological and celestial dimensions are not influenced significantly by structural locations. Fishers, males, and adults (below 50 years) tend to look for EWs from official sources more than females. Such variation of ILK within the community in terms of structural locations and other determinants validates the importance of social learning processes for community resilience being system-wide (i.e., community) learning (Berkes 2007, Pahl-Wostl 2009).

Table 2.2: Possession of various dimensions of LK by different groups of people

		Ecological	Phenomenological	Sea/Riverine	Meteorological	Celestial	Official
Occupational group	Fishers	***	**	***	***	***	***
	Farmers	*	*	*	***	**	*
	Others	*	--	--	*	**	**
Gender	Male	***	***	***	***	***	***
	Female	--	**	--	***	**	*

		Ecological	Phenomenological	Sea/Riverine	Meteorological	Celestial	Official
Age group (in years)	Below 50	**	--	***	***	**	***
	Above 50	**	***	**	***	***	*
*** most widely reported							
** moderately reported							
* less frequently reported							

2.4.2 Interplay Between Indigenous and Local Knowledge and Social Memory in Shaping Resilience

 A key question that arises from the preceding section is: why do community people suffer from loss and damage despite possessing rich ILK? We posit that responses and resilience strategies in the face of NTEE and disasters are largely shaped by the state of SM, which is a necessary condition for translating knowledge into action (Fig. 2.1). Here, we elaborate our points through an examination of the interplay between SM and ILK in two temporal phases: pre-Cyclone Sidr memory and its impact during the cyclone itself, and the current state of Cyclone Sidr memory and its role in later events.

2.4.2.1 Pre-Sidr Memory, Indigenous and Local Knowledge, and Resilience

 We have documented four interrelated factors that made Cyclone Sidr a surprise for most of the communities, despite their receiving EWs from multiple sources, including government agencies [e.g., volunteers from the Cyclone Preparedness Program (CPP), relatives, and neighbors]. The first factor is the absence of SM of cyclonic disasters. The last major cyclone disaster before Sidr in 2007 was Cyclone Bhola in 1970. The 37-year gap left most community members with no fresh memories of the previous disaster, leading many to not take EWs obtained from ILK or government agencies seriously. Focus group discussion members explained why they were not able to apply their knowledge during Sidr:

> *No one here* [present for FGD] *witnessed any event like that before. Probably only one had such an experience. Then how could we know that? ... Sidr started in the late*

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afternoon; we did not realize that can actually happen. Elders used to say about floods, but we did not experience anything like that before...

The second factor is the nonlinearity of cyclonic events. Before Sidr, some people had memories of storms (locally called *dabar*) and their associated ocean-water surges, but few had experienced severe cyclones and the associated storm-surge-induced flooding (see Brammer, 1990). Monsoon flooding normally occurs slowly enough to allow time to prepare for its arrival, but the onset of a cyclone-induced storm surge is much faster than rainwater or riparian flooding. People in the studied communities had experienced floods in 1972 and in 1988, but nothing similar to the scale of Cyclone Sidr. As one participant stated:

In case of past floods, it took 2 to 3 days for flood water to rise to 6 to 7 feet, or a maximum 10 feet. During Sidr, water came and receded within a half an hour; it washed away everything within just blink of eyes ... we did not experience anything like Sidr before ... we could not imagine the magnitude of the event.

Positive SM is likely to trigger responses necessary for reducing risks and building resilience, whereas negative SM can have the opposite effect, making people reluctant to take action. One source of negative SM is people's false confidence in structural flood-prevention measures, such as embankments (Fig. 2.3). As no community members had previously seen floodwater encroachment inside the dikes, they assumed such dikes would be able to withstand Cyclone Sidr's surge waters.
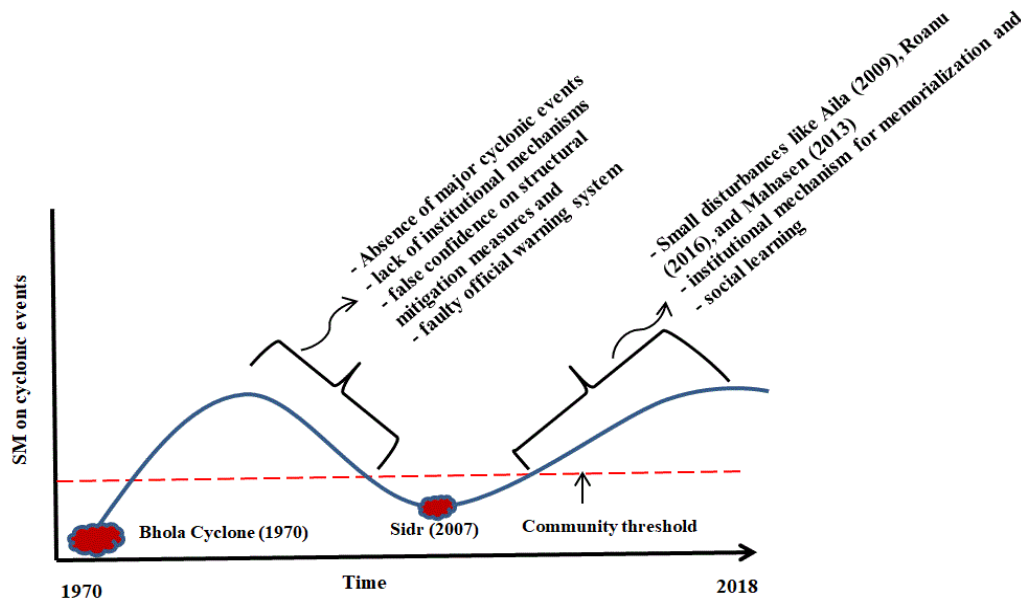
Fig. 2.3: Temporal dimension of SM and resilience implications

Another source of negative SM is feelings of mistrust toward official EW announcements (Fig. 2.3). Before Sidr, people often received false disaster warnings, typically from government agencies. For instance, there was a cautionary tsunami warning along the coastal areas in September 2007 (2 months before Sidr) due to the Sumatra earthquakes and Indian Ocean tsunami, forcing many communities to evacuate. No tsunami arrived, and subsequent warnings about Cyclone Sidr were widely ignored. A respondent noted:

> *We used to ignore early warnings because nothing happened after reception of cyclone warnings; therefore, we did not trust early warning announcements. We did not believe that Sidr would actually happen.*

In addition to the absence of positive SM and the presence of negative SM, Sidr came as a surprise to many communities because the celestial dimension of ILK was unable to predict the danger of a storm surge. Locals in these areas use lunar phases to predict the tides, with the term *Juba* used to denote high water levels (high spring tides) and *Dala* to denote low water levels (low spring tides) (see Fig. S 2.1 in Supplementary Material). As Cyclone Sidr struck during *Dala* and low tide, locals did not anticipate a storm surge over 15 feet in height was possible.

In contrast, the presence of positive SM in combination with ILK can make a significant difference in terms of DRR and resilience. We found that, in coastal Bangladesh, community elders, for whom Cyclone Sidr was not a novel event, held primarily positive SM. An elder lamented that, "I told everyone that if *pubal batash* [easterly wind] does not weaken within 24 h, there will be a storm surge and flood. No one believed me." In some cases, however, the memories of the elders, combined with EWs from ILK and government agencies facilitated the undertaking of DRR actions before the onset of the cyclone.

Drawing on their SM and ILK, elderly members could foresee impending risks and potential disaster and help younger community members avoid property damage and loss of life. One young adult respondent (age 35) stated that, "[m]y father warned us about a probable storm surge and flood; he asked us to take shelter and store some rice in a safer place."

2.4.2.2 Memory and Learning from Sidr for Later Events

After Cyclone Sidr in 2007, EWs were issued prior to Cyclones Aila (2009), Mahasen (2013), Komen (2015), Roanu (2016), and Mora (2017). During those events, locals took official government EWs more seriously and more willingly undertook measures, such as evacuation, to

reduce risks. Some of the survivors of Cyclone Sidr recounted how narrowly they escaped injury or death, the actions they took to cope with the immediate impact of the cyclone as it made landfall (e.g., climbing big trees, grabbing big plastic containers, and rushing to the embankment for safety), and their ignorance of the potential severity of the storm prior to its arrival.

Many community members have since embraced the lessons learned from Cyclone Sidr (Table 2.3). For example, a large proportion now immediately rushes to cyclone shelters upon receipt of government EW. However, since there have been no cyclones on the scale of Sidr since 2007, memory of catastrophic disaster experience has been gradually eroding, and people are becoming more reluctant to evacuate to shelters. As one key informant observed that the number of people who immediately flee to shelters was much higher in the years immediately following Sidr compared with the time of the study (2018):

> *We received early warning during Sidr, but we could not realize the severity as we did not experience anything like that in recent past. We take shelter now if we receive the early warning. During Mahasen and Aila, most people left their houses for safety. After Sidr, people began to take warnings more seriously, which they did not do before. People did not understand and used to ignore early warnings before...*

Table 2.3: Learning, coping and adaptation practices in study communities

Dimensions	Specific learning
Coping	1. Taking shelter either on the embankment or in cyclone shelters or preparing to evacuate entirely 2. Returning from the sea upon receiving EW 3. Taking measures to save property and valuable goods before evacuating 4. Preparing to take shelter in a neighbor's house with a stronger structure 5. Keeping locally available materials (e.g. bamboo trees and big plastic containers) ready to cope with coastal flooding
Adaptation	1. Raising house platforms 2. Moving houses away from the riverbank or seashore and close to or inside the embankment 3. Learning that children, (especially pregnant) women, the elderly, and

Dimensions	Specific learning
	people with disabilities are more vulnerable and require priority aid
	4. Building houses with a stronger structure

2.4.3 Community-Based Institutions, Memorialization, and Social Learning

This section focuses on the role of socially embedded practices and other local institutions (e.g., local media) in facilitating social learning and the memorialization process (the third level in Fig. 2.1). One important mechanism for social learning embedded in rural Bangladeshi culture is the *adda* (hanging around), an informal platform for sharing personal experiences. The location of *adda* varies for men and women, with men typically gathering in village marketplaces to socialize over a cup of tea and women gathering in a courtyard. Information gathered is then shared with the rest of the participants' families.

In these informal sharing platforms, community members shared their memories of survival during Cyclone Sidr and drew lessons from each other's experiences. One key lesson was how to recognize existing risks and take them more seriously. Stories related to survival and death matched with elders' advice and knowledge (e.g., not to panic and rush or try to evacuate during the onset of the storm surge). During our field research, Cyclone Titli (2018) was forming in the Bay of Bengal. The resulting atmospheric depression generated continuous rainfall, during which many community members gathered in local tea-shops to hold *adda* and discuss their previous experiences with severe weather. *Adda* thus functions as an important and effective mechanism for replenishing SM.

Local institutions, such as the Bangladesh Red Crescent Society (local unit), local press clubs, and other community-based organizations play a critical role in social learning and the memorialization process. For example, the local press club in the study area organizes a memorial event to remember Cyclone Sidr on every 15 November; they organize rallies, show videos of Sidr, and hold group discussions. A memorial to the disaster was also built in a local cemetery, and local newspapers publish feature articles on Cyclone Sidr every year (Fig. 2.4).

Fig. 2.4: Observing Sidr Day on November, 15 by the Bangladesh Red Crescent Society, Barguna Unit (4.a), and Barguna Press Club (4.b). Photo courtesy: Barguna Press Club

2.4.4 Formal Institutions, Denial of Indigenous and Local Knowledge, and Processes of Making Resilient Subjects

In Bangladesh, there has been a major institutional shift regarding disaster management in recent decades, with many disaster management initiatives being decentralized and handed over to local institutions, especially through partnering with NGOs (Choudhury, Uddin, & Haque, 2019; Haque & Uddin, 2013). This process is driven by an increased focus on local resilience in the national policy discourse, which is reflected in the National Plan for Disaster Management (2016–2020): *Building Resilience for Sustainable Human Development* (Ministry of Disaster Management and Relief (MoDMR, 2017). In addition, international donor agencies have implemented numerous large projects for building resilience, such as the National Resilience Program (US$2.25 M) run by the United Nations Development Program. Local-level disaster management institutions, such as NGOs, have been implementing community-based disaster resilience projects, where the notion of resilience has been predefined by policy makers and external donor agencies (Fig. 2.5*a, b*).

Fig. **2.5:** Billboard of the project on disaster resilience (a); a community training session - flag numbers and EW signals (b). Photo courtesy: CODEC.

Local-level NGOs implementing disaster resilience projects consider NTEE and associated disasters to be a technical, financial, and biological problem. With a predetermined framework, their fundamental intention in reducing risks and building disaster resilience is to train people in strategies and techniques that can help save "biological lives." Interventions by NGOs here reflect the government's biopolitical agenda: the national government frequently presents itself as a success story, stating that it succeeded in significantly reducing NTEE-related fatalities through institutional interventions (Paul, 2009). As Marchezini (2015) argues, state agencies often create a false sense of optimism via these claims, and distract attention from the actual needs of locals.

In the study area, in line with biopolitical rationalities, local NGOs have created social learning platforms where ILK, memory, beliefs, and practices are largely ignored. As well, people are treated as objects of scientific and expert knowledge and subjected to externally defined notions of resilience, as subjects assumed to be vulnerable and deficient in their ability to cope with shocks associated with coastal cyclones. Resilience to coastal cyclones therefore implies local people understanding and internalizing the meaning of the official EW signs and signals and responding to them in a preordained manner, e.g., by evacuating to a cyclone shelter. Nongovernmental organizations inform people through official EW systems (Fig. 2.5 *b*), which were originally established during the British colonial period for seaports (Roy, 2012). The Bangladesh Meteorological Department continues to generate EWs and associated signals for sea and river ports, which are provided to volunteers of the Cyclone Preparedness Program to be

disseminated to local communities via the Department of Disaster Management. Nongovernmental organizations also train people on preparedness, risk reduction, and post-disaster recovery strategies (Fig. 2.5 *a, b*).

We observed three interrelated factors that facilitate this top-down learning mechanism and subject-making process. First, the absence of pre-Sidr cyclone memories and traumatic memories of the Cyclone Sidr disaster have created an opportunity (i.e., "problem space") for formal institutions to intervene in people's lives. Before Sidr, there were no or merely nominal intervention programs or projects on DRR and resilience. The preceding discussion highlights that young and adult people had no cyclone disaster memory prior to Sidr, which contributed to their traumatic experience of Sidr. Education programs by NGOs on DRR and resilience appeared to be attractive for these local community members in the absence of positive SM.

In the study area, all of the six surveyed NGOs have adopted a community-based and participatory method to implement projects for DRR and enhancing resilience, as defined by the formal institutions, to cyclones and storm surges so that people can cope and adapt to surprises, shocks, and catastrophes. Initially, NGOs (e.g., Nazrul Smriti Sangsad (NSS), Community Development Centre (CODEC), and JAGO NARI) formulated community-based organizations (CBOs) comprised primarily of young and adult men and women. Through these CBOs, monthly courtyard meetings with women were organized where they discussed disaster preparedness along with other social issues, such as health, hygiene, domestic violence, and child marriage. With male CBO members, NGOs provided training, with supporting technical manuals, on evacuation, rescue, and first aid, and conducted scenario exercises such as mock drilling. A respondent stated that:

> *They* [the NGOs] *came after Sidr and taught us how to tackle disasters. ... They told us that we have to keep our eyes open for any surprising extreme events that may stem from natural or other forces. ... If early warning signal moves up to number 10, as we become aware* [prepare], *we can reduce loss and damage. ... We learned from Climate-Resilient Ecosystems and Livelihoods (CREL) Project.*

Second, people feel motivated to participate in NGO projects and social learning platforms as they expect some material gain from their participation. As most NGOs work with so-called "hard-core" poor, disaster resilience projects are often paired with health and livelihood-building initiatives (e.g., providing sewing machines, cash, or materials to install a tube well or toilet). We

observed evidence of some people's strategic participation in NGO-led learning platforms primarily for material gain as way to address poverty-related suffering and supplement income, which can be regarded as the "hidden script" of such participation. Community members who did not receive any material incentives from NGOs tended to withdraw from the learning platforms. One woman explained: "[t]hey gave [sewing machine] to others. I went to their office for training for 3 years but did not get one ... this is why I do not take part anymore." A male responded similarly:

> I took training with Caritas [an NGO] for 3 years, but I did not get any benefit from them. When they donated goats and other things, they did not give them to me ... at the end I withdrew myself.

Third, we observed that the predesigned frameworks of most NGOs did not allow elders a space in the social learning process, leading to their knowledge and memory being systematically excluded. An elderly respondent stated: "I am old, why would they call me? ... They want young, who can walk or travel to go for training in Amtali and Patuakhali, and Barisal [at distant locations]. They recruit mostly young people, and do not consider the elderly at all." Because the institutions hold power and draw authority from technical-expert knowledge, exclusion of ILK from their social learning processes is common, whereas, in the local context, ILK is the more valid form of knowledge. Through these types of practices, local organizations were seen to function with a preset structure to include and exclude various community people.

Explicit exclusion of ILK has been registered not only from the social learning processes, but also in local DRR and management decision making. As part of decentralization and localization of disaster management, the local governmental institutions at the Union Parishad (UP) level—the lowest level of the administrative hierarchy—are responsible for planning, including evacuation and response plans and DRR program implementation. In the study area, the UPs formed disaster management committees, called Union-Parishad Disaster Management Committees (UMDC) to carry out these activities. None of the UMDC members were elders, nor have they been consulted in the formal processes. The UMDCs consisted mostly of local elites and representatives from different professional groups who collaborated with NGOs to implement planning and training activities. An examination of training manuals and planning documents revealed the total absence of ILK and SM in them. A representative from an NGO explained:

While working with UP and UDMC, we mostly work with the guidelines provided by the national and district level administration and, when needed, consult with the local elites as representatives from the community. However, as community members trust us, in some exceptional cases, we consult with community members at the grass-root level.

During fieldwork we observed that, through a community-based participatory approach, NGOs sometimes attempt to incorporate local needs and knowledge in the disaster planning and response process. For example, prior to preparing local risk and resources mapping, an NGO (NSS) organized FGD meetings with community people. In the deliberations, people identified the usual timing of NTEE, including saline water intrusion during the winter season (December–February) and cyclones and storm surges during the monsoon (April and November). Indigenous and local knowledge thus received some attention and was being incorporate into such planning. In addition, in the participatory learning platforms, NGO workers collected information and knowledge of local people's (traumatic) memory of cyclones and storm surges to lay the groundwork for disseminating scientific–technocratic knowledge on EW and textbook ideas of preparedness.

Our research findings reveal that community people can generate EWs from various dimensions of ILK to reduce risk of loss and damage and enhance resilience to coastal cyclones. However, in formal social learning processes, such forms of knowledge are generally subjugated to a scientific–technocratic form of knowledge on EW, preparedness, and evacuation. Therefore, community members were being taught only the meanings of official EW signs and signals. In the absence of prior positive SM and with prevailing traumatic SM of Sidr, scientific–technocratic forms of knowledge appeared attractive to young and middle-aged participants.

The key to translating knowledge into action for building resilience is the presence of positive SM, which is mostly held by elders. Moreover, elders successfully combined official warnings with ILK to generate their own EWs, and those who listened to them were able to avoid loss and damage. Because the social learning platforms systematically exclude elders, important dimensions of ILK, positive SM to translate this knowledge into action, and elders' capacity for integrating scientific–technocratic knowledge with ILK are frequently excluded as well. People therefore are likely to ignore EWs from official sources (as discussed earlier) and from ILK, and suffer losses and damages as a result. Thus, the imposition of scientific–

technocratic knowledge and subjugation of ILK by community-based resilience programming may in many cases enhance vulnerability rather than resilience.

2.5 Discussion and Conclusion

The fundamental linkage between social learning and community resilience to NTEE and associated disasters was our point of entry into this investigation. We took a critical stance on the programmatic intervention of community resilience and social learning and argued that local knowledge, beliefs, practices, and SM are crucial elements in the social learning process for building community resilience to NTEEs and disasters. Our findings are novel in three respects: (i) alternative possibilities for and local notions of resilience are undermined when ILK is unevenly folded into programmatic interventions for social learning and resilience building, which can paradoxically make communities more vulnerable to environmental extremes; (ii) by combining various dimensions of ILK with SM and official warnings and information, local knowledge holders can successfully generate accurate EWs to reduce risks due to cyclones; and (iii) the asymmetrical distribution of ILK in terms of occupation, gender, and age across communities highlights the value of social learning for system-wide (i.e., community) learning and building community resilience to NTEEs.

These findings have serious implications for the development and implementation of future strategies for reducing the increasing risks posed by climate-change-induced hydrometeorological extreme events like tropical cyclones (Marsooli, Lin, Emanuel, & Feng, 2019; Uriarte, Thompson, & Zimmerman, 2019; Woodruff, Irish, & Camargo, 2013). To cite some recent examples, Hurricane Harvey in the southern United States of America brought with it unprecedented volumes of rainwater for which most communities were not prepared, and the later Category 5 Hurricane Irma lasted far longer than any storm of its size in history (Rahmstorf, 2017). We found that community people have rich stocks of ILK that help in generating EWs to reduce disaster risks and build resilience to coastal cyclones. However, climate-induced shocks could still appear as a surprise for community people. Cyclone Sidr struck as a surprise to many coastal communities as they were unable to predict the storm surge danger with the celestial ILK dimension. Some studies, however, suggest that some communities are capable of adapting well to climate extremes that surpass the parameters predicted by IPCC scenario-building models (Nyong, Adesina, & Osman Elasha, 2007), whereas other communities are struggling to adapt with their ILK (Kagunyu, Wandibba, & Wanjohi, 2016; Lebel, 2013). In this regard, several

authors rightly argue for collaborative knowledge production for building resilience and facilitating effective disaster management (Rodela & Swartling, 2019; Sitas et al., 2016; Srivastava, 2012). By integrating ILK with scientific knowledge to formulate and disseminate EWs, the risks posed by climate-induced disaster shocks can be substantially reduced (Fig. 2.6).
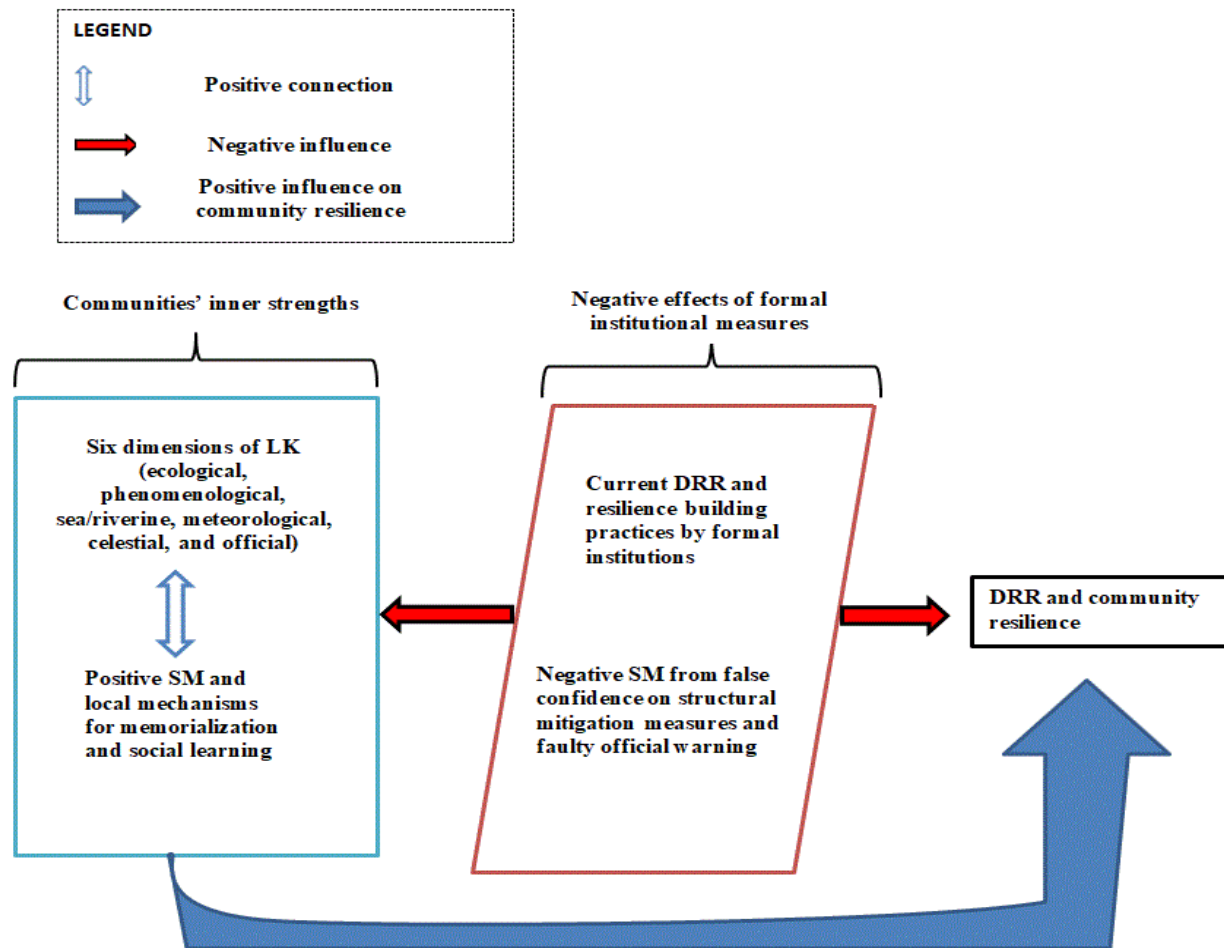
Fig. 2.6: Interconnections between communities' inner strengths and formal institutional measures, and their effects upon DRR and community resilience

The problem of ILK and technical–scientific knowledge integration raises some critical questions: how can this potential integration take place, and what are the power–knowledge dynamics within an institutional context that in turn shape social learning processes and resilience outcomes? Most proposals and efforts have hitherto sought to integrate ILK with scientific knowledge via community-based participatory approaches (Tran & Rodela, 2019). Nadasdy (1999, 2005), however, cautions regarding integration process where ILK is unevenly

folded into formal institutional practices, and as a consequence, efforts to build and/or enhance resilience through community-based interventions may have the unintended consequence of eroding rather than enhancing resilience. Our study demonstrates that NGOs tend to consider ILK in community-based resilience programming in some cases merely to lay the groundwork for disseminating scientific–technocratic knowledge on EW and preparedness.

It can, therefore, be argued that the goal of social learning processes should be to nurture and build upon local strengths for developing communities' own conceptualization and components of resilience. In this regard, Berkes and Folke (1998) argue that a resilient system has inbuilt "social mechanisms" based on local knowledge that act as buffers against disturbances and maintain community resilience. Rather than solely relying on conventional interventionist strategies, the goal should be to recognize the power of human agency, dignity, and capability at the local level, and to provide and cogenerate the resources necessary so that communities can make their own choices for building and enhancing resilience (Kevin and Jonathan 2015, Evans and Reid 2014). Our study in coastal Bangladesh provides evidence that the local community have adopted modern technologies and knowledge in their own way to generate EWs to coastal cyclones. Hilhorst et al. (2015) have similarly found that indigenous people proactively adopt modern technologies to adapt with changing circumstances.

Although social learning is a process of collaborative knowledge production, and the knowledge produced through these processes shapes resilience pathways (Barrios 2016, Boyd et al. 2014), state agencies and formal institutions (e.g., NGOs) are increasingly taking unilateral, interventionist approaches to enhancing resilience to natural hazards (Grove 2013a). Our critical stance on the role of formal institutions in the social learning process highlights the empirical evidence that formal institutions do not recognize the significance of ILK, and therefore operate on the basis of predesigned resilience frameworks defined by nonlocals and external policy makers (Fig. 6). Indigenous and local knowledge is thus excluded from programmatic social learning processes, leading to the subjugation of local community members to externally defined conceptions of resilience and consequently reducing learning from such events to biopolitical rationalities (Hofmann, 2014). Furthermore, because these social learning platforms systematically exclude elders and other local sources of ILK, key dimensions of ILK and the positive SM necessary for translating knowledge into action are excluded too. Due to this lack of cogenerated knowledge and reliable information, people are likely to ignore EWs from official

sources and from ILK, and consequently suffer loss and damage. The imposition of scientific–technocratic knowledge and subjugation of ILK by neoliberal community-based resilience programming may enhance vulnerability rather than building communities' inner strengths and capabilities.

The relationship between ILK and SM is often not clearly delineated. Most studies on DRR and resilience either address ILK or SM separately or only mention one in relation to the other (cf. Garde-Hansen, McEwen, Holmes, & Jones, 2017; Moreno, Lara, & Torres, 2019; Setten & Lein, 2019). Our detailed examination of ILK and SM emphasizes that SM is a necessary condition for translating knowledge into action (Fig. 2.6). We also observed that community members' responses to disaster risks are shaped by the nature of their SM, despite having a rich stock of ILK. Such gaps are also known as the "temporal variability in hazardscapes" (de Vries, 2011). Madsen and Mullan (2013) argue that as NTEEs and disasters are episodic events, each event is remembered and considered as an isolated event rather than as part of a larger trend. In our study communities, people were familiar with gusty winds and monsoon rain but they had no prior SM of severe cyclones and associated storm-surge-induced flooding, and therefore, the impacts of Cyclone Sidr were a complete surprise for most communities. This resonates with Berkes and Ross's (2013) observation that the attributes of community resilience tend to differ depending on the types of shocks experienced (e.g., floods or wildfire). However, the presence of positive SM (mostly held by elders) made a significant difference in terms of risk reduction and resilience, which has also been documented in other contexts (e.g., Berkes, 2007; Osterhoudt, 2018) (Fig. 2.6).

In this article, we attempted to integrate scholarship on social learning, community resilience, and ILK, and address the issue of gaps between the community resilience literature and some of its social science critics (cf. Grove 2014*b*, 2014*a*, Hill and Larner 2017). Regarding the former, we found that using ILK as the point of convergence between the social learning and the community resilience literature helps to substantially improve our understanding of actual social learning and resilience building processes. Regarding the engagement of critical social theories with the current community resilience literature, we hold that the former present a similar argument, i.e., in building resilience the focus should be on building upon a community's strengths rather than simply correcting its perceived weaknesses. Further efforts are required for bridging these literatures, including critical engagement and interaction, dialog and deliberation,

and integration and knowledge cogeneration, as one anonymous reviewer succinctly states that, at present the "two strands of literature ... often talk past each other," and this needs to be transformed into "meaningful interaction."

In this article, we limited our investigation to whether the established, formal institutions consider local voices, learning, ILK, and SM in social learning processes, and whether these processes are characterized mostly by a top-down structure. There is also a need to investigate the synergies among learning at different institutional levels and mechanisms for scaling-up learning from community and lower level institutions to higher level institutions. Although we specifically focused on the role of social learning in shaping community resilience and the role of locals as active agents in such learning processes, further research needs to be carried out on how other forms of learning (e.g., transformative learning) function to shape community resilience. Further research on how worldviews, beliefs, values, and other cultural factors shape learning and resilience building processes is also needed. Specifically, the views, meanings, and interpretations of community people concerning resilience to NTEEs and disasters and the roles they can play in the coproduction of pertinent knowledge need further attention. As an anonymous reviewer appropriately suggested, "it is important to consider potential tensions or clashes in attitudes and knowledge among [heterogeneous] indigenous people and inequities within local power structures" in the analysis of efforts to integrate ILK and scientific knowledge. We agree that such diversities and complexities should not be overlooked, but rather demand   in-depth   examination

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i We triangulated some of the ILK-informed EWs against established scientific explanations of pertinent phenomena and in relation to the onset of a particular cyclone disaster event (i.e., Sidr).

References

Acharya, A., & Prakash, A. (2019). When the river talks to its people: local knowledge-based flood forecasting in Gandak River basin, India. *Environmental Development*, *31*, 55–67. https://doi.org/10.1016/j.envdev.2018.12.003

Adger, W. N., Hughes, T. P., Folke, C., Carpenter, S. R., & Rockstrom, J. (2005). Social-ecological resilience to coastal disasters. *Science*, *309*(1036), 1036–1039. https://doi.org/10.1126/science.1112122

Adger, W. N., Benjaminsen, T. A., Brown, K., & Svarstad, H. (2001). Advancing a political ecology of global environmental discourses. *Development and Change*, *32*(4), 681–715. https://doi.org/10.1111/1467-7660.00222

Agrawal, A. (2005). Environmentality: community, intimate government, and the making of environmental subjects in Kumaon, India. *Current Anthropology*, *46*(2), 161–190. https://doi.org/10.1086/427122

Armitage, D., Marschke, M., & Plummer, R. (2008). Adaptive co-management and the paradox of learning. *Global Environmental Change*, *18*(1), 86–98. https://doi.org/10.1016/j.gloenvcha.2007.07.002

Baird, J., Plummer, R., Haug, C., & Huitema, D. (2014). Learning effects of interactive decision-making processes for climate change adaptation. *Global Environmental Change*, *27*(1), 51–63. https://doi.org/10.1016/j.gloenvcha.2014.04.019

Barrios, R. E. (2016). Resilience: a commentary from the vantage point of anthropology. *Annals of Anthropological Practice*, *40*(1), 28–38. https://doi.org/10.1111/napa.12085

Beilin, R., & Wilkinson, C. (2015). Introduction: governing for urban resilience. *Urban Studies*, *52*(7), 1205–1217. https://doi.org/10.1177/0042098015574955

Berkes, F. (2018). *Sacred Ecology* (4th ed.). Routledge. https://doi.org/10.4324/9781315114644

Berkes, F., & Ross, H. (2013). Community resilience: toward an integrated approach. *Society and Natural Resources*, *26*(1), 5–20. https://doi.org/10.1080/08941920.2012.736605

Berkes, F. (2007). Understanding uncertainty and reducing vulnerability: lessons from resilience thinking. *Natural Hazards*, *41*(2), 283–295. https://doi.org/10.1007/s11069-006-9036-7

Berkes, F., & Folke, C. (2002). Back to the future: ecosystem dynamics and local knowledge. In L. Gunderson & C. S. Holling (Eds.), *Panarchy: Undestanding transformations in human*

and natural systems (pp. 121–146). Island press.

Berkes, F., & Folke, C. (1998). Linking social and ecological systems for resilience and sustainability. In F. Berkes & Carl Folke (Eds.). *Linking social and ecological systems: Management practices and social mechanisms for building resilience.* (pp.13–20). Cambridge University Press.

Bockstael, E. (2017). Critical capacity development: an action research approach in coastal Brazil. *World Development*, *94*, 336–345. https://doi.org/10.1016/j.worlddev.2017.01.017

Boillat, S., & Berkes, F. (2013). Perception and interpretation of climate change among Quechua Farmers of Bolivia. *Ecology & Society*, *18*(4), 21. https://doi.org/10.5751/ES-05894-180421

Bonilla, Y. (2020). The coloniality of disaster: race, empire, and the temporal logics of emergency in Puerto Rico, USA. *Political Geography*, *78*, 102181. https://doi.org/10.1016/j.polgeo.2020.102181

Boyd, E., Ensor, J., Broto, V. C., & Juhola, S. (2014). Environmentalities of urban climate governance in Maputo, Mozambique. *Global Environmental Change*, *26*(1), 140–151. https://doi.org/10.1016/j.gloenvcha.2014.03.012

Brammer, H. (1990). Floods in Bangladesh : geographical background to the 1987 and 1988 floods. *The Geographical Journal*, *156*(1), 12–22.

Briggs, J., & Sharp, J. (2004). Indigenous knowledges and development: a postcolonial caution. *Third World Quarterly*, *25*(4), 661–676. https://doi.org/10.1080/01436590410001678915

Brown, K. (2016). *Resilience, development and global change*. Routledge. https://doi.org/10.4324/9780203498095

Brown, K., & Westaway, E. (2011). Agency, capacity, and resilience to environmental change: lessons from human development, well-being, and disasters. *Annual Review of Environment and Resources*, *36*(1), 321–342. https://doi.org/10.1146/annurev-environ-052610-092905

Bulley, D. (2013). Producing and governing community (through) resilience. *Politics*, *33*(4), 265–275. https://doi.org/10.1111/1467-9256.12025

Cannon, T., & Müller-Mahn, D. (2010). Vulnerability, resilience and development discourses in context of climate change. *Natural Hazards*, *55*(3), 621–635. https://doi.org/10.1007/s11069-010-9499-4

Carr, E. R. (2019). Properties and projects: reconciling resilience and transformation for adaptation and development. *World Development*, *122*, 70–84.

https://doi.org/10.1016/j.worlddev.2019.05.011

Chandler, D. (2019). Resilience and the end(s) of the politics of adaptation. *Resilience:International Policies, Practices and Discourses*, *7*(3), 1–10. https://doi.org/10.1080/21693293.2019.1605660

Chandler, D. (2018). *Ontopolitics in the anthropocene:an introduction to mapping, sensing and hacking*. Routledge. https://doi.org/10.4324/9780203703434

Choudhury, M-U-I, Uddin, M. S., & Haque, C. E. (2019). "Nature brings us extreme events, some people cause us prolonged sufferings": the role of good governance in building community resilience to natural disasters in Bangladesh. *Journal of Environmental Planning and Management*, *62*(10), 1761–1781. https://doi.org/10.1080/09640568.2018.1513833

Choudhury, M-U-I., & Haque, C. E. (2016). "We are more scared of the power elites than the floods": adaptive capacity and resilience of wetland community to flash flood disasters in Bangladesh. *International Journal of Disaster Risk Reduction*, *19*, 145–158. https://doi.org/10.1016/j.ijdrr.2016.08.004

Christensen, L., & Krogman, N. (2012). Social thresholds and their translation into social-ecological management practices. *Ecology and Society*, *17*(1):5. https://doi.org/10.5751/ES-04499-170105

Cleaver, F. (2007). Understanding agency in collective action. *Journal of Human Development*, *8*(2), 223–244. https://doi.org/10.1080/14649880701371067

Collier, S. J. (2009). Topologies of power: Foucault's analysis of political government beyond 'governmentality.' *Theory, Culture & Society*, *26*(6), 78–108. https://doi.org/10.1177/0263276409347694

Cote, M., & Nightingale, A. J. (2011). Resilience thinking meets social theory: situating social change in socio-ecological systems (SES) research. *Progress in Human Geography*, *36*(4), 475–489. https://doi.org/10.1177/0309132511425708

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). Sage. https://doi.org/10.1007/s13398-014-0173-7.2

Creswell, J. W. (2013). *Qualitative inquiry and research design: choosing among five approaches* (3rd ed.). Sage.

Creswell, J. W., (2007). *Qualitative inquiry and research design: choosing among five approaches.* (1st ed.). Sage.

Cretney, R. (2014). Resilience for whom? Emerging critical geographies of socio-ecological resilience. *Geography Compass*, *8*(9), 627–640. https://doi.org/10.1111/gec3.12154

Cutter, S. L., Barnes, L., Berry, M., Burton, C., Evans, E., Tate, E., & Webb, J. (2008). A place-based model for understanding community resilience to natural disasters. *Global Environmental Change*, *18*(4), 598–606. https://doi.org/10.1016/j.gloenvcha.2008.07.013

de Vries, D. H. (2011). Temporal vulnerability in hazardscapes: flood memory-networks and referentiality along the North Carolina Neuse River (USA). *Global Environmental Change*, *21*(1), 154–164. https://doi.org/10.1016/j.gloenvcha.2010.09.006

Dekens, J. (2007). *Local knowledge for disaster preparedness: a literature review*. International Centre for Integrated Mountain Development (ICIMOD). https://www.preventionweb.net/files/2693_icimod8fc84ee621cad6e77e083486ba6f9cdb.pdf

Dunstan, P. K., Foster, S. D., King, E., Risbey, J., O'Kane, T. J., Monselesan, D., Hobday, A. J., Hartog, J. R., & Thompson, P. A. (2018). Global patterns of change and variation in sea surface temperature and chlorophyll a. *Scientific Reports*, *8*(1), 1–9. https://doi.org/10.1038/s41598-018-33057-y

Ensor, J., & Harvey, B. (2015). Social learning and climate change adaptation: evidence for international development practice. *Wiley Interdisciplinary Reviews: Climate Change*, *6*(5), 509–522. https://doi.org/10.1002/wcc.348

Evans, B., & Reid, J. (2014). *Resilient life: The art of living dangerously.* John Wiley & Sons.

Evans, B., & Reid, J. (2013). Dangerously exposed: the life and death of the resilient subject. *Resilience: International Policies, Practices and Discourses*, *1*(2), 83–98. https://doi.org/10.4324/9781315765006

Fabinyi, M., Foale, L. E., J., S., Evans, L., Foale, S. J. S. J., Reflections, C., & Debate, C. (2014). Social-ecological systems, social diversity, and power : insights from anthropology and political ecology. *Ecology and Society*, *19*(4), 28. https://doi.org/10.5751/ES-07029-190428

Faulkner, L., Brown, K., & Quinn, T. (2018). Analyzing community resilience as an emergent property of dynamic social-ecological systems. *Ecology and Society*, *23*(1), 24. https://doi.org/10.5751/ES-09784-230124

Folke, C., Carpenter, S. R., Walker, B., Scheffer, M., Chapin, T., & Rockstrom, J. (2010).

Resilience thinking: integrating resilience, adapatability, and transformability. *Ecology and Society*, *15*(4), 20 . http://www.ecologyandsociety.org/vol15/iss4/art20/.

Folke, C., Hahn, T., Olsson, P., & Norberg, J. (2005). Adaptive governance of social-ecological systems. *Annual Review of Environment and Resources*, *30*(1), 441–473. https://doi.org/10.1146/annurev.energy.30.050504.144511

Folke, C., Colding, J., & Berkes, F. (2003). Synthesis: building resilience and adaptive capacity in social–ecological systems. In F. Berkes, J. Colding, & C. Folke (Eds.), *Navigating social-ecological systems: Building resilience for complexity and change* (pp. 352–387). Cambridge University Press. https://doi.org/10.1017/cbo9780511541957.020

Foucault, M. (1980). Power/knowledge. *in* M. Foucault and S. Mills. (2005). *Routledge critical thinkers essential guides for literary studies.* Routledge. https://doi. org/10.4324/9781003060963-10

Foucault, M. (1978). The history of sexuality. Volume 1. *in* M. Foucault and S. Mills. (2005). *Routledge critical thinkers essential guides for literary studies.* Routledge. https://doi. org/10.4324/9781003060963-10

Gaillard, J. C. (2010). Vulnerability, capacity and resilience: perspectives for climate and development policy. *Journal of International Development*, *22*, 218–232. https://doi.org/10.1002/jid.1675

Garde-Hansen, J., McEwen, L., Holmes, A., & Jones, O. (2017). Sustainable flood memory: remembering as resilience. *Memory Studies*, *10*(4), 384–405. https://doi.org/10.1177/1750698016667453

Gómez-Baggethun, E., Corbera, E., & Reyes-García, V. (2013). Traditional ecological knowledge and global environmental change: research findings and policy implications. *Ecology and Society*, *18*(4). https://doi.org/10.5751/ES-06288-180472

Gómez-Baggethun, E., Reyes-García, V., Olsson, P., & Montes, C. (2012). Traditional ecological knowledge and community resilience to environmental extremes: a case study in Doñana, SW Spain. *Global Environmental Change*, *22*(3), 640–650. https://doi.org/10.1016/j.gloenvcha.2012.02.005

Government of Bangladesh (GoB). (2008). *Cyclone Sidr in Bangladesh: damage, loss, and needs assessment for disaster recovery and reconstruction*. A report prepared by the Government of Bangladesh assisted by the international development community with

financial support from the European Commission.

https://reliefweb.int/sites/reliefweb.int/files/resources/F2FDFF067EF49C8DC12574DC0

0455142-Full_Report.pdf

Grove, K. (2018). *Resilience*. Routledge. https://doi.org/10.4324/9781315661407-3

Grove, K. (2014a). Agency, affect, and the immunological politics of disaster resilience.
Environment and Planning D: Society and Space, *32*(2), 240–256.
https://doi.org/10.1068/d4813

Grove, K. (2014b). Biopolitics and adaptation: governing socio-ecological contingency through
climate change and disaster studies. *Geography Compass*, *8*(3), 198–210.
https://doi.org/10.1111/gec3.12118

Grove, K. (2013a). Hidden transcripts of resilience: power and politics in Jamaican disaster
management. *ResilienceInternational Policies, Practices and Discourses*, *1*(3), 193–209.
https://doi.org/10.1080/21693293.2013.825463

Grove, K. (2013b). On resilience politics: from transformation to subversion.
Resilience:International Policies, Practices and Discourses, *1*(2), 146–153.
https://doi.org/10.1080/21693293.2013.804661

Gunderson, L. (2010). Ecological and human community resilience to natural disasters. *Ecology
and Society*, *15*(2), 18. http://www.ecologyandsociety.org/vol15/iss2/art18

Haque, C. E., Choudhury, M.-U.-I., & Sikder, M. S. (2018). "Events and failures are our only
means for making policy changes": learning in disaster and emergency management
policies in Manitoba, Canada. *Natural Hazards*, *98*(1), 137–162.
https://doi.org/10.1007/s11069-018-3485-7

Haque, C. E., & 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 J. Tiefenbacher (Ed.), *Approaches to examining the
implementations of hazards, emergency and disasters* (pp. 33–54). InTechOpen.
https://doi. org/https://doi.org/10.5772/54973

Henderson-Sellers, A., Zhang, H., Berz, G., Emanuel, K., Gray, W., Landsea, C., … McGuffie,
K. (1998). Tropical cyclones and global climate change: a post-IPCC assessment. *Bulletin
of the American Meteorological Society*, *79*(1), 19–38. https://doi.org/10.1175/1520-
0477(1998)079<0019:TCAGCC>2.0.CO;2

Hernandez, O., Jouanno, J., Echevin, V., & Aumont, O. (2017). Modification of sea surface temperature by chlorophyll concentration in the Atlantic upwelling systems. *Journal of Geophysical Research: Oceans*, *122*, 2647–2651. https://doi.org/10.1002/2016JC012330

Hewer, C. J., & Kut, M. (2010). Historical legacy, social memory and representations of the past within a polish community. *Memory Studies*, *3*(1), 18–32. https://doi.org/10.1177/1750698009348292

Hilhorst, D., Baart, J., Haar, G. van der, & Leeftink, F. M. (2015). Is disaster "normal" for indigenous people? Indigenous knowledge and coping practices. *Disaster Prevention and Management*, *24*(4), 468–483. doi:10.1108/DPM-02-2015-0027

Hill, L. J., & Larner, W. (2017). The resilient subject. In V. Higgins & W. Larner (Eds.), *Assembling neoliberalism: expertise, practices, subjects*. Springer Nature. https://doi.org/10.1057/978-1-137-58204-1

Hofmann, M. (2014). Reduced learning processes due to biopolitical patterns of interpretation: Michel Foucault and the contamination disaster. In H. Egner, M. Schorch, & M. Voss (Eds.), *Learning and calamities: Practices, interpretations, patterns* (1st ed., pp. 253–271). Routledge. https://doi.org/10.4324/9780203794678

Holling, C. S. (2004). From complex region to complex worlds. *Ecology and Society*, *9*(1),11 https://doi.org/10.5751/ES-00612-090111

Hooli, L. J. (2016). Resilience of the poorest: coping strategies and indigenous knowledge of living with the floods in Northern Namibia. *Regional Environmental Change*, *16*(3), 695–707. https://doi.org/10.1007/s10113-015-0782-5

IPCC. (2014). Summary for Policymakers. In C. B. Field, V. R. Barros, D. J. Dokken, K. J. Mach, M. D. Mastrandrea, T. E. Bilir, M. Chatterjee, K. L. Ebi, Y. O. Estrada, R. C. Genova, B. Girma, E. S. Kissel, A. N. Levy, S. MacCracken, P. R. Mastrandrea, & L. L. White (Eds.). *Climate Change 2014: Impacts, Adaptation and Vulnerability - Contributions of the Working Group II to the Fifth Assessment Report* (pp. 01–32). Cambridge University Press. https://doi.org/www.cambridge.org/9781107641655

Jacobson, M., & Rugeley, C. (2007). Community-based participatory research: group work for social justice and community change. *Social Work with Groups*, *30*(4), 21–39. https://doi.org/10.1300/J009v30n04_03

Johannessen, Å., & Hahn, T. (2013). Social learning towards a more adaptive paradigm? Reducing flood risk in Kristianstad municipality, Sweden. *Global Environmental Change*, *23*(1), 372–381. https://doi.org/10.1016/j.gloenvcha.2012.07.009

Jordan, J. C. (2019). Deconstructing resilience: why gender and power matter in responding to climate stress in Bangladesh. *Climate and Development*, *11*(2),167-179. https://doi.org/10.1080/17565529.2018.1442790

Kagunyu, A., Wandibba, S., & Wanjohi, J. G. (2016). The use of indigenous climate forecasting methods by the pastoralists of Northern Kenya. *Pastoralism*, *6*(7), 1–6. https://doi.org/10.1186/s13570-016-0054-0

Kelman, I., Mercer, J., & Gaillard, J. (2012). Indigenous knowledge and disaster risk reduction. *Geography*, *97*(1), 12–21. https://doi.org/10.1080/00167487.2012.12094332

Kevin, G., & Jonathan, P. (2015). Assemblage thinking and participatory development: potentiality, ethics, biopolitics. *Geography Compass*, *9*(1), 1–13. https://doi.org/doi:10.1111/gec3.12191

Khan, T. M. A., Singh, O. P., & Rahman, M. S. (2000). Recent sea level and sea surface temperature trends along the bangladesh coast in relation to the frequency of intense cyclones. *Marine Geodesy*, *23*(2), 103–116. https://doi.org/10.1080/01490410050030670

Komac, B. (2009). Social memory and geographical memory of natural disasters. *Acta Geographica Slovenica*, *49*(1), 199–226. https://doi.org/10.3986/ags49107

Kossin, J. P. (2017). Hurricane intensification along United States coast suppressed during active hurricane periods. *Nature*, *541*(7637), 390–393. https://doi.org/10.1038/nature20783

Lebel, L. (2013). Local knowledge and adaptation to climate change in natural resource-based societies of the Asia-Pacific. *Mitigation and Adaptation Strategies for Global Change*, *18*(7), 1057–1076. https://doi.org/10.1007/s11027-012-9407-1

MacKinnon, D., & Derickson, K. D. (2013). From resilience to resourcefulness: a critique of resilience policy and activism. *Progress in Human Geography*, *37*(2), 253–270. https://doi.org/10.1177/0309132512454775

Madsen, W., & Mullan, C. O. (2013). Responding to disaster: applying the lens of social memory. *Australian Journal of Communication*, *40*(1), 57–70. https://search.informit.org/doi/10.3316/informit.430871383389493

Magis, K. (2010). Community resilience: an indicator of social sustainability. *Society and*

Natural Resources, *23*(5), 401–416. https://doi.org/10.1080/08941920903305674

Maneesha, K., Murty, V. S. N., Ravichandran, M., Lee, T., Yu, W., & McPhaden, M. J. (2012). Upper ocean variability in the Bay of Bengal during the tropical cyclones Nargis and Laila. *Progress in Oceanography*, *106*, 49–61. https://doi.org/10.1016/j.pocean.2012.06.006

Marchezini, V. (2015). The biopolitics of disaster: power, discourses, and practices. *Human Organization*, *74*(4), 362–371. https://doi.org/10.17730/0018-7259-74.4.362

Marsooli, R., Lin, N., Emanuel, K., & Feng, K. (2019). Climate change exacerbates hurricane flood hazards along U.S. Atlantic coast in spatially varying patterns. *Nature Communications*, (2019), 1–9. https://doi.org/10.1038/s41467-019-11755-z

Melo Zurita, M. de L., Cook, B., Thomsen, D. C., Munro, P. G., Smith, T. F., & Gallina, J. (2018). Living with disasters: social capital for disaster governance. *Disasters*, *42*(3), 571–589. https://doi.org/10.1111/disa.12257

Melo Zurita, M. de L., Cook, B., Harms, L., & March, A. (2015). Towards new disaster governance: subsidiarity as a critical tool. *Environmental Policy and Governance*, *25*(6), 386–398. https://doi.org/10.1002/eet.1681

Mertens, D. M. (2012). Transformative mixed methods: addressing inequities. *American Behavioral Scientist*, *56*(6), 802–813. https://doi.org/10.1177/0002764211433797

Mertens, D. M. (2010). Transformative mixed methods research. *Qualitative Inquiry*, *16*(6), 469–474. https://doi.org/10.1177/1077800410364612

Mertens, D. M. (2009). *Transformative research and evaluation*. Guilford Press.

Mertens, D. M. (2007). Transformative paradigm: mixed methods and social justice. *Journal of Mixed Methods Research*, *1*(3), 212–225. https://doi.org/10.1177/1558689807302811

Ministry of Disaster Management and Relief (MoDMR). (2017). *National plan for disaster management (2016–2020): Building resilience for sustainable human development.* MoDMR, Dhaka, Bangladesh.

Moreno, J., Lara, A., & Torres, M. (2019). Community resilience in response to the 2010 tsunami in Chile: the survival of a small-scale fishing community. *International Journal of Disaster Risk Reduction*, *33*, 376–384. https://doi.org/10.1016/j.ijdrr.2018.10.024

Nadasdy, P. (2005). The anti-politics of TEK: the institutionalization of co-management discourse and practice. *Anthropologica*, *47*(2), 215–232. https://www.jstor.org/stable/25606237

Nyong, A., Adesina, F., & Osman Nadasdy, P. (1999). The politics of TEK: power and the
"integration" of knowledge. *Arctic Anthropology*, *36*(1–2), 1–18.
https://www.jstor.org/stable/40316502

Elasha, B. (2007). The value of indigenous knowledge in climate change mitigation and
adaptation strategies in the African Sahel. *Mitigation and Adaptation Strategies for Global
Change*, *12*(5), 787–797. https://doi.org/10.1007/s11027-007-9099-0

Olick, J. K. (2016). The poverty of resilience: on memory, meaning, and well-being. *Memory
Studies*, *9*(3), 315–324. https://doi.org/10.1177/1750698016645265

Oliver-Smith, A. (2002). Theorizing disasters: nature, power, and culture. In S. M. Hoffman &
A. Oliver-Smith (Eds.), *Catastrophe and culture: The anthropology of disaster* (pp. 23–48).
School of American Research Press.

Osterhoudt, S. (2018). Remembered resilience : oral history narratives and community resilience
in agroforestry systems. *Renewable Agriculture and Food Systems*, *33*(3),252–255.
https:// doi.org/https://doi.org/10.1017/s1742170517000679

Ostrom, E. (2008). Institutions and the environment. *Economic Affairs*, *28*(3), 24–31.
https://doi.org/10.1111/j.1468-0270.2008.00840.x

Pahl-Wostl, C. (2009). A conceptual framework for analysing adaptive capacity and multi-level
learning processes in resource governance regimes. *Global Environmental Change*, *19*(3),
354–365. https://doi.org/10.1016/j.gloenvcha.2009.06.001

Pahl-Wostl, C. (2006). The importance of social learning in restoring the multifunctionality of
rivers and floodplains. *Ecology and Society*, *11*(1), 10.
http://www.ecologyandsociety.org/vol11/iss1/art10/

Paul, B. K. (2009). Why relatively fewer people died? The case of Bangladesh's Cyclone Sidr.
Natural Hazards, *50*(2), 289–304. https://doi.org/10.1007/s11069-008-9340-5

Pelling, M. (2011). *Adaptation to climate change:From resilience to tranformation*. Routledge.
https://doi.org/10.4324/9780203889046

Pfister, C. (2009). Learning from nature-induced disasters: theoretical considerations and case
studies from Western Europe. In C. Mauch & C. Pfister (Eds.), *Natural disasters and
cultural responses* (pp. 17–40). The Rowman & Littlefield publishing groups, Inc.

Pugh, J. (2013). Speaking without voice: participatory planning, acknowledgment, and latent
subjectivity in Barbados. *Annals of the Association of American Geographers*, *103*(5),

1266–1281. https://doi.org/10.1080/00045608.2012.706571

Rahmstorf, S. (2017). Rising hazard of storm-surge flooding. *Proceedings of the National Academy of Sciences*, *114*(45), 201715895. https://doi.org/10.1073/pnas.1715895114

Reed, M. S., Evely, A. C., Cundill, G., Fazey, I., Glass, J., Laing, A., Newig, J., Parrish, B., Prell, C., Raymond, C., & Stringer, L. C. (2010). What is social learning? *Ecology and Society*, *15*(4), r1. https://doi.org/10.5751/ES-03564-1504r01

Rodela, R., & Swartling, Å. G. (2019). Environmental governance in an increasingly complex world: reflections on transdisciplinary collaborations for knowledge coproduction and learning. *Environmental Policy and Governance*, 1–4. https://doi.org/10.1002/eet.1842

Rodela, R. (2013). The social learning discourse: trends, themes and interdisciplinary influences in current research. *Environmental Science and Policy*, *25*, 157–166. https://doi.org/10.1016/j.envsci.2012.09.002

Rodela, R. (2011). Social Learning and natural resource management: the emergence of three research perspectives. *Ecology & Society*, *16*(4), 30. http://dx.doi.org/10.5751/ES-04554-160430

Roy, T. (2012). *Natural disaster and Indian history*. Oxford University Press.

Rumbach, A., & Foley, D. (2014). Indigenous institutions and their role in disaster risk reduction and resilience: evidence from the 2009 tsunami in American Samoa. *Ecology and Society*, *19*(1),19. https://doi.org/10.5751/ES-06189-190119

Secor, D. H., Zhang, F., O'Brien, M. H. P., & Li, M. (2019). Ocean destratification and fish evacuation caused by a Mid-Atlantic tropical storm. *ICES Journal of Marine Science*, *76*(2), 573–584. https://doi.org/10.1093/icesjms/fsx241

Setten, G., & Lein, H. (2019). "We draw on what we know anyway": the meaning and role of local knowledge in natural hazard management. *International Journal of Disaster Risk Reduction*, *38*, 101184. https://doi.org/10.1016/j.ijdrr.2019.101184

Sitas, N., Reyers, B., Cundill, G., Prozesky, H. E., Nel, J. L., & Esler, K. J. (2016). Fostering collaboration for knowledge and action in disaster management in South Africa. *Current Opinion in Environmental Sustainability*, *19*, 94–102. https://doi.org/10.1016/j.cosust.2015.12.007

Spampinato, C., Palazzo, S., Boom, B., Van Ossenbruggen, J., Kavasidis, I., Di Salvo, R., Lin, F. P., Giordano, D., Hardman, L., & Fisher, R. B. (2014). Understanding fish behavior during

typhoon events in real-life underwater environments. *Multimedia Tools and Applications*, *70*(1), 199–236. https://doi.org/10.1007/s11042-012-1101-5

Srivastava, S. K. (2012). Managing indigenous and scientific knowledge for resilience building. *Journal of Advances in Management Research*, *9*(1), 45–63. https://doi.org/10.1108/09727981211225644

Thiessen, C., & Byrne, S. (2017). Proceed with caution: research production and uptake in conflict-affected countries. *Journal of Peacebuilding and Development*, *13*(1). https://doi.org/10.1080/15423166.2017.1401486

Thomalla, F., & Larsen, R. K. (2010). Resilience in the context of tsunami early warning systems and community disaster preparedness in the indian ocean region. *Environmental Hazards*, *9*(3), 249–265. https://doi.org/10.3763/ehaz.2010.0051

Tidball, K. G., Krasny, M. E., Svendsen, E., Campbell, L., & Helphand, K. (2010). Stewardship, learning, and memory in disaster resilience. *Environmental Education Research*, *16*(5–6), 591–609. https://doi.org/10.1080/13504622.2010.505437

Tran, T. A., & Rodela, R. (2019). Integrating farmers' adaptive knowledge into flood management and adaptation policies in the Vietnamese Mekong Delta: a social learning perspective. *Global Environmental Change*, *55*, 84–96. https://doi.org/10.1016/j.gloenvcha.2019.02.004

Trenberth, K. (2005). Uncertainty in hurricanes and global warming. *Science*, *308*, 1753–1754. https://doi.org/10.1126/science.1112551

Trogrlić, R. Š., Wright, G., Duncan, M., van den Homberg, M., Adeloye, A., Mwale, F., & Mwafulirwa, J. (2019). Characterising local knowledge across the flood risk management cycle: a case study of southern Malawi. *Sustainability*, *11*(6), 1681. https://doi.org/10.3390/su11061681

Uriarte, M., Thompson, J., & Zimmerman, J. K. (2019). Hurricane María tripled stem breaks and doubled tree mortality relative to other major storms. *Nature Communications*, *10*(1), 1–7. https://doi.org/10.1038/s41467-019-09319-2

Wicks, A. J., & Atkinson, D. E. (2017). Identification and classification of storm surge events at Red Dog Dock, Alaska, 2004–2014. *Natural Hazards*, *86*(2), 877–900. https://doi.org/10.1007/s11069-016-2722-1

Wilson, G. A. (2014). Community resilience: path dependency, lock-in effects and transitional

ruptures. *Journal of Environmental Planning and Management*, *57*(1), 1–26. https://doi.org/10.1080/09640568.2012.741519

Woodruff, J. D., Irish, J. L., & Camargo, S. J. (2013). Coastal flooding by tropical cyclones and sea-level rise. *Nature*, *504*(7478), 44–52. https://doi.org/10.1038/nature12855

Zhao, H., & Wang, Y. (2018). Phytoplankton increases induced by tropical cyclones in the South China Sea during 1998–2015. *Journal of Geophysical Research: Oceans*, *123*(4), 2903–2920. https://doi.org/10.1002/2017JC013549

Supplementary Materials S 2.1

In scientific literature, *Juba* and *Dala* are explained as spring tides (when the earth, the moon, and sun are in alignment). During a new moon, the gravitational forces of the moon and the sun pull along the same direction resulting in high water level (i.e. *Juba*). During a full moon, the gravitational forces of the sun and the moon exert forces in opposite direction resulting in low level of water (i.e. *Dala*) (Fig. S.1) (Gönnert & Sossidi, 2011; Park & Suh, 2012). When a high tide coincides with *Juba* it produces a very high level of tide (i.e. higher than average) and conversely, when low tide coincides with *Dala* it produces a very low level of tide (i.e. lower than average). During Cyclone Sidr, it was low tide with low spring tide (lower left Quatrain in Fig. S.1).
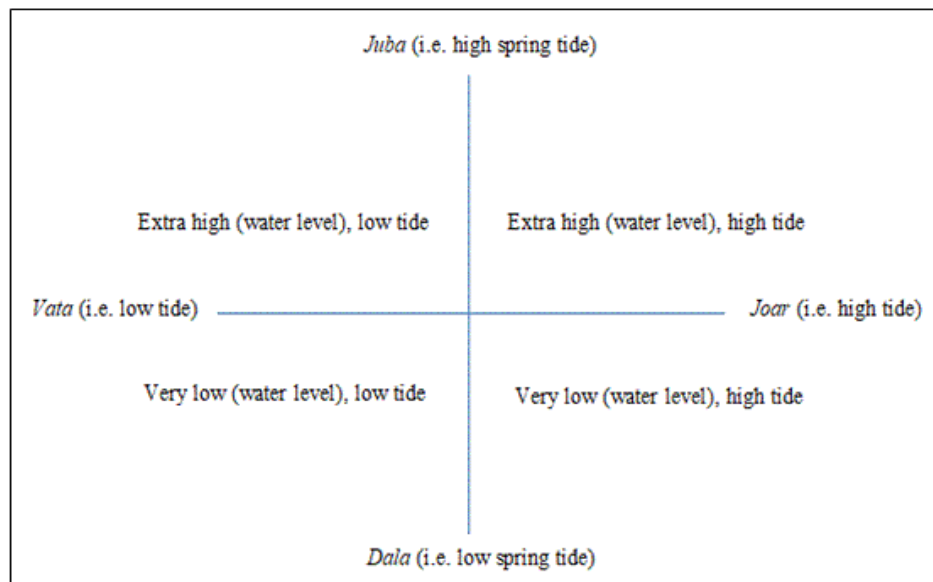
Fig. S.1: Connection between spring tides with high and low tides

References

Gönnert, G., & Sossidi, K. (2011). A new approach to calculate extreme storm surges. *Irrigation and Drainage*,*60*, 91-98. https://doi.org/10.1002/ird.681

Park, Y. H., & Suh, K. D. (2012). Variations of storm surge caused by shallow water depths and extreme tidal ranges. *Ocean Engineering*, *55*, 44–51. https://doi.org/10.1016/j.oceaneng.2012.07.032

CHAPTER THREE

Transformative Learning and Community Resilience to Cyclones and Storm Surges: The Case of Coastal Communities in Bangladesh[3]

Abstract

While it has been widely recognized that building community resilience to climate-induced shocks requires learning processes at multiple societal levels, there has been limited research on the specific types of learning required at individual level to influence change and transformation at the community level. To determine how transformative learning and risk-mitigation actions shape community resilience to climate-induced disasters, we carried out a mixed-method empirical investigation on the southern coast of Bangladesh. We found that the relationship between transformative learning and resilience-building is complex, involving multiple social-cultural-structural factors (e.g., beliefs, values, power structures), practical considerations (e.g., impact on livelihood, evacuation and relocation logistics), and cognitive factors. From our observations, we draw four general conclusions: i) local culture can constrain people's framing of risk and capacity for critical reflection, resulting in a deliberate denial and amnesia of past traumatic experiences; ii) learning alone cannot enhance resilience unless it is translated into action; iii) dependence on experiential learning can lead to the assumption that the severity of past disasters will not be surpassed, generating a false sense of security; and iv) the cultivation of forward-thinking attitudes coupled with innovative strategies, such as social networking, can successfully enhance resilience to climate-related disasters. Future policymaking aimed at building community resilience to climate shocks should therefore take into account cultural and individual cognitive barriers to transformative learning and attempt to remove structural barriers to translating learning into practical action.

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3. 1 Introduction

The capacity of individuals and communities to learn and transform their perspectives and practices has been recognized as a prerequisite for building community resilience to climate-induced shocks (Berkes & Ross, 2013; Cutter et al., 2008; Faulkner et al., 2018). Often overlooked, however, are the specific types of learning required at the individual level in order to influence change and transformation at the community level – specifically transformative learning, wherein individuals' frames of reference and embedded assumptions are fundamentally altered (O'Brien, 2018; Wilner et al., 2012).

Individuals typically learn about disaster shocks and risks through personal experience (i.e. experiential learning) (Berkes, 2007; Imperiale & Vanclay, 2016), but in the face of increasing climatic variability this may no longer be sufficient. For example, assessing future risks based on one's experience with past climate-induced shocks may lead to a false sense of security and a lack of preparedness for future, more extreme events (Abreu-Santos et al., 2017; Choudhury & Haque, 2018; Fincher et al., 2014; Plümper et al., 2017).

In this study, we argue that transformative learning is essential for building community resilience to climate-change-induced environmental risks. To this end, we draw insight from transformative leaning theory (Mezirow, 1978, 1997, 2008) to further our understanding of the connections between learning and community resilience to disaster shocks. Over recent decades, theories concerning resource users' decisions under conditions of risk and uncertainty have primarily been developed by economists and psychologists. Among them, Bernoulli's (1954) expected utility theory and Kahneman and Tversky's (1979) prospect theory have made pioneering contributions to this area of study. Nonetheless, in this paper we contend that the decision-making matrix actually used by individuals is broader and more complex than uncertainty weighting and loss-aversion, and often includes intertwined social, cultural, relational, and structural factors (Bankoff, 2003). We therefore expand our position by drawing from the sociological and anthropological traditions on the social and cultural framing of risks and disasters, specifically power and human agency, in conceptualizing transformative learning (Douglas & Wildavsky, 1983; Giddens, 1984; Tierney, 2014).

Understanding the socio-cultural-institutional factors that shape the exercise of agency is essential to understanding the relationship between learning and action in building community resilience to nature-induced disasters. To explore this, we carried out an empirical investigation

in two coastal communities of Bangladesh. These communities, being extremely dependent on local natural resources (e.g., fish, reeds and other plants for building materials) and physically exposed to the Bay of Bengal, are particularly vulnerable to climate-related extreme events relative to interior regions. These resource-dependent and place-based communities would arguably also have a greater scope to benefit from transformative learning and resilience-building initiatives (Choudhury & Haque, 2018).

The primary goal of this study is to advance our knowledge and understanding of the cultural and cognitive processes related to transformative learning and community resilience to nature-triggered extreme events. Our findings in Sections 3.4.1 and 3.4.2 provide answers to: How do socially and culturally-embedded norms, values, beliefs, and practices shape critical reflection? How are actions based on critical reflection and learning shaped by social, cultural, and institutional factors? Under what circumstances do people consider both risks and benefits? and Why do people continue to take risks despite past traumatic experience? Section 3.4.3 offers answers to: Why do some people take action to minimize risks while others in the same cultural context do not? and What forms of consciousness drive action and in turn shape risk and resilience? Transformative learning theory in relation to the current community resilience literature is briefly examined in section 3.2.1, and the effects of cultural attitudes, local power structures, and human agency on transformative learning and resilience building are explored in section 3.2.2.

3.2 Conceptual Considerations

3.2.1 Transformative Learning Theory and Community Resilience to Natural Hazards

Transformative Learning Theory was first proposed by Jack Mezirow (1978), who defined *transformation* as the processes whereby individuals "transform problematic frames of reference … to make them more inclusive, discriminating, open, reflective and emotionally able to change" (Mezirow, 2008, p. 26). Frames of reference are integrated sets of assumptions and expectations, built up through socialization and experience, through which individuals understand and attach meaning to their experiences, and which guide future action (Mezirow, 1978, 2008). The theory assumes that changes in frames of reference will lead to changes in actions. For example, individuals' responses (reactive, proactive, or transformative) to natural hazards and their associated risks, such as deciding whether to evacuate, are largely shaped by the way they frame and attach meaning to those risks.

Frames of reference are problematic when they fail to serve as reliable guides to understanding and action – for example, when an individual encounters a "disorienting dilemma" where outcomes or emerging situations do not match prior assumptions or expectations (Mezirow, 2008). This is particularly relevant to the problem of building resilience to climate-related shocks, as assumptions, risk assessments, and plans of action based on experience of past nature-induced disasters may prove mistaken or inadequate in the face of more severe and frequent future extreme events. Critical reflection on assumptions embedded in problematic frames of reference is fundamental to transformative learning and can lead to transformed frames of reference and/or better-supported assumptions, enabling clearer understanding of and functionally improved responses to future experiences (Mezirow, 1997). Relatedly, the resilience literature, drawing on the work of Paulo Freire, highlights the importance of 'conscientization'– coming to a critical awareness of one's present circumstances (cf. Pelling, 2011; Sharpe, 2016).

Altering resilience requires taking action, but transformative learning theory generally overlooks the manifestation of learning in action (Casebeer & Mann, 2017; Hoggan, 2016). To address this gap, we focus on both the behavioral and cognitive aspects of learning to identify the relationships between transformative learning and resilience and examine how people rationalize their actions. Applying the theory in the context of resilience to natural hazards, we focused on people's critical reflection on assumptions about risks associated with natural hazards and consequential changes in their understanding of and behavioral responses to those risks. In this we consider learning both as a *process* (i.e. continually learning from direct experience though critical reflection, creativity, and imagination) and an *outcome* (i.e. change or transformation in frames of reference and actions). Enhanced resilience can thus be considered an outcome of action informed by transformative learning.

Mezirow's outline of transformative learning theory has been criticized for its overly psychoanalytic approach and overemphasis on individuals' cognitive and reflective capacities. These capacities are significantly affected by culture (embedded norms, values, beliefs, and practices) and socioeconomic and structural factors such as occupation and gender, and cannot be considered in isolation (Casebeer & Mann, 2017; Johnson-Bailey, 2012; Merriam & Ntseane, 2008). As Cerulo (2002, p. 3) notes, cognition is "an act of social beings – an act both enabled and constrained by one's position in the complex web of social and cultural experience." The following section elaborates how: i) socially and culturally-embedded norms, values, beliefs, and

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practices shape critical reflection; and ii) action required to enhance resilience is shaped by social, cultural, and institutional factors.

3.2.2 From Critical Reflection to Action for Resilience: Culture, Human Agency, and Behavior Under Risk

In behavioral theory in economics literature, *risk* is distinguished from uncertainty, where decision makers have incomplete knowledge of outcome probabilities, and from certainty, where they have complete knowledge. Expected utility theory – introduced in the early 18th century – describes decision making under conditions of risk where each decision option generates a set of possible outcomes, and the probability of and preference for each outcome is known. This rational model assumes that individuals under these conditions will attempt to maximize expected utility in choosing among risky options (Luce and Raiffa 1957; Levy 1992). An alternative theory of decision making under conditions of risk was proposed by Kahneman and Tversky (1979), who asserted that individuals are risk-averse in regard to potential gains and risk-acceptant with respect to losses – known as prospect theory. It focuses the importance of the actor's framing of decisions around a reference point rather than with respect to net asset levels (Levy 1992). As Wakker (2010) explained, the significant change in this theory is that "risk and uncertainty attitudes are no longer modeled solely through utility curvature" (p. 6). Here, uncertainty weighting and loss-aversion dimensions need particular attention.

However, we contend that the decision-making matrix under risk is often much broader and more complex than either utility maximization or uncertainty weighting and loss-aversion, and is intertwined with social, cultural, relational, and structural dimensions of decision contexts. We define *culture* here in the context of natural hazards and associated risks, referring to "beliefs, attitudes, feelings, experiences, values and narratives, and their associated behaviours, actions and day-to-day routines that are shared by, or at least abided by, most people in respect to threats and hazards" (Bankoff et al., 2015, p. 5). Culture plays a significant role in shaping people's learning processes, attitudes toward risk, and willingness/likelihood to take the actions needed to enhance their resilience to hazards (Baer et al., 2019; Douglas & Wildavsky, 1983; Webb, 2018); therefore, any examination of resilience-building measures is incomplete without an examination of these cultural and structural factors, including people's engagement with the natural environment for livelihood, the location of their housing, and their social relationships (Kulatunga, 2010; Webb, 2018).

As Boholm (2015) argues, *risk* is a contextual and relational construct, i.e. perceptions of risk are embedded within a social structure and the processes that produce and transmit cultural practices and norms. Social relationships (including modes of domination and power), the sense of belonging within a social group, and moral/social values are all considered socio-cultural drivers of risk (Sun & Faas, 2018; Tierney, 2014). Often, culture plays a greater role in shaping risk perception than actual exposure to risk itself (Gierlach et al., 2010), with the denial and active forgetting of past disasters – and consequently of future risk – being deeply embedded in certain cultures (McEwen et al., 2016).

Attitudes toward risk are shaped by people's encounters with hazards and their interaction with the environment for their livelihoods (Bankoff et al., 2015; Paveglio et al., 2017). Many choose to live in hazard-prone areas because it allows them to sustain their livelihood, and consider natural hazards and disasters not as aberrant phenomena but rather a part of everyday life (Bankoff, 2007) – a process Anderson (1968) terms the "normalisation of threat". In Bourdieuan terminology, risk is part of people's *habitus* (i.e. spontaneity without consciousness), and it is a *doxa* (risk as taken-for-granted) in their cultural setting. In a given cultural setting, *habitus* and *doxa* furnish a person's practical sense of what measures are possible or feasible in order to reduce risk and build resilience (Tierney, 2014). In many cases, cultural factors and practical considerations may lead an individual to make trade-offs with regards to risk (such as remaining in a disaster-prone region to access available natural resources) that may seem irrational to an outside observer, further highlighting the importance of considering cultural context when examining risk-management and resilience-building strategies.

However, we find this cultural framing of nature-induced disaster risks to be lacking in two important respects. First, decades of research on disaster vulnerability highlights that people do not live in hazard-prone areas for cultural reasons or by choice only, but often due to constraints imposed upon them by poverty, exploitation, exclusion, and marginalization (Blaikie et al., 2005; Walters & Gaillard, 2014; Watts & Bohle, 1993). Second, cultural framing tends to paint people as merely hostages of culture rather than active agents, and cannot fully account for the variety of individual responses to disaster risks (McCaffrey et al., 2018; Oliver-Smith, 2015a).

In this case it is useful to draw insights from Giddens' (1984) notion of power and agency. For Giddens, power operates through various resources, including authoritative and

allocative resources ("command and control" over people and goods and services, respectively) (Giddens 1984). Exercising agency means exercising some form of power (Loyal, 2015). Giddens' (1984) notion of agency underscores the reflexive nature of action. However, he identifies various constraints (i.e. material, power, and structural) within which agents operate, and consequential variations (e.g., intended and unintended consequences) that result from their exercise of agency. For our purposes, *agency* implies the ability of actors to act independently to change the course of circumstances based on critical reflection upon past disaster experiences (i.e. retrospective learning) and by imagining an alternative future (i.e. prospective learning).

Giddens (1984) noted three types of consciousness that are relevant to critical reflection and imagination for transformative learning: i) discursive or reflexive consciousness (discursively scrutinizing beliefs, values, and worldviews that shape actions), ii) practical consciousness (everyday practices that are rarely subject to scrutiny), and iii) the unconscious (where reasons for actions are unknown to the actors themselves). In a context of continuity and change, discursive consciousness may lead toward transformative learning or transformational adaptation, while actions and practices based on practical consciousness and unconsciousness are likely to maintain current practices.

3.3 Methods and Study Area

3.3.1 Resilience and Learning Assessment Methods

Literature on approaches and methods of assessing learning and resilience is diverse, interdisciplinary, and contextual (Casebeer & Mann, 2017; Merriam & Ntseane, 2008; Ross & Berkes, 2014). Holling's (1973) notion of ecological resilience, which later expanded to include social-ecological and community resilience, distinguishes itself from conventional scientific-engineering notions of resilience (Gunderson, 2000). The interdisciplinary resilience scholarship that has evolved over the past half a century since Holling's seminal publication in 1973, from an ontological perspective, has promoted the notion of multiple forms of truth. In addition, social-ecological resilience scholars consider "resilience" as a mode of thinking rather than "something out there" to be objectively measured (Folke et al., 2010; Walker et al., 2004).

In consideration of this ontological and epistemological orientation, and critiquing attempts to numerically measure resilience and learning "indicators", strong arguments have been advanced in favor of applying qualitative measurement approaches using "surrogates" of the indicators (Berkes & Seixas, 2005; Carpenter et al., 2005; Ross & Berkes, 2014). These

analysts posit that it is inappropriate to assess or measure resilience numerically as the attributes and dynamics of a SES are not directly observable (Carpenter et al., 2005). Resilience is a forward-looking phenomenon, and hence indicators that measure past or present condition cannot reflect vital resilience attributes of a community (Berkes & Seixas, 2005). They view resilience as an emergent property or a *process* phenomenon (Faulkner et al., 2018), and therefore it can only be successfully investigated qualitatively using "surrogates" or "attributes".

For the present study, we adopt a Transformative-Interpretive Framework (TIF) (Mertens, 2007) to investigate the connection between transformative learning and community resilience. This framework emerged to address issues of power, inequality, and justice in order to facilitate change and transformation, and argues that the goal of research is to represent the voice of marginalized people (Mertens 2007). Mertens (2012) defines the TIF as "a meta-physical framework that directly engages the complexity encountered by researchers and evaluators in culturally diverse communities when their work is focused on increasing social justice" (p. 804).

Knowledge is argued to be socially, historically, and culturally contingent, and for a deeper understanding of these contexts the TIF draws insights from critical literature on race, gender, ethnicity, disability, and colonialism, among others, to approach research questions (Mertens 2007). Application of the TIF requires the involvement of community people in the research process and the application of the tools and techniques that are culturally appropriate. Transformative learning, from the standpoint of this framework, implies the emergence of critical awareness and consciousness; people are assumed to be *active* agents rather than *passive* hostages of culture and unequal power structures (Hoggan, 2016). Here, emphasis is placed on the *strength* of marginalized and disadvantaged communities rather than on their *weaknesses* (Mertens, 2007).

Considering the purpose of our study to advance our knowledge and understanding of the cultural and cognitive processes related to transformative learning and community resilience to nature-triggered extreme events, we applied the TIF, with modifications appropriate to the social-ecological context of the coastal communities of Bangladesh, to frame and collect the empirical data.

3.3.2 Study Area

We carried out our empirical investigation in the cyclone and storm-surge prone southern coastal zone (Barguna district) of Bangladesh. IPCC (2014) scenario-building models rank this area as one of the most vulnerable to environmental extremes in a CO_2-doubling scenario. In 2007, Barguna district was stuck by Cyclone Sidr, killing 1,292, injuring 16,310, and destroying large amounts of property and infrastructure (GoB, 2008). The field study was conducted from August 2018 to January 2019 in two *Upazilas* (sub-districts) of Barguna, Amtali and Taltali. Criteria applied in *Upazilas* selection were: i) whether inhabitants experienced loss and damage due to the recent Cyclone Sidr; ii) whether they are especially prone to nature-induced shocks, such as from tropical cyclones, storm surges, and/or stress from river bank erosion hazards; and iii) whether a large portion of the inhabitants directly or indirectly derive their livelihood from fishing in local rivers and the Bay of Bengal. From the two selected *Upazilas* a total of six villages – two from Amatali (Baliatali and Gupkhali villages) and four from Taltali (Nidrarchar, Idupara, Tatulbaria, and Nolbonia villages) – were randomly selected (Fig. 3.1).
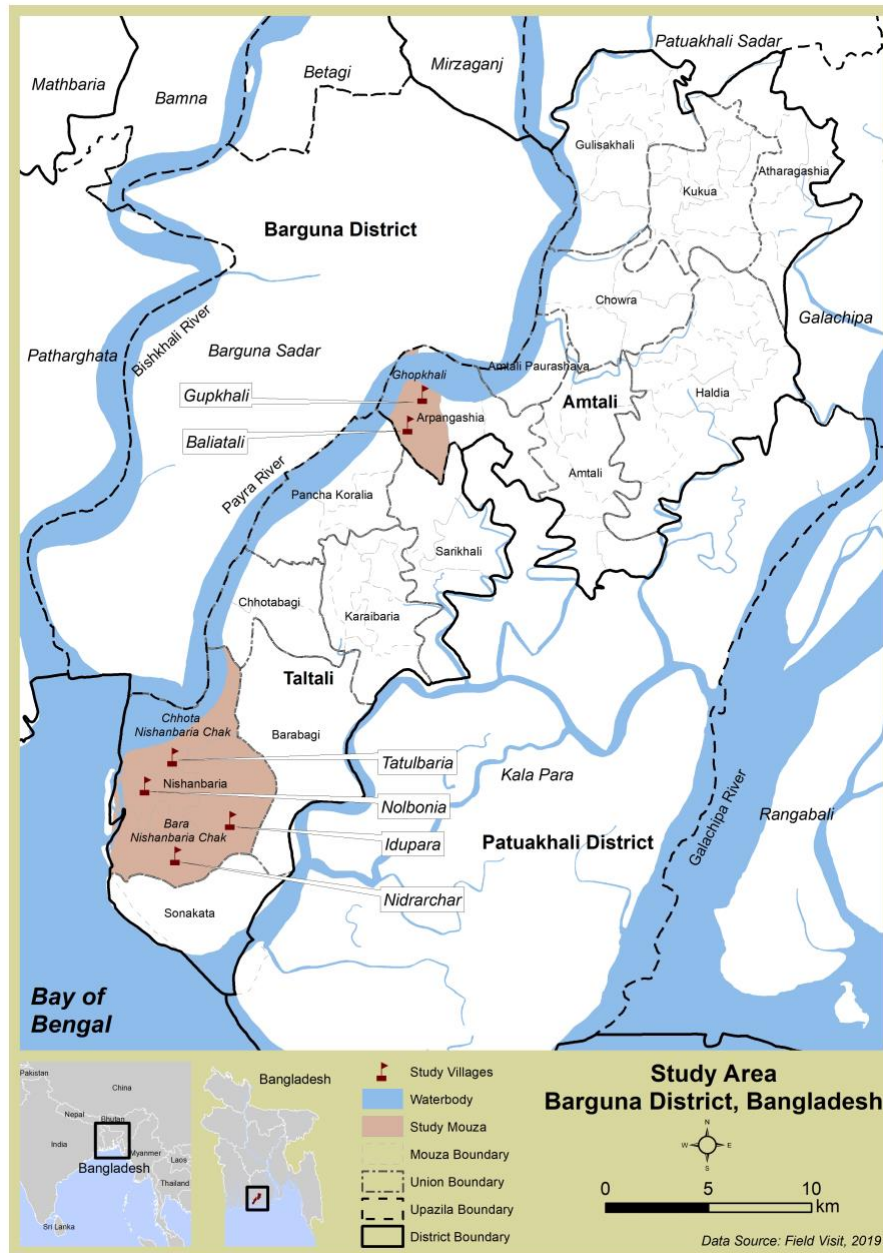
Fig. 3.1: Map of the study area

3.3.3 Data Collection Methods and Instruments

A community-based participatory approach was employed in the empirical investigation, which is a transformative approach to research that aims to unshackle people from oppressive-hegemonic power structures (Jacobson & Rugeley, 2007) and facilitate positive change in the lives of participants as well as "the institutions in which they live and work" (Creswell 2007:21). To assist in the data collection process, the first author recruited a local field assistant from the

local area who had previously worked for Non-Governmental Organizations (NGOs) in the area of climate change adaptation. The field assistant served as a gatekeeper and translator of local dialects. Prior to collecting the data, the first author made several informal visits to the communities with the field assistant to build rapport with community members. This research was approved by the University of Manitoba's (Canada) Joint-Faculty Research Ethics Board, and appropriate verbal or written consent was obtained from each participant following the approved protocol.

We applied techniques from the Participatory Rural Appraisal (PRA) toolbox to gather the necessary information and data, which was primarily qualitative. The PRA tools used in the field included Semi-Structured Interviews (SSIs), Focus Group Discussions (FGDs), and Key Informants Interviews (Pretty and Vodouhê 1997). A total of 50 SSIs, ranging from 30 to 90 minutes in length, were conducted by the first author with locals (30 males and 20 females) who had first-hand experience with Cyclone Sidr. Talk-based methods like this fit well with transformative learning research (Kerton & Sinclair, 2010), and its use helped us capture local people's diverse experiences and approaches to risk management.

Questions in the SSIs explored: How did the respondents view natural hazards (i.e. cyclones) before their experience? How, and to what extent do respondents think that their exposures to environmental hazards shaped their attitude and behavioral orientation toward risks and hazards? How did they initially prepare for major cyclones they faced? How did they prepare for later events? How would the respondents prepare for one in the future? What did they learn from their experiences with natural hazards? How did their learning contributed to coping and adaptation? What are the factors that shaped translating their learning into action (agency factors), such as evacuation and relocation? How did the respondents react and respond to official warnings?

Following this, 10 FDG meetings – five with males (three with fishers and two with mixed-occupation groups) and five with females – were organized by the first author. The purpose of the mixed-occupation male meetings was to understand overall community perspectives on risk, disaster, learning, coping, and adaptation practices, while those with fishers helped reveal their collective narratives regarding risks, fishing practices, and struggles against powerful actors. Issues covered while conducting FGDs with fishers were: fishing practices and their relationship with employers; challenges and barriers they face to secure livelihood;

problems fishers face regarding cyclone warnings; and the trade-off between risk and livelihood. FGDs with females helped capture women's collective narratives on learning, coping (e.g., evacuation), and preparedness. Questions explored were: How do women prepare for cyclones in the absence of their husbands? What problems and barriers do they face regarding evacuation? What have they learned from experiences with cyclonic disasters? What challenges do they face in translating learning into action? Each meeting involved 10-12 participants and lasted 60-90 minutes.

In the final stage of the research, five Key Informants Interviews were conducted by the first author with representatives from community-based local institutions (e.g., local press club) and local NGOs in order to unpack community power dynamics and residents' struggles in coping with environmental risks. Our data collection also involved field observation notes and informal conversations.

3.3.4 Supplementary Household Survey and Sampling Procedure

We supplemented this qualitative data with a household-level survey of the six study villages. We formulated a multistage study design for this purpose, applying the stratified cluster sampling procedure at the household-level for data collection. As explained above, multiple criteria were applied to select the two *Upazilas* of Barguna District. Based on the population size of these *Upazilas* and using the Probability Proportional to Size (PPS) procedure, two villages in Amatali *Upazila* and four villages in Taltali *Upazila* were allocated for sampling, and the six study villages noted above were randomly selected for this. The number of households (i.e. Primary Sampling Unit) to survey was determined by applying a standard sample-size determination formula (see Supplementary Fig. S 3.1) on the assumption that it is 95% likely that such a sample would generate an estimate with a given level of precision for the larger population (i.e. 5% or less margin of error) (Islam 2018). This calculation determined a minimum required sample of 236 households, and following the PPS of the village populations, 80 households from the study villages in Amatali and 160 households from those in Taltal *Upazilla* were drawn at random. Thus, we surveyed a total of 240 households, with a response rate of 85%. We administered the survey in-person with household heads, most of who were males, and in the absence of a male household head, surveys were conducted with female household members. Survey questions focused on the estimation of loss and damages from Cyclone Sidr, annual household income, socio-economic status, and land ownership.

3.3.5 Data Processing

The SSIs and qualitative portions of the household surveys were transcribed verbatim. For analysis and quotations, these verbatim transcripts were later translated into English by the first author. Both the first and second authors are native Bengali speakers, and both cross-checked the translation for consistency and to retain original meaning. To code collected data, we applied both deductive and inductive approaches. Deductive coding helped identify and trace underlying themes running through the data. Inductive coding involved applying a priori themes drawn from the literature, such as marginalization, gender and risk, and complexity of evacuation decisions. Quantitative survey data were coded and analyzed using IBM's SPSS software.

3.4 Findings and Analysis

3.4.1 Deliberate Forgetting, Risk Denial, and Livelihood Practices

In our study area, risk and livelihood are inextricably interlinked. People take significant risks in order to pursue their livelihoods, such as living close to waterbodies to access natural resources (i.e. fish) and remaining out at sea for long periods despite advance warnings of incoming cyclones. Such practices persist even after the traumatic experience of Cyclone Sidr in 2007 that caused significant loss of lives and damage of property (Table 3.1 and 3.2). More than 12% of the sampled households lost family member(s) in Cyclone Sidr; the one-sample proportions test revealed that the 95% confidence intervals exist between 0.083 and 0.17 ($\chi^2 = 136.5$; df = 1; p-value = 2.2e-16). Among the sampled households, almost two-thirds (63.8%) lost up to US $2000 (BD Taka 169,800) as a result of Cyclone Sidr (Table 2). A test of homogeneity has shown that the proportions of the loss and damage categories were not equal at the 5% level of significance, implying that the overwhelming majority of the population experienced some degree of loss and damage from the cyclone disaster (Table 3.2).

Table 3.1: Loss of family members in the study area due to Cyclone Sidr (n=240)

Loss of family members	Frequency (n = 240)	Percentage	*p*-value
Yes	29	12.1	< 2.2e-16
No	211	87.9	
$\chi^2 = 136.5$; df = 1			

Table 3.2: Loss and damage of property of the respondent households due to Cyclone Sidr (n=240)

Total loss and damage of property (US$)*	Frequency	Percentage	*p*-value**
0-1000	95	39.58	<0.00001
1001-2000	58	24.17	
2001-3000	31	12.92	
3001-4000	29	12.08	
4001-5000	27	11.25	
Total	240	100.00	
$\chi^2 = 70.833$; df = 4			
* 1 US$= 84.9 taka (Bangladeshi currency) on January 28, 2020 as per exchange rate of Bangladesh Bank (https://www.bb.org.bd/econdata/exchangerate.php) ** 95% level of significance			

However, such climate-induced disaster shocks do not appear to constitute a 'disorienting dilemma' for most locals, with livelihood security taking precedence over perceived risks. There are two possible explanations for this phenomenon: cultural framing of risk perception, and the involuntary imposition of risk by socio-economic pressures (Bankoff, 2007; Oliver-Smith, 2016; Smith, 2004). We found that these factors are inseparable and reinforce one another; often both factors influence fishers' decisions to take risks for livelihood in coastal communities (Fig.3.2).
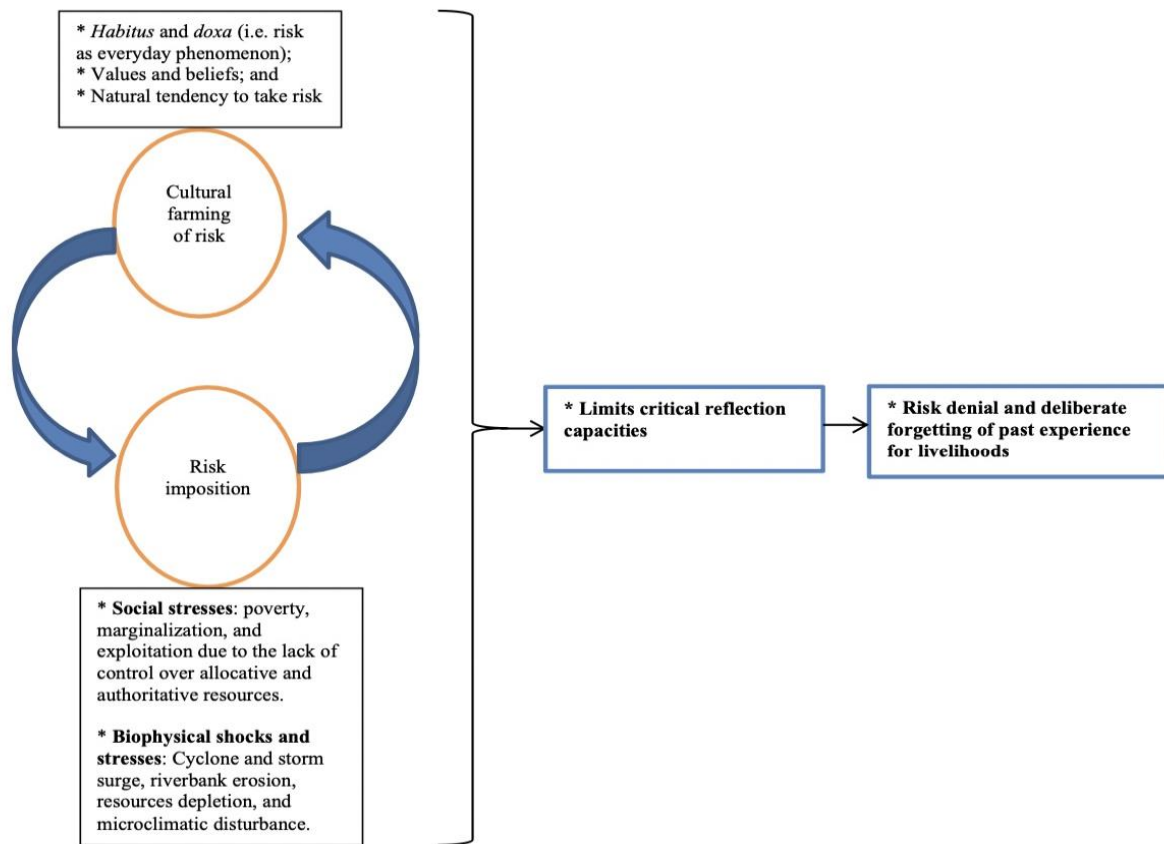
Fig. 3.2: Coupling effects of culture framing of risk and social-biophysical stresses on critical reflection capacity

As noted earlier, perception of and response to risk is a manifestation of *habitus* and *doxa* (Tierney 2014). People's capacity to reflect on past traumatic experiences and take action to mitigate future risks is greatly shaped by cultural perceptions and prescriptions, such that culturally-embedded beliefs, values, norms, and practices can cause people to act against their personal perceptions of risk. Furthermore, many individuals have no choice but to accept environmental risk because poverty, exploitation, and marginalization make it impossible to relocate, find alternate livelihood sources, or take other risk mitigation actions.

Transformative learning requires time, space, and opportunity for critical reflection in order to meaningfully alter deeply-rooted values, beliefs, and practices (Sharpe 2016). These elements are not attainable when people are fully consumed with their daily survival. In the study area, the majority of the sampled households are landless (57.9%) and poor who rely on

diversified livelihoods (Table 3.3). The result of the one-sample proportions test reveals that the true proportion of landless in the population lies between 51-64% (CI is between 0.5139 and 0.6419) at the 95% level of confidence (χ^2 = 5.7042; df = 1; p-value = 0.01692). Lacking land resources and opportunities for other non-agricultural activities, the majority of the study area population live below the poverty line (below US $3.2/day). A comparison among the income categories of the sampled households (n = 240) revealed that the proportions of daily income categories are significantly different (χ^2 = 70.3; df = 2; p-value = 0.0001) at the 95% level of confidence (Table 3.4). These findings lead us to infer that the majority of the study population live in chronic poverty and confront significant livelihood struggles.

Table 3.3: Land ownership status of the respondents (n=240)

Landownership	Number of respondents	Percentage	*p*-value	95% CI*
Landless	139	57.9	0.01692	0.3589-0.4862
Landowners	101	42.1		
χ^2 = 5.7042; df = 1				
*95% confidence interval				

Table 3.4: Daily household income of the respondents (n=240)

Daily income Category (US $)**	Number of respondents (n = 240)	Percentage	*p*-value*
Below poverty line (US $ 3.2/day)***	132	55.0	<0.0001
From 3.2 to 6.4	82	34.2	
Above 6.4	26	10,8	
χ^2 = 70.2; df = 2			
* 95% level of significance			
** 1 US$= 84.9 taka (Bangladeshi currency) on January 28, 2020 as per exchange rate of Bangladesh Bank (https://www.bb.org.bd/econdata/exchangerate.php)			
*** Poverty line for low-middle-income countries (World Bank 2018)			

Multiple and interlinked social-biophysical stresses, such as riverbank erosion (Fig. 3.3), seasonal and weather variability, marginalization, and exploitation by boat- and land-owners all serve to maintain this state of perpetual poverty while gradually increasing locals' vulnerability to natural hazards. For instance, riverbank erosion and land encroachment cause destruction of agricultural land, houses, and other infrastructure such as roads, schools, and clinics located in riparian areas, leading to the displacement of locals, while climatic variability leads to fluctuating fish populations and harvests, creating great livelihood uncertainty.

Fig. 3.3: Riverbank erosion causes loss of land and settlement (Source: Photo taken by the first author; permission obtained from the standing research assistant)

Under these circumstances, fishers are left with no real choice but to accept increasingly high risk in order to secure their livelihoods. Fishers know that if they die while out at sea their family members will not receive any compensation from their employer. Local fishers therefore purposefully try to put the risks they face out of mind and focus on the task at hand. Fishers are therefore not unaware of risks; rather, practical considerations take precedence over those risks, as one interviewed fisher explained:

> *If you are hungry, you cannot sleep. This is why we* [fishers] *go to the sea and stay there and continue fishing even after receiving Signal Number 2. What will I eat, if I do not go there for work?* [...] *How do I survive and feed my family is my concern, not a cyclone nor a flood. We will confront it when it comes…*

Fishers' critical reflective capacity is constrained by the nature of their occupation. Although fishing is their inherited occupation, most are too poor to own their own fishing equipment (boats, nets, etc.) and are forced to work for fishing companies and *Mohajans* (money lenders and employers) who exploit their employees in various ways, including forcing them to remain out at sea despite bad weather. Fishers also often shoulder all of the financial risks, for example, *Mohajans* provide fishers with all necessary supplies (e.g., fuel, food, boat, and nets) for a one or two-week fishing trip, but if this cost exceeds the profit from the fisher's catch, the fisher is forced to absorb the loss. Fishers are also often forced to take loans from the *Mohajans* in order to feed their families, further indebting them to their employers.

Interviewed fishers pointed out that there is always risk involved in fishing, regardless of the weather, and that this risk is amplified by the unequal power structure within their industry. As recently as a decade ago, fishers used to catch fish close to shore and could retreat quickly from incoming storms, but depletion of coastal fish stocks and increased domination of coastal fishing areas by large fishing companies have forced local fishers to venture farther and farther out to sea. As one fisher explained:

> *Khuta jal and bhada jal* [specific types of nets] *is completely prohibited. Those who use* [these nets] *are very powerful, unlike us* [poor]; *they are not bothered by police. Local chairman does this business* [type of manipulative tactic]. *He is connected with local fishery department and ministry.*

Due to the cost of nets and the fact that fishers do not own their own equipment, nets must be hauled in before fishers can retreat from incoming weather – a process that can take 3-5 hours. These compounding risks lead many fishers to adopt a fatalistic attitude, as one respondent explained:

> *Going to sea is risky, whether it is good weather condition or not. Allah would bring us back shore or may not* […] *People stay on boat for livelihood risking life* […] *We do not go to sea thinking that we will return; rather we think that we would die. We rely on Allah* […]

Another added:

> *Those who go fishing in the sea take life in their hand. Most fishers go for fishing by borrowing a boat or loans from Mohajan. They have to repay the loan or show their good performance to please Mohajans. Earning from sea could be greater, risks also*

become higher […] *We do not go to sea thinking that whether we will die or live. If fate is to die on water, no one will able to revert it, this is like gambling…*

As Boholm (2015) pointed out, since risk is a relational and contextual construct, social and cultural processes can shape people's perception of the trade-off between risks and benefits. Fishers are in constant competition with each other to be re-hired by fishing companies and *Mohajans* in subsequent years, and are thus reluctant to retreat from severe weather lest it reflects poorly on their performance and value to their employers.

People living close to the sea or rivers are most vulnerable to coastal cyclones and storm surges – especially those living between the embankment and the shore (Fig. 3.4) – yet they continue to occupy these areas because they contain the only sources of livelihood that they know. Risks due to weather events are thus outweighed by the risk of failing to find another occupation. Furthermore, many have lived in these areas for their entire lives and have acquired fishing skills and ecological knowledge from their ancestors; they thus feel a deep personal connection to the area.

Fig. 3.4: Settlements on the edge of the embankment and close to the riverbank (Source: Photo taken by the first author)

3.4.2 Learning, Risk, and Complexity of Evacuation Decisions and Practices

Enhancing resilience through transformative learning entails a change in attitude toward natural hazard risks and resultant changes in coping practices to address and mitigate those risks. This requires both critical reflection on past disaster experiences (i.e. retrospective learning) and imagining future scenarios (i.e. prospective learning). In this section we examine how the traumatic experience of Cyclone Sidr affected risk perception and evacuation practices as well as decisions made during later weather events. We found risk mitigation measures are shaped by four main factors: i) the nature of the past traumatic event; ii) individuals' ability to imagine a worst-case scenario; iii) people's structural locations (e.g., gender); and iv) societal norms, values, and belief systems.

Relying solely on past experiences for risk evaluation without imagining potential worst-case scenarios can often lead to a lack of adequate preparedness (Abreu-Santos et al., 2017). For instance, most of the local people were not prepared for Cyclone Sidr (2007) as they had not experienced an event of that magnitude in the recent past. They had also received numerous false early warnings, to which they had become desensitized. When Cyclone Sidr made landfall many took refuge on the embankment as they had during previous storms, but the unprecedented intensity of Sidr was such that the embankment was breached by the storm surge in many places. Nevertheless, during Cyclones Aila (2009), Mahasen (2013), and Roanu (2016), many again took refuge on the embankment, and when interviewed suggested that they would continue to do so during future cyclones. Some even dismantled their houses and moved them closer to the embankment so they could quickly take refuge there in an emergency. Even though such actions demonstrate learning-based behavior, they relied on the false assumption that no Cyclone would ever be as or more powerful than Sidr.

Such assumptions may derive from an inability to imagine possible future scenarios. Locals reported, based on their indigenous knowledge, that Cyclone Sidr made landfall during a *dala* period, when a low spring tide causes lower-than-usual water levels ((-) (-) in Table 3.5). Based on this, many were confident that the surge would never reach the top of the embankment and felt safe sheltering there. They reported that even if a future cyclone coincided with a *Juba* high-water period, they would still seek shelter on the embankment and rely on the will of *Allah* to save them ((+) (+) in Table 3.5).

Table 3.5: Connection of lunar day and month with tides and water level

Tide type (by lunar day)	Water level by lunar month	
	Juba (i.e. very high water level) (+)	*Dala* (i.e. very low water level) (-)
High tide (+)	(+) (+)	(+) (-)
Low tide (-)	(-) (+)	(-) (-)

Source: Field investigation, 2018

However, the decision to evacuate is not linearly linked with past traumatic experience and the inability to predict worst-case scenarios; rather, numerous social-cultural signifiers, including societal norms, values, gender roles, and belief systems, shape people's decisions to evacuate or take refuge. The decision to not evacuate and risk remaining at home is a strategic choice – a form of practical consciousness. After receiving an early warning, women, children, and elders are often evacuated to cyclone shelters, while adult men remain home to safeguard their property from potential vandalism.

Another reason for not taking refuge in cyclone shelters is the distance to and lack of space within the shelters, which leads many people to conclude it is safer or more practical to remain at home:

> *How could we go to cyclone shelter that is far away from where we live? We cannot go that far. Cyclone shelter is in Chairman's office. What are we supposed to do? We do not have cyclone shelter nearby to go there quickly.*

Another important factor is the timing of the onset of a cyclone. People are more likely to take precautionary measures if a cyclone is expected to make landfall at night (which is considered more dangerous), while during the day they tend to wait until the last minute to evacuate.

> *Cyclone Aila came during day-time. No one bothered about it thinking that embankment could tackle the surge. No one took refuge ... in our region people do business with the sea. They are fearless. This is why no one evacuated during Aila as it was during day. We take shelter if a cyclone makes landfall during night.*

The final critical factor that shapes preparedness and evacuation is related to socially embedded practices, values, and norms. The gender dimension of these factors deserves particular attention here. On most days, fishers, who are mostly men, are out at sea while women remain at home with the children. Consequently, the responsibility of safeguarding the family and their property

during severe weather events falls mainly on women, and the decision to evacuate is heavily influenced by gendered cultural roles, norms, and expectations.

Women are generally more likely to evacuate and take refuge in the absence in their husband or adult male family member, particularly when they have small children. However, women in the study area were found to be reluctant to evacuate on account of numerous practical and social factors such as the need to prepare food, clothing, and other supplies for the children; risk of violating social norms such as *purdah* that for some would require a veiled area to conceal women from men; the physical difficulty of moving aged family members; and the desire to safeguard the family's property from vandalism or looting. Furthermore, as one respondent explained: "*Husband is in the sea why should I leave house for shelter, I would also die here*".

3.4.3 Transformative Learning, Risks, and Transformational Adaptation

Enhancing resilience via transformative learning entails a fundamental alteration in behavioral orientation toward risks associated with natural hazards and an accompanying transformation of adaptation practices. Such actions are collectively termed *transformational adaptation* – a fundamental change or alteration in adaptation practices (Few et al., 2017; Fook, 2015). We found that the key impetus for transformational adaptation is agents' ability for forward-thinking – that is, imagining a better future and altering their behavioral orientation toward risk to work towards it. Here, transformative learning is triggered by a form of discursive or reflexive consciousness, i.e. agents discursively scrutinizing their current adaptation practices and orientation toward risks.

Some examples of non-transformational preventative measures taken by locals after Cyclone Sidr include: raising house platforms, rebuilding houses with stronger materials, and dismantling houses and moving them closer to embankments. For inhabitants living outside or on the edge of the embankment, these measures were not sufficient to reduce risk significantly. However, our research documented actions based on transformative learning from disaster-shocks that resulted in transformational adaptation and consequent mitigation of risk from future cyclone events. One form of transformational adaptation that reduced risk significantly was complete relocation to areas protected by the embankment and with stronger housing structures, and sometimes productive agricultural land was even converted into settlement housing, representing a trade-off of livelihood for risk reduction. Many residents without access to protected land (the extremely

poor and/or landless) temporarily moved to towns or cities to work in the garment industry or open small shops in order to save enough money to relocate their homes behind the embankments. Some farmers with agricultural land behind embankments chose to relocate their homes to this land, with one respondent justifying the reduction in crop land by saying: "*Life is much worth than the crop*".

As outlined in the previous section, many people continue to live dangerously close to the seashore or riverbanks in order to gain access to natural resources. Many have found innovative ways of maintaining their traditional livelihoods while also mitigating risks from future cyclone events, for example, relocating their houses away from the shoreline and using different fishing nets that do not require staying close to the river, and making strategic use of household labor, such as dividing the fishing workload between father and adult son.

Some residents have found themselves unable to adapt and have been forced to move permanently inland to cities and towns to seek alternative livelihoods through inter- or intra-livelihood diversification. Notably, such permanent migration may also result from livelihood stress stemming from disaster-shocks rather than learning alone. As one respondent explained: "*I lost my house and boats during Sidr*[…] *I did not have two/three hundred thousand taka* [Bangladesh currency] *to reconstruct my boat* […] *we could not grow paddy for three years* […] *I was then 'forced' but voluntarily moved here* [town]". Some key informant interviewees reported that several households permanently migrated from the study community to other places due to a considerable decline in earnings following Cyclone Sidr.

The key question throughout this study was why, when faced with a disaster like Cyclone Sidr, some affected locals chose to adapt and carry out preventative measures while others did not. A thorough analysis of our data identified five major factors that shaped people's capacity for transformational adaptation: i) financial constraints; ii) type of household structure; iii) social networks and relationships; iv) social-cultural factors; and v) individual skills. Financial constraints were by far the greatest factor impeding peoples' ability to adapt to disasters. Few have the money to carry out preventative measures like relocating their homes, nor the spare time and energy to do so as most must work long hours every day just to survive. As one respondent explained: "*Some of us who do not have any option must stay on the embankment … if we had financial capacity we would have moved inside … but we have no other option and hence stay and live here…*".

Procurement of loans through social networks – such as remittances from close kin – helped some respondents overcome financial constraints and relocate. Many challenges still remain, however, such as adapting their livelihood to the new location and making the new home culturally conforming by excavating a pond for domestic uses, planting trees around the house to maintain *purda* (veiling/concealment of women), and building washroom facilities.

Some residents refuse to relocate despite having the financial capacity to do so due to close social-cultural ties to the community, as one woman explained:

> *I asked my husband several times that if we need to migrate where could we go. He replied that if other people can live here, why we could not. I saved some money to buy land elsewhere, but my husband wants to stay here to look after my parents-in-law. He does not want to leave his parents here. I wanted to take them with us but they do not want to go, so we cannot move inside the embankment.*

Lastly, individual skills – both social and technical – play critical roles in the transformational adaptation process. Fishing is the inherited occupation for most residents of the study area; they possess no other livelihood skills. Transformational adaptation may require changing occupation and learning a new skillset. Consequently, younger people with higher levels of education are better positioned to adapt to new challenges presented by the changing environment. One woman explained: *"They* [her husband and son] *understand matters of gung* [sea and river] *only. This is what they learned from their ancestors and their children will continue with the same. They do not know what education or other skills are all about…"*.

3.5 Discussion and Conclusion

Our investigation sought to understand the processes and factors that shape transformative learning and resilience to natural-induced disaster-shocks in southern coastal Bangladesh. We found that the relationship between transformative learning and resilience is complex, shaped by multiple social-cultural factors. Our findings are novel in three respects: i) little research has thus far been conducted on the links between transformative learning and hazard resilience through a cultural lens; ii) our emphasis on individual agency allows the factors that constrain critical reflective capacities and actions to be more accurately identified; and iii) we determined that the structural location of agents is crucial to learning and building resilience. These findings have profound policy and practical implications for building resilience in resource-dependent and place-based communities vulnerable to climate-induced disaster-shocks.

The cultural framing of risk and hazards underscores that the trade-off between risks and benefits with regards to livelihood security is an everyday phenomenon (Bankoff et al., 2015; Boholm, 2015; Oliver-Smith, 2015b). Our findings indicate that people may deny risk for cultural reasons, and that structural factors (e.g., power, wealth and/or lack of it) often lead people to accept higher levels of risk. Some recent empirical studies have affirmed that people often weight economics over disaster-risk in decision making. For example, Correll et al. (2020), in their investigation in the Mississippi River Delta in Louisiana, USA, found that although flood risk was an important factor in out-migration, economic opportunities had much greater effects on peoples' decisions. However, in our study in coastal Bangladesh, we found that individual decisions under conditions of cyclone disaster-risk and uncertainty are only partly consistent with the probability-weighting function of prospect theory or with calculations of utility maximization; rather, their decision matrix is much broader and more complex, and is intertwined with cultural and structural factors (also see Botzen et al. 2015).

The current literature on resilience through a cultural lens acknowledges the effects of cultural and social structures on risk and resilience (Webb 2018; Tierney 2014), but such framing ignores individuals' reflexive capacity for change/transformation in the context of climate change. Our study emphasizes that the coupled effects of both power and culture shape the process of transformative learning and resilience-building at the individual and community levels.

People take and accept excessive risks when they lack sufficient time, space, and opportunity to exercise discursive or reflexive consciousness. Building resilience to climate-induced disaster risks requires critical reflexivity and 'conscientization' (Pelling 2011). Moreover, both transformative learning theory and the climate resilience literature argue for a fundamental alteration in consciousness at the individual level in order to drive change at higher societal levels (Bahadur & Tanner, 2014; Hoggan, 2016). The combined influence of culturally-embedded practices, norms, and values, and structural identity (e.g., gender) factors appear to be major barriers to such shifts in consciousness.

Given the friction between building resilience and maintaining a livelihood, many people deliberately choose to forget past traumatic experiences and thus deny their risk, or they fatalistically accept the risk in order to carry on productively with their day-to-day struggle for survival (McEwen et al., 2016). Such deliberate amnesia is a strategic choice that helps maintain

what McWethy et al., (2019) call 'basic resilience' (i.e. the ability to "bounce back" from traumatic experiences) (Table 3.6). But while such strategies may appear productive in the short-term, they are likely to be counter-productive in the long term as they interfere with transformational learning and adaptation and are likely to constrain individuals from moving beyond basic resilience in the face of future, more severe disasters (McEwen et al. 2016; McWethy et al. 2019).

Table 3.6: Relationships of forms of consciousness, action, disaster risk with resilience

Types of actions	Nature of consciousness	Facilitating or constraining factors	Implication for disaster-risk and resilience
Livelihood activity	Practical consciousness	i) Cultural practices, beliefs, and values; and ii) risk imposition due to power asymmetry	- Denial of risk; - maintenance of 'basic resilience'
Preparedness and evacuation	Practical consciousness	i) Nature of experiential learning from past events; ii) ability to imagine a worst-case scenario; iii) people's structural location (e.g. gender); and iv) societal norms, values, and belief systems	- Neither complete denial nor full acknowledgement of risk - some preparedness measures and willingness to evacuate help reduce risk of loss and damage and consequently shape resilience positively
Relocation and transformational adaptation	Discursive consciousness	i) Financial constraints; ii) household structure; iii) social network and relationship; iv) social-cultural factors; and v) individual skills	- A serious consideration of risk; - a transformation in adaptation practices and consequent enhancement of resilience

Cognitive limitations (e.g., the inability to imagine worst-case scenarios) and fatalistic rationality (e.g., leaving one's fate in the hands of the Almighty) constrain individuals' reflective

capacities for transformative learning, and recent research suggests that experiential learning may lead to the perpetuation of false assumptions (e.g., that extreme weather events will never get worse) that leave people ill-prepared for future events (Abreu-Santos et al., 2017; Plümper et al., 2017). And when 'positive' learning does result from disaster experiences, many people are unable to translate this into action that would enhance resilience due to various social-cultural and structural constraints. While the psychological literature focuses on the cognitive aspects of risk reduction and evacuation from hazards (Paton, 2003; Slovic et al., 1977), sociological and anthropological literature focuses more on social and cultural factors (Baer et al., 2019; Tierney, 2014). The findings of our investigation reveal that these aspects are intertwined, cognitive reflective capacity being profoundly shaped by culture while disaster-preparedness and coping decisions depend significantly on socio-economic circumstances (Table 3.6).

In the context of climatic variability and change, incremental change or adaptation is not sufficient: transformational adaptation is required (Kates et al., 2012). The exercise of discursive consciousness helps overcome cultural constraints and enables reflection on risks associated with natural hazards, which can lead to a fundamental change in behavioral orientation and attitude toward risk (Table 3.6). Similarly, Choudhury and Haque (2016) documented that actions driven by discursive or reflexive consciousness have led to transformational adaptation to flash flood hazards in northeastern Bangladesh. While the role of consciousness in transformation in adaptation practices is highlighted in the psychological literature (Gifford, 2011; Swim et al., 2011), we posit that cognitive transformation must be accompanied by a transformation in practice, i.e. transformation in both the *personal* and *practical* spheres (O'Brien, 2018). However, we also acknowledge that some people are unable to transform their adaptation practices, despite achieving critical awareness, due to lack of financial capacity, skills, and other socio-cultural factors (Table 3.6). Our findings reaffirm that a shift in consciousness is not sufficient for a transformation in adaptation practices, especially at the community level. The structural and cultural barriers we identified that limit critical reflection capacity and constrain actions demand serious policy attention and need to be addressed with effective interventions.

To conclude, our investigation endeavored to unpack the complex link between transformative learning and community resilience to coastal cyclones. Evidence from Bangladesh's coastal communities reveals that both cultural and structural factors profoundly affect disaster-risk-reduction behavior. Future policy formulation should therefore pay serious

attention to removing some of the structural constraints and addressing individuals' cognitive barriers for change and transformation in order to build community resilience to disaster-shocks.

References

Abreu-Santos, I., Vasconcelos, L., & Pires, I. (2017). Learning from risk: lessons from L'Aquila and Japan / *Aprender del riesgo: lecciones de L'Aquila y Japón*. *Psyecology*, *8*(1), 107–147. https://doi.org/10.1080/21711976.2016.1267854

Anderson, J. (1968). Cultural adaptation to threatened disaster. *Human Organization*, *27*(4), 298–307. https://doi.org/10.17730/humo.27.4.anm4586632557246

Baer, R. D., Weller, S. C., & Roberts, C. (2019). The role of regional cultural values in decisions about hurricane evacuation. *Human Organization*, *78*(2), 133–146. https://doi.org/10.17730/0018-7259.78.2.133

Bahadur, A., & Tanner, T. (2014). Transformational resilience thinking: putting people, power and politics at the heart of urban climate resilience. *Environment and Urbanization*, *26*(1), 200–214. https://doi.org/10.1177/0956247814522154

Bankoff, G., Cannon, T., Krüger, F., Lisa, E., & Schipper, F. (2015). Introduction: exploring the links between cultures and disasters. In F. Krüger, G. Bankoff, T. Cannon, B. Orlowski, & E. L. F. Schipper (Eds.), *Cultures and disasters: Understanding cultural framings in disaster risk reduction* (pp. 1–16). Routledge. https://doi.org/10.1192/bjp.112.483.211-a

Bankoff, G. (2007). Living with risk; coping with disasters: hazard as a frequent life experience in the Philippines. *Education About Asia*, *12*(2), 26–29.

Bankoff, G. (2003). *Cultures of disaster: Society and natural hazard in the Philippines*. Routledge.

Berkes, F., & Ross, H. (2013). Community resilience: toward an integrated approach. *Society and Natural Resources*, *26*(1), 5–20. https://doi.org/10.1080/08941920.2012.736605

Berkes, F. (2007). Understanding uncertainty and reducing vulnerability: lessons from resilience thinking. *Natural Hazards*, *41*(2), 283–295. https://doi.org/10.1007/s11069-006-9036-7

Berkes, F., & Seixas, C. S. (2005). Building resilience in lagoon social-ecological systems: a local-level perspective. *Ecosystems*, *8*(8), 967–974. https://doi.org/10.1007/s10021-005-0140-4

Bernoulli, D. (1954). Exposition of a new theory on the measurement of risk. *Econometrica, 22*(1), 23-36.

Blaikie, P., Cannon, T., Wisner, B., & Davis, I. (2005). *At risk: natural hazards, people's vulnerability and disasters* (2nd ed.). Routledge. https://doi.org/10.4324/9780203428764

Boholm, Å. (2015). *Anthropology and risk*. Routledge. https://doi.org/10.1017/CBO9781107415324.004

Botzen, W. W., Kunreuther, H., & Michel-Kerjan, E. (2015). Divergence between individual perceptions and objective indicators of tail risks: evidence from floodplain residents in New York City. *Judgment and Decision Making*, *10*(4), 365-385.

Carpenter, S. R., Westley, F., & Turner, M. G. (2005). Surrogates for resilience of social-ecological systems. *Ecosystems*, *8*(8), 941–944. https://doi.org/10.1007/s10021-005-0170-y

Casebeer, D., & Mann, J. (2017). Mapping theories of transformative learning. *Cartographica: The International Journal for Geographic Information and Geovisualization*, *52*(3), 233–237. https://doi.org/10.3138/cart.52.3.3956

Cerulo, K. A. (2002). Eatablishing a sociology of culture and cognition in K. A.Cerulo (Eds.), *Culture in mind: Toward a sociology of culture and cognition* (pp. 1-14). Routledge.

Choudhury, M-U-I, & Haque, C. E. (2018). Interpretations of resilience and change and the catalytic roles of media: a case of Canadian daily newspaper discourse on natural disasters. *Environmental Management*, *61*(2), 236–248. https://doi.org/10.1007/s00267-017-0980-7

Choudhury, M-U-I, & Haque, C. E. (2016). "We are more scared of the power elites than the floods": adaptive capacity and resilience of wetland community to flash flood disasters in Bangladesh. *International Journal of Disaster Risk Reduction*, *19*, 145–158. https://doi.org/10.1016/j.ijdrr.2016.08.004

Correll, R. M., Lam, N. S. N., Mihunov, V. V., Zou, L., & Cai, H. (2020). Economics over risk: flooding is not the only driving factor of migration considerations on a vulnerable coast. *Annals of the American Association of Geographers*, *111*(1), 300-315. https://doi.org/10.1080/24694452.2020.1766409

Creswell, J. W., (2007). *Qualitative inquiry and research design: choosing among five approaches.* (1st ed.). Sage.

Cutter, S. L., Barnes, L., Berry, M., Burton, C., Evans, E., Tate, E., & Webb, J. (2008). A place-based model for understanding community resilience to natural disasters. *Global Environmental Change*, *18*(4), 598–606. https://doi.org/10.1016/j.gloenvcha.2008.07.013

Douglas, M., & Wildavsky, A. (1983). *Risk and culture: An essay on the selection of technical*

and environmental dangers. University of California Press.

Faulkner, L., Brown, K., & Quinn, T. (2018). Analyzing community resilience as an emergent property of dynamic social-ecological systems. *Ecology and Society*, *23*(1), 24. https://doi.org/10.5751/ES-09784-230124

Few, R., Morchain, D., Spear, D., Mensah, A., & Bendapudi, R. (2017). Transformation, adaptation and development: relating concepts to practice. *Palgrave Communications*, *3,* 17092. https://doi.org/10.1057/palcomms.2017.92

Fincher, R., Barnett, J., Graham, S., & Hurlimann, A. (2014). Time stories: making sense of futures in anticipation of sea-level rise. *Geoforum*, *56*, 201–210. https://doi.org/10.1016/j.geoforum.2014.07.010

Folke, C., Carpenter, S. R., Walker, B., Scheffer, M., Chapin, T., & Rockstrom, J. (2010). Resilience thinking: integrating resilience, adapatability, and transformability. *Ecology and Society*, *15*(4), 20. http://www.ecologyandsociety.org/vol15/iss4/art20/

Fook, T. C. T. (2015). Transformational processes for community-focused adaptation and social change: a synthesis. *Climate and Development*, *9*(1), 5–21. https://doi.org/10.1080/17565529.2015.1086294

Giddens, A. (1984). *The constitution of society: Outline of the theory of structuration*. University of California Press.

Gierlach, E., Belsher, B. E., & Beutler, L. E. (2010). Cross-cultural differences in risk perceptions of disasters. *Risk Analysis*, *30*(10), 1539–1549. https://doi.org/10.1111/j.1539-6924.2010.01451.x

Gifford, R. (2011). The dragons of inaction: psychological barriers that limit climate change mitigation and adaptation. *American Psychologist*, *66*(4), 290–302. https://doi.org/10.1037/a0023566

GoB. (2008). *Cyclone Sidr in Bangladesh- damage, loss and needs assessment for disaster recovery and reconstruction*. https://reliefweb.int/report/bangladesh/cyclone-sidr-bangladesh-damage-loss-and-needs-assessment-disaster-recovery-and

Gunderson, L. H. (2000). Ecological resilience—in theory and application. *Annual Review of Ecology and Systematics*, *31*(1), 425–439. https://doi.org/10.1146/annurev.ecolsys.31.1.425

Hoggan, C. D. (2016). Transformative learning as a metatheory: definition, criteria, and typology. *Adult Education Quarterly*, *66*(1), 57–75.

https://doi.org/10.1177/0741713615611216

Holling, C. S. (1973). Resilience and stability of ecological systems. *Annual Review of Ecology and Systematics.*, *4*, 1–23. https://doi.org/10.1146/annurev.es.04.110173.000245

Imperiale, A. J., & Vanclay, F. (2016). Experiencing local community resilience in action: learning from post-disaster communities. *Journal of Rural Studies*, *47*, 204–219. https://doi.org/10.1016/j.jrurstud.2016.08.002

IPCC. (2014). Climate Change 2014: Impacts, Adaptation, and Vulnerability Part B: Regional Aspects. In C. B. Field, V. R. Barros, D. J. Dokken, K. J. Mach, M. D. Mastrandrea, T. E. Bilir, M. Chatterjee, K. L. Ebi, Y. O. Estrada, R. C. Genova, B. Girma, E. S. Kissel, A. N. Levy, S. MacCracken, P. R. Mastrandrea, & L. L. White (Eds.). *Working group II contribution to the fifth assessment report of the Intergovernmental Panel on Climate Change*. Cambridge University Press. https://doi.org/www.cambridge.org/9781107641655

Islam, M.R. (2018). Climate change, natural disasters and socioeconomic livelihood vulnerabilities: migration decision among the char land people in Bangladesh. *Social Indicators Research*, *136*(2): 575–593. https://doi.org/10.1007/s11205-017-1563-y

Jacobson, M., & Rugeley, C. (2007). Community-based participatory research: group work for social justice and community change. *Social Work with Groups*, *30*(4), 21–39. https://doi.org/10.1300/J009v30n04_03

Johnson-Bailey, J. (2012). Positionality and transformative learning: a tale of inclusion and exclusion. In E. W. Taylor & P. Cranton (Eds.), *The handbook of transformative learning: Theory, research, and practice* (pp. 260-273). John Wiley & Sons.

Kahneman, D., & Tversky, A. (1979). Prospect theory: an analysis of decision under risk. *Econometrica*, *47*(2), 263–292.

Kates, R. W., Travis, W. R., & Wilbanks, T. J. (2012). Transformational adaptation when incremental adaptations to climate change are insufficient. *Proceedings of the National Academy of Sciences*, *109*(19), 7156–7161. https://doi.org/10.1073/pnas.1115521109

Kerton, S., & Sinclair, A. J. (2010). Buying local organic food: a pathway to transformative learning. *Agriculture and Human Values*, *27*(4), 401–413. https://doi.org/10.1007/s10460-009-9233-6

Kulatunga, U. (2010). Impact of culture towards disaster risk reduction. *International Journal of*

Strategic Property Management, *14*(4), 304–313. https://doi.org/10.3846/ijspm.2010.23

Loyal, S. (2015). *The Sociology of Anthony Giddens*. Pluto Press.

Levy, J. S. (1992). An introduction to prospect theory. *Political Psychology*, *13*(2),171-186. http://www.jstor.org/stable/3791677

Luce, R.D. and H. Raffia. (1957). *Games and decisions*. John Wiley & Sons, Inc.

McCaffrey, S., Wilson, R., & Konar, A. (2018). Should I stay or should I go now? Or should I wait and see? Influences on wildfire evacuation decisions. *Risk Analysis*, *38*(7), 1390–1404. https://doi.org/10.1111/risa.12944

McEwen, L., Garde-Hansen, J., Holmes, A., Jones, O., & Krause, F. (2016). Sustainable flood memories, lay knowledges and the development of community resilience to future flood risk. *Transactions of the Institute of British Geographers*, *42*(1), 14–28. https://doi.org/10.1111/tran.12149

McWethy, D. B., Schoennagel, T., Higuera, P. E., Krawchuk, M., Harvey, B. J., Metcalf, E. C., Schultz, C., Miller, C., Metcalf, A. L., Buma, B., Virapongse, A., Kulig, J. C., Stedman, R. C., Ratajczak, Z., Nelson, C. R., & Kolden, C. (2019). Rethinking resilience to wildfire. *Nature Sustainability*. https://doi.org/10.1038/s41893-019-0353-8

Merriam, S. B., & Ntseane, G. (2008). Transformational learning in Botswana: how culture shapes the process. *Adult Education Quarterly*, *58*(3), 183–197. https://doi.org/10.1177/0741713608314087

Mertens, D. M. (2012). Transformative mixed methods: addressing inequities. *American Behavioral Scientist*, *56*(6), 802–813. https://doi.org/10.1177/0002764211433797

Mertens, D. M. (2007). Transformative paradigm: Mixed methods and social justice. *Journal of Mixed Methods Research*, *1*(3), 212–225. https://doi.org/10.1177/1558689807302811

Mezirow, J. (2008). An overview on transformative learning. In P. Sutherland & J. Crowther (Eds.), *Lifelong learning concepts and contexts* (2nd ed., pp. 24–38). Routledge.

Mezirow, J. (1997). Transformative learning: theory to practice. *New Directions for Adult and Continuing Education*, *1997*(74), 5–12. https://doi.org/10.1002/ace.7401

Mezirow, J. (1978). Perspective transformation. *Adult Education Quarterly*, *28*(2), 100–110. https://doi.org/10.1177/074171367802800202

O'Brien, K. (2018). Is the 1.5°C target possible? Exploring the three spheres of transformation. *Current Opinion in Environmental Sustainability*, *31*, 153–160.

https://doi.org/10.1016/j.cosust.2018.04.010

Oliver-Smith, A. (2016). Disaster risk reduction and applied anthropology. *Annals of Anthropological Practice*, *40*(1), 73–85. https://doi.org/10.1111/napa.12089

Oliver-Smith, A. (2015a). Conversations in catastrophe: neoliberalism and the cultural construction of disaster risk. In F. Krüger, G. Bankoff, T. Cannon, B. Orlowski, & E. L. F. Schipper (Eds.), *Culture and disasters: Understanding cultural framings in disaster risk reduction* (pp. 37–52). Routledge.

Oliver-Smith, A. (2015b). Hazards and disaster research in contemporary anthropology. In *International Encyclopedia of the Social & Behavioral Sciences* (2nd ed., pp. 546-553). Elsevier. https://doi.org/10.1016/B978-0-08-097086-8.12188-9

Paton, D. (2003). Disaster preparedness: a social-cognitive perspective. *Disaster Prevention and Management: An International Journal*, *12*(3), 210–216. https://doi.org/10.1108/09653560310480686

Paveglio, T. B., Boyd, A. D., & Carroll, M. S. (2017). Re-conceptualizing community in risk research. *Journal of Risk Research*, *20*(7), 931–951. https://doi.org/10.1080/13669877.2015.1121908

Pelling, M. (2011). *Adaptation to climate change: from resilience to tranformation*. Routledge. https://doi.org/10.4324/9780203889046

Pretty, Jules. N., & Vodouhê, Simplice.D. (1997). Using rapid or participatory rural appraisal. In Swanson, B.E., Bentz, R.P. & Sofranko, A.J. (eds.). *Improving agricultural extension*. A reference manual. Rome: Food and Agriculture Organization of the United Nations.

Plümper, T., Quiroz Flores, A., & Neumayer, E. (2017). The double-edged sword of learning from disasters: mortality in the Tohoku tsunami. *Global Environmental Change*, *44*, 49–56. https://doi.org/10.1016/j.gloenvcha.2017.03.002

Ross, H., & Berkes, F. (2014). Research approaches for understanding, enhancing, and monitoring community resilience. *Society and Natural Resources*, *27*(8), 787–804. https://doi.org/10.1080/08941920.2014.905668

Sharpe, J. (2016). Understanding and unlocking transformative learning as a method for enabling behaviour change for adaptation and resilience to disaster threats. *International Journal of Disaster Risk Reduction*, *17*, 213–219. https://doi.org/10.1016/j.ijdrr.2016.04.014

Slovic, P., Fischhoff, B., & Lichtenstein, S. (1977). Cognitive processes and societal risk taking. *Decision Making and Change in Human Affairs*, *16*(40), 7–36. https://doi.org/10.1007/978-94-010-1276-8_2

Smith, K. (2004). *Environmental hazards: Assessing risk and reducing disaster* (4th ed.). Routledge.

Sun, L., & Faas, A. J. (2018). Social production of disasters and disaster social constructs: an exercise in disambiguation and reframing. *Disaster Prevention and Management: An International Journal*, *27*(5), 623–635. https://doi.org/10.1108/DPM-05-2018-0135

Swim, J. K., Stern, P. C., Doherty, T. J., Clayton, S., Reser, J. P., Weber, E. U., Gifford, R., & Howard, G. S. (2011). Psychology's contributions to understanding and addressing global climate change. *American Psychologist*, *66*(4), 241–250. https://doi.org/10.1037/a0023220

Tierney, K. (2014). *The social roots of risk : Producing disasters, promoting resilience*. Stanford University Press.

Wakker, P. P. 2010. *Prospect theory for risk and ambiguity*. Cambridge University Press.

Walker, B., Holling, C. S., Carpenter, S. R., & Kinzig, A. (2004). Resilience, adaptability and transformability in social–ecological systems. *Ecology and Society*, *9*(2), 5. http://www.ecologyandsociety.org/vol9/iss2/art5/

Walters, V., & Gaillard, J. C. (2014). Disaster risk at the margins: homelessness, vulnerability and hazards. *Habitat International*, *44*, 211–219. https://doi.org/10.1016/j.habitatint.2014.06.006

Watts, M. J., & Bohle, H. G. (1993). Hunger, famine and the space of vulnerability. *GeoJournal*, *30*(2), 117–125. https://doi.org/10.1007/BF00808128

Webb, G. R. (2018). The cultural turn in disaster research: understanding resilience and vulnerability through the lens of culture. In H. Rodríguez, W. Donner, & J. E. Trainor (Eds.), *Handbook of disaster research* (2nd ed., pp. 109–121). Springer International Publishing. https://doi.org/10.1007/978-3-319-63254-4_2

Wilner, K. B., Wiber, M., Charles, A., Kearney, J., Landry, M., & Wilson, L. (2012). Transformative learning for better resource management: the role of critical reflection. *Journal of Environmental Planning and Management*, *55*(10), 1331–1347. https://doi.org/10.1080/09640568.2011.646679

Supplementary Materials S 3.1

Determination of sample size

The size (n) of the sample was determined by employing the following commonly-used statistical formula:

$$n = \frac{P(1-P)\left(Z_{\alpha/2}\right)^2}{(P-p)^2}$$

n = 0.19 (1- 0.19) x $(1.96)^2/(0.05)^2$

n = 0.19 (0.81) (3.8416) /0.0025

n = 236.49 ≈ 236

where n = Size of sample (Households) = 236, P = Proportion to be estimated = 0.19, p = Estimate of P, P - p = Margin of error in p = 0.05. Z = 1.96 (95%)

Source: Based on Islam (2018).

CHAPTER FOUR

Adaptive Governance and Community Resilience to Cyclones in Coastal Bangladesh:

Addressing the Problem of Fit, Social Learning, and Institutional Collaboration[4]

Abstract

Building community resilience to climate-induced disaster shocks requires an innovative, adaptive, and forward-looking approach. However, empirical data on such initiatives is lacking. Adopting an Adaptive Governance Framework, we gathered evidence that collaborative multi-loop social learning by multilevel institutions (local, regional, and national) can significantly enhance community resilience to climate-induced disaster shocks and reduce gaps between institutional disaster governance responsibilities and capacities. Following a Case Study approach, we investigated the disaster resilience of two coastal communities in Bangladesh. Our primary data collection techniques were Key Informant Interviews and document reviews. The results of our investigation revealed three key prerequisites for building community resilience to nature-triggered disasters like cyclones or floods: i) the presence of multiple nested institutional structures at the local level; ii) multi-loop social learning at multiple institutional levels; and iii) documentation of lessons learned from each disaster and the application of these lessons to disaster governance at all institutional levels. We documented that bridging organizations play a decisive role in documenting and scaling-up lessons learned from episodic extreme weather events. Therefore, more emphasis needs to be placed on the importance of bridging organizations in scaling up lessons from episodic disaster events into national-level policy and practice.

4.1 Introduction

Disaster risks associated with extreme weather events are increasing due to increased climatic variability (Woodruff et al., 2013). Despite numerous initiatives for disaster risk reduction (DRR) at the national, regional, and local level, the financial cost and loss of human lives from extreme weather events continues to climb (UNDRR, 2019). We posit that building and strengthening resilience to such complex problems requires adaptive, innovative, and forward-thinking approaches (Berkes, 2007), especially in the area of governance.

Adaptive governance (AG) has been proposed as a useful strategy for dealing with the uncertainty associated with climate-induced disaster risks (Walch, 2019; Djalante et al., 2011). This approach involves three main strategies: i) *analytic deliberation* – dialogue among multiple actors, ii) *nesting* – multi-layered institutions, and iii) *institutional variety* – the involvement of state, non-state, and community-based institutions (Dietz et al., 2003, p. 1910). Djalante et al. (2011, p. 4) have identified four components of AG relevant to the context of environmental disasters: i) *polycentric and multilayered institutions,* ii) *participation and collaboration,* iii) *self-organization and networks,* and iv) *learning and innovation.* In this paper, we primarily focus on two types of formal institutions for adaptive disaster governance: i) state institutions at multiple jurisdictional levels, and ii) national and local level non-governmental organizations (NGOs) and community-based institutions working on DRR and disaster management (DM). *Governance* is understood here as the creation and design of institutions or development of mechanisms for sharing power and responsibility for societal collaboration and the setting of procedural rules for collective action (Folke et al., 2005); and *institutions* refers primarily to the formal and informal norms, formal legal rules and regulations, and the associated organizational infrastructure that governs behavior, action, and practices at collective level (Ostrom, 2008).

A key question that arises is whether these institutions are a good fit for the temporal, functional, and spatial requirements of DRR and DM (Cash et al., 2006; Folke et al., 2007). In this study, we are primarily concerned with problems of institutional fit at the local level, where three forms of mismatch are relevant. *Spatial mismatches* occur when the capacity (e.g., financial, technical) of an institution does not align with the spatial aspects of DM (e.g., a drought or a flood that spreads across several administrative jurisdictions). *Temporal mismatches* include the inability of an institution to respond rapidly to a disaster occurring in real-time, or to plan long-term for future disasters. Finally, *functional mismatches* occur when institutional

functions are not suited to effective DM (e.g., due to lack of adequate staff, training, equipment, etc.) (cf. Cumming et al., 2006; Lee, 1993).

Recognizing that community resilience is an important element in the AG process (Berkes, 2017), we focus specifically on community resilience to climate-related environmental shocks. *Community resilience* is defined here as the ability of a community to withstand external shocks and disruptions with minimal or no external support (Berkes and Ross, 2013; Faulkner et al., 2018). It also implies the extent to which communities and institutions at multiple levels are able to learn from past experiences and reduce future risks (UNISDR, 2005). We identify three key aspects of institutions relevant to using AG to strengthen community resilience: i) local institutional capacity; ii) multilevel institutional collaboration; and iii) multilevel institutional learning.

The capacity of local institutions to carry out DRR and DM is closely associated with community resilience and self-organization, as external assistance often requires significant time to arrive (Berkes, 2007; Choudhury et al., 2019). However, often the capacity of local institutions is insufficient to cope with large-scale disasters; strengthening resilience at the local level therefore requires a multilevel governance system (Adger et al., 2005). We posit that the intent and practice of collaboration among nested institutions is likely to increase self-organization and flexibility and, help overcome the problems of fit described above (Berkes, 2017; Pahl-Wostl, 2009). In understanding institutional collaboration, the degree of horizontal and vertical institutional linkages and the role of bridging organizations has been recognized as vital (Crona & Parker, 2012; Young, 2002, 2006). Bridging organizations connect multiple actors through strategic linkages and networking actions (Crona and Parker, 2012).

AG and resilience building require social or institutional learning (Berkes, 2007; Pahl-Wostl, 2009), defined as "a change in understanding that goes beyond the individual to become situated within wider social units or communities of practice through social interactions between actors within social networks" (Reed et al., 2010, p. 6). Learning can be single-, double- and triple-loop. The former two was developed by Argyris and Schon (1978) in the context of organizational studies while a number of authors in the 1990s contributed to the development of the latter, inspired by Bateson (1973) (for more detail see Tosey et al., 2011). *Single-loop* refers to the adjustments made in response to mistakes and involving improvement in routinized practices: Are we doing things correctly? In the context of DM, it implies increasing the

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effectiveness and efficiency of existing institutional protocols and practices for evacuation, response, relief, and rehabilitation operations, i.e. improvement in action (Fig. 1). Single-loop learning is concerned with several key questions: What needs to be done to ensure such activities are done correctly? What are the experiences and observations regarding implementation of such activities that can inform further improvement? What are the challenges to implementing these improvements? *Double-loop* learning involves thinking 'outside the box' and examining the fundamental assumptions behind actions taken in response to crises. The key question is: Are we doing the right things to accomplish our goals? In the context of DM, it implies asking questions or making observations regarding the effectiveness of established procedure or strategies to successfully manage disasters, such as: Is relief distribution the right thing to do to support early recovery? (Fig. 4.1). *Triple-loop* learning involves making changes to underlying norms and values that guide action: What is the right thing to do? What should our goals be? How do we decide what is right? In the case of institutional learning in relation to DM, triple-loop learning involves a paradigm shift in the approach to DM and DRR, and in the developing country context this usually involves upper-level institutions (Fig. 4.1) (Medema et al., 2014; Pahl-Wostl, 2009).

Multi-loop learning is an iterative and reflexive process (Pahl-Wostl, 2009), which in this paper we explore at multiple institutional levels. We assert that institutions at different administrative levels are likely to register multi-loop learning differently (Mian, 204; Mutahara et al., 2018). In such cases, bridging organizations play a critical role in: i) institutionalizing and scaling up social learning, and ii) nurturing institutional memory and bringing innovation and global experience into governance mechanisms. These can be regarded as necessary conditions for enhancing community resilience to nature-triggered extreme events, i.e., outcomes (Fig. 4.1).
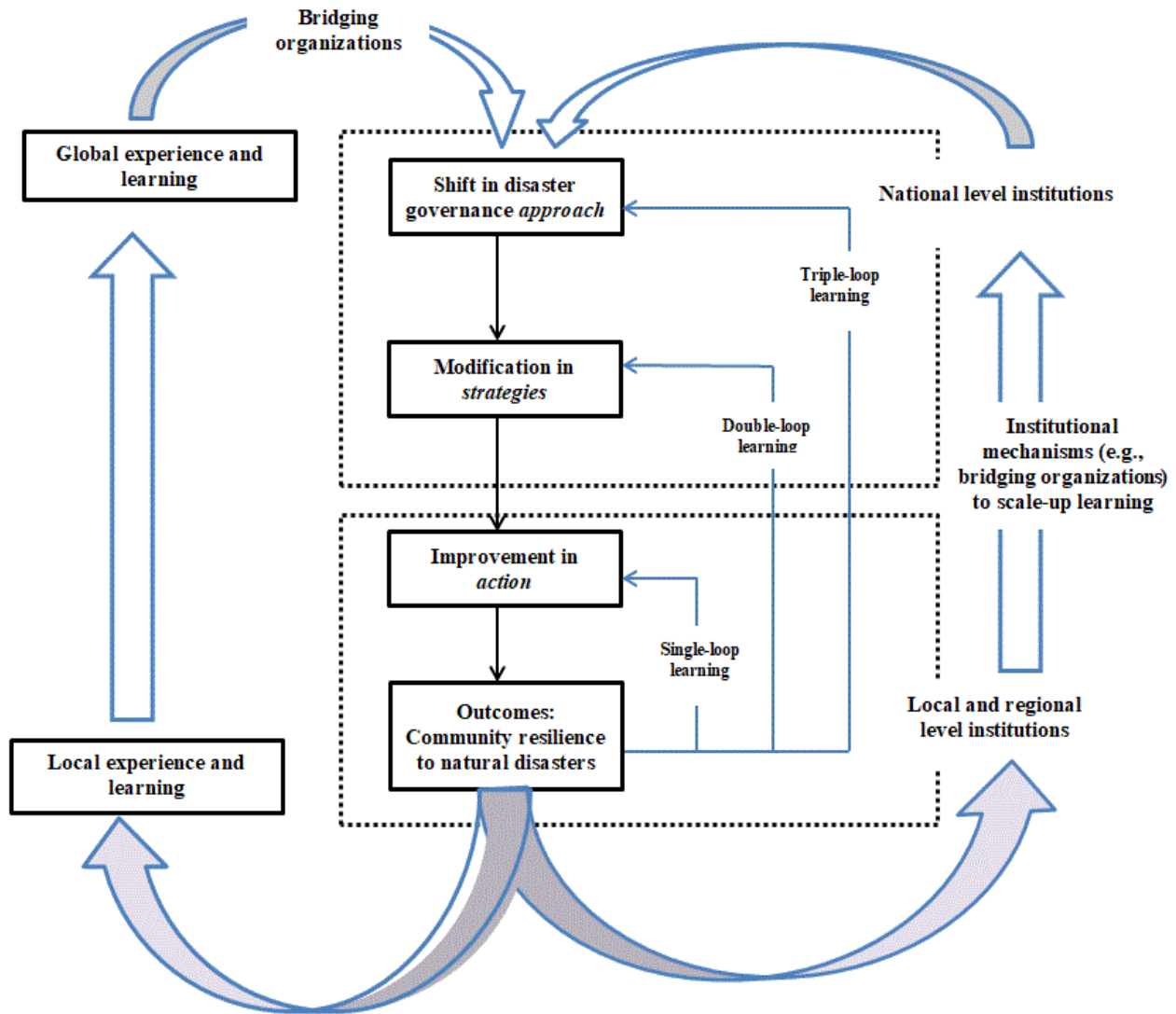
Fig. 4.1: Multi-loop learning, multi-level institutions, adaptive disaster governance, and community resilience to nature-triggered extreme events [after Armitage et al., 2008 and Pahl-Wostl (2009)].

Despite a wide recognition of the role of institutional capacity building, collaboration, and social learning in AG, some scholars argue for a fundamental change in governance strategies and institutional culture for successful AG (Young, 2017). For instance, power sharing at all levels (i.e., from national to local and among different actors) is a necessary element in adaptive and multi-level environmental governance, including in relation to disaster risks (Blackburn, 2014; Folke et al., 2005). Problems of institutional fit at the local level partly result from the lack of a transfer of power regarding financial decision making and authority (Clement, 2010). Some have highlighted that devolution of disaster governance to the local level remains

incomplete due to the retention of power and resources at higher levels (Blackburn, 2014; Gera, 2018; Marks and Lebel, 2016). Moreover, attention to local-level politics and decision-making dynamics also facilitates a contextualized understanding of the underlying causes of institutional mismatches (Mutahara et al., 2019; Whaley and Weatherhead, 2015). However, the transfer of power and resources is a means to an end. Disaster management and planning at the local level also has a technical underpinning, lack of which may limit the ability to exercise power and utilize resources. At the national level, fundamental alternations in institutional practice, culture, and flexibility are also required for learning-based improvement in actions (Pierre, 2012).

Bangladesh has a long history of DRR accomplishments, despite being highly vulnerable to climate-induced shocks. Compared to the two most devastating cyclones in Bangladesh's history in 1970 and 1991, which claimed more than 500,000 and 138,868 lives respectively, the 2007 'super-cyclone' Sidr caused the deaths of only 3,406 people (Paul, 2009). Such a reduction in human fatalities can be attributed to institutional changes in DRR and the reinforcement of local community resilience to climate-induced disasters. This makes the coastal communities of Bangladesh a valuable case study for exploring how multilevel institutional learning contributes to the enhancement of resilience to climate-induced shocks.

Parallel to the AG approach, Bangladesh has developed a multilevel institutional partnership approach to improve disaster governance. This approach is evident in recent policy documents, such as the National Plan for Disaster Management (2010–2015 and 2016–2020) (DMB-Bangladesh, 2010; MoDMR, 2017) and the Standing Orders on Disaster (SOD) (MoFDM, 2010, 2019). The SOD outlines the roles that every governing institution (both governmental and non-governmental) is required to perform within its jurisdiction for each component of the DM cycle (i.e., preparedness, response, recovery, and rehabilitation). (MoFDM, 2010, 2019). The SOD was first formulated in 1997 and subsequently updated in 2010 and 2019. Experience and learning from multilevel institutional interventions are assumed to play a significant role in such revisions and modifications.

The primary purpose of this article is to examine the role of multilevel collaboration and learning in shaping community resilience to cyclones in coastal Bangladesh. The specific objectives are: i) to examine local-level institutional collaborations and their effectiveness in strengthening community resilience to disaster shocks; ii) to identify and document multi-loop

learning by multilevel institutions; and iii) to determine the roles of bridging organizations in institutionalizing social learning and shaping community resilience to disaster shocks.

4.2 Methods and Study Area

To understand the role of social learning and institutional collaboration in shaping community resilience to cyclones in coastal regions of Bangladesh, we applied a case study approach using a qualitative research lens. We applied a *single instrumental* case study design since our focus was on a single issue (social learning) rather than the 'case' itself (Yin, 2014). Data collection techniques consisted of key informant interviews (KIIs) and document reviews. We conducted a total of 51 KIIs and collected relevant documents from August 2018 to January 2019. The primary criterion for selecting KIs for interviews was direct or indirect involvement in DM activities and associated institutional decision making (see Supplementary Materials).

Our empirical investigation was conducted in the southern coastal Barguna district of Bangladesh. We covered two *Upazilas* (sub-districts) – Amtali and Taltali – and one Union *Parishad* (UP) per *Upazila*. We conducted 32 KIIs with local and regional-level representatives from government, non-government, and community-based institutions, each interview ranging from 45 to 90 minutes in length (see Supplementary Materials for KII key questions).

Interviews were also conducted with three members of the Government of Bangladesh's Department of Disaster Management, the central authority that manages all DRR and disaster resilience activities, as well as with the representative of the Bangladesh Meteorological Department, the organization in charge of detecting cyclones and providing early warning. To understand issues related to learning and bureaucratic culture, we conducted interviews with four senior level bureaucrats, both retired and in service. We conducted 11 interviews with nine national and international NGOs that we considered to be bridging organizations. Key factors considered in these interviews included: i) the nature of collaboration with governmental departments and local-level institutions, ii) lessons learned from past experiences, and iii) changes in DRR and DM approaches and strategies over time.

The first author conducted all the interviews with appropriate verbal (audio recorded) and written consent, following ethics protocol approved by the University of Manitoba Research Ethics Board. Interviews were conducted either in Bengali or in English language according to the convenience of the respondents. All interviews were audio recorded, later transcribed into verbatim. Bengali verbatim was translated into English by the first author. The first and second

authors can speak and write Bengali language, both of them cross-checked the translation to ensure that meanings are not distorted during translation.

The first author took lead in coding interview texts, adopting a two-stage hybrid coding process with necessary modifications of the Fereday and Muir-Cochrane (2006) and Azungah (2018) processes. In the first stage, texts were inductively coded (i.e. drive by theory) following several *a priori* themes (Fereday and Muir-Cochrane, 2006), such as texts that exhibit the attributes of *single-*, *double-*, and *triple-loop* learning; forms of institutional collaborations; types of institutional mismatches and strategies to overcome them; and strategies to nurture institutional memory. All authors checked the alignment of *a priori* themes with the conceptual framing of this manuscript and agreed upon these *a priori* themes. In the second stage, data were then coded deductively (i.e. data-driven) for additional themes and sub-themes. For example, after extracting texts under the categories of different learning loops and institutional collaboration, additional categories and themes were recognized for a number of key questions (see Supplementary Materials).

Document analysis provided data on: i) various types of recorded social learning, ii) various forms of institutional collaboration, and iii) the capacity (financial and technical) of local-level state institutions. Documents considered for analysis included Lessons Learned documents, minutes of DM committee meetings, annual UP budgets, NGO project reports, and workshop reports. To analyze the selected documents, we developed, following Deverell (2009), a protocol to code and extract data on social learning and other relevant topics, such as institutional collaboration (see Supplementary Materials).

Lastly, themes emerging from document analysis were cross-tabulated and triangulated with themes from interview for overlaps, connections, and robust themes and analysis (Azungah, 2018). The first two authors individually cross-checked all coding for consistency and overlap. A peer debriefing strategy with collaborators was applied to ensure interval validity and credibility of this research (Baxter and Eyles, 1997). After several round of cross-checking and consultations by the members of the research team, all authors reached a consensus agreement.

4.3 Findings and Analysis:

4.3.1 Local-level Dynamics and Community Resilience: Issues of Mismatch and Institutional Collaboration

We concentrate here on the UP, the lowest formal administrative level in the Government of Bangladesh. According to the SOD, UPs are required carry out 30 different activities during various phases of disasters. It is thus vital to determine whether local-level institutions possess the capacity to effectively carry out their assigned roles and responsibilities.

Our empirical findings reveal that the current financial and technical capacities of the studied UPs exhibit significant spatial, functional, and temporal mismatches. Due largely to budgetary constraints, UPs struggle to fulfil their routine duties, such as structural and non-structural development activities. UPs generally rely on the national government and donor agencies to overcome deficits in their annual budget; however, such financial assistance is often accompanied with conditions to spend funds in certain ways. This does not allow UPs to utilize the funding according to their own needs and preferences.

We found that DM and DRR roles and responsibilities are delegated to the UPs by higher authorities without the accompanying funds, authority, or resources necessary for capacity building. For instance, during the 2011-2019 period, Arpangashia UP's own contribution to its annual budget was only 10-19% (Table 4.1). A senior decision maker in the Arpangashia UP revealed that UPs are only able to collect 25-30% of their targeted tax revenues, creating large deficits. This reflects institutional weakness in both raising funds and carrying out even routine duties, never mind taking on DRR initiatives. The Arpangashia UP was able to allocate less than 1% of its total development budget to disaster preparedness and response (Table 4.1). The same senior decision maker also revealed that they lack the technical knowledge and equipment needed to disseminate early warnings.

Table 4.1: Distribution (%) and allocation of UP's annual budget fund for development programs, DRR and DM activities, Arpangashia Union (Amtali Sub-district of Barguna District)

Fiscal year	% of UP's own fund in budget (development)	% of budget fund allocated for DRR and DM
2011-2012	10.51	0.99
2012-2013	10.72	0.92

Fiscal year	% of UP's own fund in budget (development)	% of budget fund allocated for DRR and DM
2013-2014	10.72	0.92
2014-2015	11.84	0.92
2015-2016	12.98	0.46
2016-2017	12.23	0.38
2017-2018	18.86	-
2018-2019	13.47	0.27

Source: UP's annual budget

We identified two important political processes that significantly shape UPs' access to resources. First, the process of local politics becoming encapsulated into national politics is relevant here. Even though such processes commenced in the 1970s, in recent years it has become consolidated through institutionalization, i.e., a process of electoral reform has taken place. In the past, candidates for local office (i.e., UPs and *Upazilas*) participated in the election process without representing any political party. Since 2016, candidates are required to be affiliated with as well as represent a political party. Therefore, elected representatives who are from the ruling party are likely to receive greater patronage in terms of financial resources compared to those who represent the opposing party. The second process involves the local political power structure, where Members of Parliament (MPs) exert considerable influence on the allocation of central government funds to local projects and programs (Lewis and Hossain, 2019; Uddin, 2016). In regard to this, a senior level UP representative stated: "In reality, local development and associated decision making in our country is made by local MPs". Moreover, another national level key informant opined that the receipt and size of resource allocations largely depend on the closeness of an MP's relationship with the Prime Minister.

Our research revealed that local-level institutional collaboration among formal, quasi-formal (e.g., Scouts), and civil society organizations often helps overcome spatial, functional, and temporal mismatches (Table 4.2). Usually, such multi-institutional coordination is facilitated by NGOs working at the local and regional level. UPs' inability to engage diverse groups in

undertaking strategic DRR measures are clearly a reflection of spatial and functional mismatches. Certain key informants suggested that NGOs greatly assist UPs in building their technical and organizational DRR capacity by, for example, preparing annual budgets, risk assessments, and resource maps, or assisting in the construction and maintenance of physical mitigation infrastructure, like evacuation roads and cyclone shelters (Table 4.2).

Table 4.2: Selected examples of NGO-facilitated horizontal collaboration that addressed the problems of mismatches in the study area

Purpose of coordination	Specific coordination activity	Name of NGOs	Outcome/Implications	
			Overcoming problems of fit	**Implications for DRR, and community resilience**
Technical and response capacity building	- Mapping local risks and resources with UP - Helping UP prepare a DRR informed annual budget - Facilitating risk assessment and formulating Disaster Management Plans - Providing training to CPP volunteers and UDMC members - Forming a youth club and providing training to volunteers	SAP-Bangladesh, NSS, CODEC, Jago nari, and Songram	Spatial and functional	Focus on preparedness and capacity building for DRR and resilience
Overcoming financial constraints	- Repairing cyclone shelters and connecting roads, installing tube	Red Crescent, RDF, and	Spatial and functional	Structural mitigation measures to

Purpose of coordination	Specific coordination activity	Name of NGOs	Outcome/Implications	
			Overcoming problems of fit	Implications for DRR, and community resilience
through structural interventions and logistic support	wells, and harvesting rainwater - Providing logistic support and equipment for warning dissemination (e.g. megaphones) and rescue operation (e.g. axes)	NSS, Scout		reduce risk and enhance shock absorption capacities
Keeping disaster management committees (Union and Upazilla) functioning and active	- Helping organize bi-monthly meetings - Updating meeting minutes - Reminding committee members of their roles and responsibilities	CODEC, NSS, and Jago nari,	Functional	Staying alert for episodic events like nature-induced disasters
Response, rescue, and rehabilitation	- Preparing Emergency Response Plans (ERP) in collaboration with UDMC and UzDMC - Distributing relief and housing materials for early recovery - Repairing community assets such as schools and	Jago nari, CODEC, CPP, Fire Service and Civil Defense, RDF	Temporal and functional	Short-term and long term recovery

Purpose of coordination	Specific coordination activity	Name of NGOs	Outcome/Implications	
			Overcoming problems of fit	Implications for DRR, and community resilience
	roads - Organizing disaster drills and First Aid training in collaboration with the Fire Service and Civil Defence, local community, CPP, UDMC, and UzDMC.			

Although the inability to respond quickly enough during the post-disaster period is an indicator of temporal and functional mismatches, interventions by NGOs help address such issues. For example, NGOs are currently assisting Union Disaster Management Committees (UDMC) and Upazilla Disaster Management Committees (UzDMC) to prepare Emergency Response Plans (ERP); conducting disaster drills in collaboration with local institutions (e.g., Fire Service, Civil Defense, Cyclone Preparedness Program (CPP) volunteers, UDMC, and UzDMC); and providing First Aid training to CPP volunteers. During the post-disaster period, NGOs also carry out relief and rehabilitation activities. Most importantly, while government measures are mostly concerned with structural interventions, non-structural DRR activities related to community mobilization and disaster preparedness are carried out primarily by NGOs in collaboration with government departments and community-based institutions (Table 4.2).

The research also revealed that NGO personnel have realized that they must act together in order to become agents of change. The Barguna Disaster Risk Reduction Network (BDRRN) is such a network of local-level NGOs. The BDRRN is active in local advocacy for DRR and overcoming problems of institutional fit, for example working with local government authorities to train and equip CPP volunteers and sharing information among network members through online platforms.

4.3.2 Multi-loop Learning at Multiple Institutional Levels

In this Section, we examine the process of social learning in multilevel institutions. Our findings reveal that learning in lower-level institutions has mostly single- and double-loop characteristics stemming from direct engagement with cyclone-disaster management. By contrast, learning in upper-level institutions is mostly double- and triple-loop in character, with little evidence of single-loop learning (Fig. 4.2) (Table 4.3).
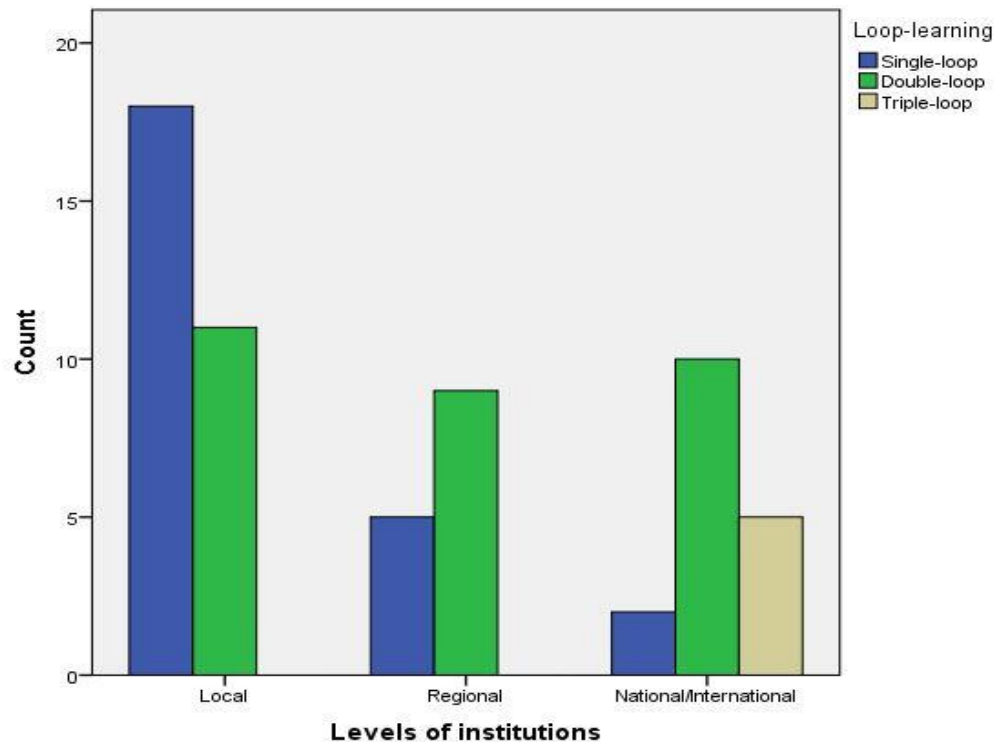
Fig. 4.2 Multi-loop learning and level of institutions

Single-loop learning, mostly related to the crisis and post-crisis periods, i.e., dealing with evacuation, response, and relief activities, was evident only in local and regional-level institutions (Fig. 4.2 and 4.3). This is primarily because local and regional-level institutions carry out on-the-ground DM activities. For example, trees brought down during Cyclone Sidr created road blockages, hampering rescue and relief operations (Table 4.3). Consequently, NGOs provided local community-based institutions with equipment, such as axes and saws, to clear the roads. Prior experience also revealed friction between evacuation procedures and cultural and religious beliefs regarding the separation of men and women, so current procedures and cyclone shelters have been redesigned with these cultural sensitivities in mind (Table 4.3). In regard to evaluation, one key informant from a local-level CPP stated:

Based on our experience and lessons learned during Cyclone Sidr, the rooms were separated with designated space for men and women in the cyclone shelters. There were carried out by the financial supports from the NSS [an NGO]. Such renovation took place after 25 years of construction of the shelter. Now we have separate spaces and washrooms for men and women.

In relation to relief operations, another regional-level key informant stated:

After Sidr, relief operation was largely uncoordinated. Organizations who came here to distribute relief were reluctant to go to and work in the remote areas. This reluctance instigated the government authorities to formulate a policy that any organization responsible for regional and local relief operations must inform and coordinate with the respective local government entities.
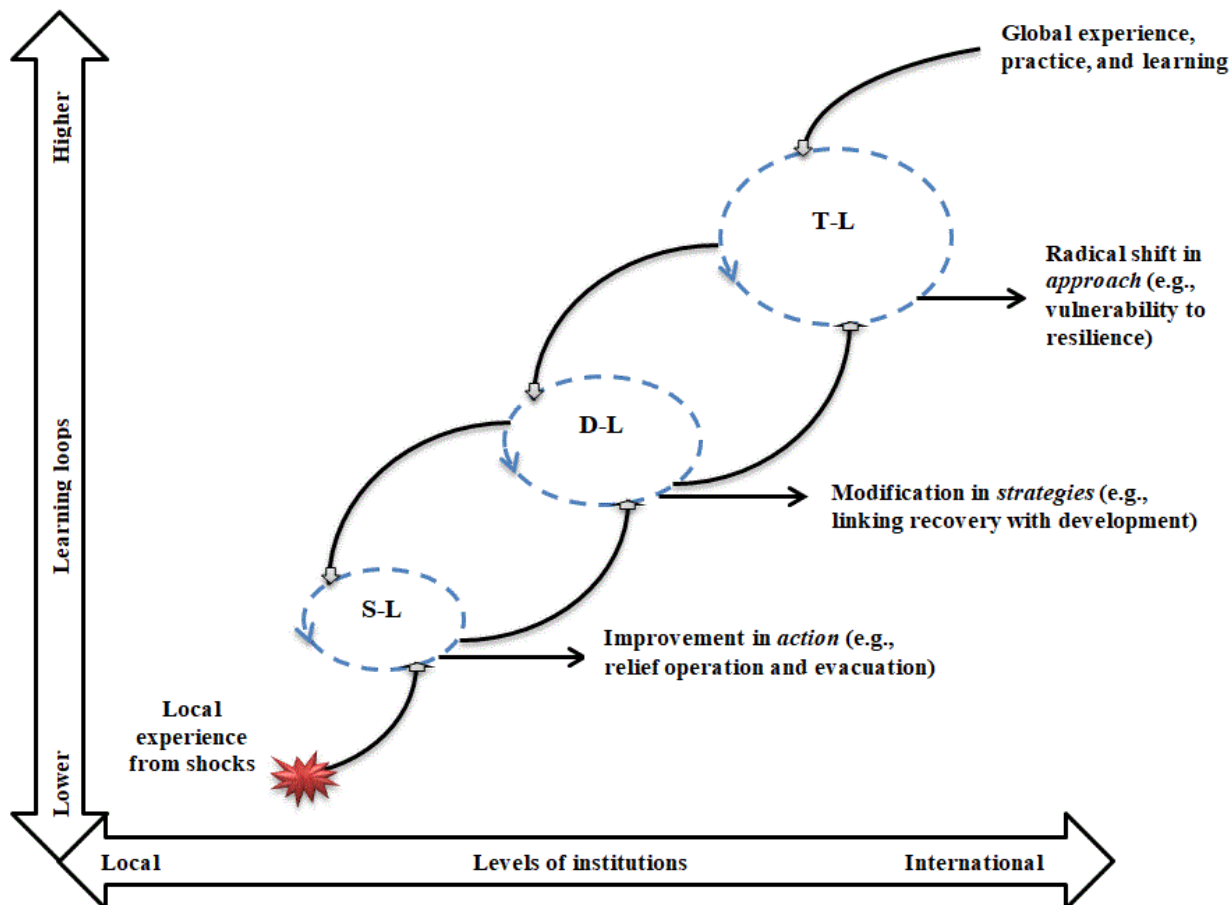
Fig. 4.3 Connection between multi loop-learning and multiple levels of institutions

Table 4.3: Examples of selected multi-loop learning by multilevel institutions in areas on DRR and DM in Bangladesh

Type of Loop learning	Key thematic area	Specific examples of learning	Actual or potential implications for DRR, DM and community resilience	Level of institution
Single-loop learning (Are we doing the things right?	Disaster response and evacuation	-It is easier for local institutions to work with community members when they have fresh social memories - Making cyclone shelters multipurpose and gender- and culturally-sensitive - Equity in relief distribution and more coverage of remote areas - Collapse of communication infrastructure impedes response and rescue efforts	Likely to improve management of evacuation, response, and recovery activities.	Local and regional
Double-loop learning (Are we doing the right things?)	DRR, climate change, and development linkages	- Linking development principles with DRR to transform risk into resilience (i.e. 'build back better') - Climate change adaptation and DRR must include women's participation and leadership for transformational change at the	Development interventions at local level is observed to be more DRR and DM sensitive	Local, regional, national, and

Type of Loop learning	Key thematic area	Specific examples of learning	Actual or potential implications for DRR, DM and community resilience	Level of institution
		local level; - Gender-responsiveness strategies - Capacity building (social, human, technological, economic, and institutional) of community members		international
	Relief, recovery, and development	- Relief creates a dependency syndrome; therefore, people should be encouraged to develop skills and self-reliance - Relief needs to be connected with livelihood recovery and resilience enhancement - Socially and culturally-sensitive and local needs-based relief operations - Risk-informed investment in recovery - Strengthening disaster risk financing - Integration of early recovery and other clusters (e.g. health and education)	Reduction of external dependency and building local capacity	

Type of Loop learning	Key thematic area	Specific examples of learning	Actual or potential implications for DRR, DM and community resilience	Level of institution
	Institutional linkages	- Lack of guidelines for civil-military cooperation and absence of an incident management system - Mainstreaming DRR out of the MoFDM remains a key challenge - Lack of inclusion of private sector in DRR - Fund mobilization for disaster recovery requires partnership development before disasters	Establishing institutional linkages may facilitate collaboration required to manage disasters at its all phases	National, and international
	Knowledge and learning	- Knowledge management for learning based intervention; - Lack of consensus and understanding among development partners and government entities regarding the meaning of 'early recovery' and 'resilience'	Preserving and nurturing institutional memory, learning, and knowledge for improvement in practice	
	Local institution, participatio	- Building capacities of local institutions to leverage additional resources and	Enhancing local governance may enhance community	

Type of Loop learning	Key thematic area	Specific examples of learning	Actual or potential implications for DRR, DM and community resilience	Level of institution
	n, and governance	authority - Involving community people in local development planning - Creating a mechanism for transferring funds to community members	resilience	
	Risk communication and evacuation	- Official early warnings about cyclones are not locally understandable; - Special early warning for fishers is required - Livestock and crop insurance may encourage people to evacuate	Trustworthy early warning may encourage timely evacuation and preparedness	Local and regional
	Resources management and DRR	- Better water resources management for DRR and resilience; - Mangrove forest preservation and restoration is part of DRR; - Planting storm resilient local species	Managing local natural resources likely to enhance buffer capacity of community	

Type of Loop learning	Key thematic area	Specific examples of learning	Actual or potential implications for DRR, DM and community resilience	Level of institution
Triple-loop learning (What is the right thing to do/ how do we decide what is right?)	Approach to risks and disasters	- A comprehensive and integrated way of looking at disaster rather than a standalone phenomenon; - Resilience emerged as a comprehensive and integrated approach as opposed to vulnerability reduction	Resilience is the central theme of intervention	International

The research revealed numerous themes related to double-loop learning in local, regional, national, and international institutions (Table 4.3). Some instances of double-loop learning were only identified in upper-level institutions, while others were only identified in lower-level institutions (Table 4.3). For example, institutional linkages to facilitate collaboration, continuous improvement of practices, and enhancement of local institutional capacity were all found only in national and international institutions. A key informant from a reputed national-level NGO highlighted that they learned many lessons from their responses to Cyclone Sidr and associated floods in 2007:

> *We realized that parallel to awareness building at the community level we needed a system, a procedure; it also needed to develop the capacity of our staffs for disaster response further. From this thinking and learning from responses during Sidr, we established in 2008 a separate unit named Disaster, Environment, and Climate Change.*

Conversely, risk communication and resource management were identified only in local and regional institutions. One CPP volunteer who had been working for 22 years reported:

> *People have difficulty in understanding the warning system… Even many CPP volunteers cannot remember the interpretations of the warning signals since large cyclones do not*

come often. People get confused between warning signals for river ports and warning signals for seaports.

The interviews and document reviews revealed that the intimate interrelationships among DRR, DM, climate change, recovery, and development had been recognized by all levels of institutions. The required learning by local institutions usually stems from their collaboration with upper-level institutions (i.e., vertical learning). For instance, microcredit and microfinancing programs have also incorporated a strong DRR component, regularly conducting courtyard meetings to raise awareness about cyclone loss reduction, preparedness, and appropriate response options. The following lessons on disaster response and recovery documented by the United Nations Development Programme (UNDP) substantiate such claims:

[E]arly recovery is a multi-dimensional process, which includes interventions from other clusters as well…, it cannot be limited to the work of one cluster. Each of IASC [Inter-Agency Standing Committee] units on the ground -- such as Health, Education etc. needs to systematically plan and implement early recovery interventions within the context of their own specific areas of work (UNDP, 2011, p.12).

Our empirical findings suggest that to strengthen self-recovery, recovery needs should be linked with skill development and self-reliance modalities. The actions identified in the research include: i) connecting people with market mechanisms and social safety net programs; ii) linking recovery clusters with other clusters (e.g., health and education); iii) investing in DRR to reduce post-recovery risk; and iv) addressing livelihoods as part of relief and recovery (Table 4.3). Staff in all levels of DM institutions also recognized that the current practice of 'relief operations' is problematic, as it can breed dependency on upper-level institutions, is often incapable of addressing diverse needs, and often generates a passive 'dependency syndrome' among community members. One key informant from a national level NGO stated:

From our long experience with relief operation after a disaster-event, we learned that relief makes people dependent [upon external institutions]. *From this learning we have started working on financial inclusion and connecting people with development modalities to enhance their access to public services and social safety net programs.*

One key aspect of double-loop learning alluded to above (Table 4.3) is that most of the double-loop learning have emanated from local, regional, national, and international level NGOs and donor agencies. Three instances of double-loop learning were evident in the national-level state

agencies in the areas of risk communication, institutional linkages, and relief, recovery, and development. In the case of local and regional-level state agencies, only risk communication, evacuation, and relief and recovery issues were evident as double-loop learning. This is attributed to the fact that state agencies are mostly concerned with social safety-net programs and structural mitigation, and are less concerned with institutional and human capacity building or with preparedness for emergencies and disasters. While interviewing local (sub-district) and regional (district) level Project Implementation Officers – responsible for coordinating, monitoring, and implementing DM activities for state agencies – we observed that most of them were concerned with structural mitigation measures (e.g., constructing bridges and culverts), with limited knowledge of institutional and human dimensions of DM.

Triple-loop learning was evident among the international NGOs working in Bangladesh. Information from KIIs revealed that local disaster experience and changes in global discourse were responsible for major shifts in thinking and practices (Fig. 4.3). These shifts were away from treating disasters as stand-alone phenomena and towards approaching them in a comprehensive and integrated manner, emphasizing the strength and resilience of the community instead of focusing on the weakness and vulnerability of 'passive' people. Such significant changes in DM approaches among multilevel institutions in Bangladesh led to the implementation of the Comprehensive Disaster Management Programme (CDMP) (2005-2009; 2010-2014) and National Resilience Programme (2017-2021) by the UNDP (Table 4.3).

Based on decade-long on-the-ground experience, the UNDP-Bangladesh has highlighted the importance of risk-informed and gender responsive approaches for national resilience building (UNDP, 2017). Other pertinent institutions have also adopted such an integrated approach. In this regard, one key informant from an international-level institution (i.e., Oxfam-Bangladesh) stated:

> *As a humanitarian organization, we realized that we responded to humanitarian crises in the same community several times. We began to raise questions about the sustainability of our work. We saw that poor people and women still remained vulnerable. From such observation and understanding, we moved towards an integrated approach and started to consider disaster vulnerability from a resilience perspective. This resulted in the formulation and implementation of the REECALL* [Resilience through Economic Empowerment, Climate Adaptation, Leadership and Learning] *project, where economic*

justice and women's empowerment, active citizenship and knowledge management, and
climate action and DRR are key components.

4.3.3   Bridging Organizations, Institutionalization of Learning, and Community Resilience

4.3.3.1 Institutional Collaboration and Scaling-up Learning: Shaping Policy

In this section, the roles of bridging organizations (i.e., national and international NGOs that collaborate horizontally with policy actors and vertically with lower-level institutions) are examined. The UNDP is a good example of such a bridging organization: it coordinates CDMP and National Resilience Programme projects and played a significant role in the review process of the 2010 and 2019 versions of the SOD. As such, UNDP's own observations as well as local-level learning are reflected in the latest version of the SOD.

In the aftermath of Cyclone Sidr, a National Lessons Learned Workshop (NLLW) (April 30, 2008) was held involving 120 participants from 55 organizations, including government bodies, national and international NGOs, donor agencies, media, and the private sector. This NLLW was organized by the CDMP project in collaboration with the Ministry of Food and Disaster Management and the Disaster Management Bureau.

Lessons Learned documents reveal that the overall aim of the NLLW was to strengthen Bangladesh's DM system through a thorough review of the strengths and weaknesses of various institutions, and by taking local experience into account (Fig.4.4). The key lessons identified in the 2008 NLLW document are: i) working collaboratively during non-emergency periods to build and strengthen trust and working relationships is more effective than doing so only during emergencies, and ii) that sharing information on a regular basis can create synergy between DRR and DM outcomes.

Two major themes that emerged from the NLLW were the need for: i) efficient and effective coordination at multiple levels and scales, and ii) building the capacity of institutions at multiple levels (Table 4.4). The NLLW documented three major examples of social learning, mostly double-loop, from the experience of Cyclone Sidr, the details of which are outlined below. It also recommended specific mechanisms for institutional collaboration that echo the instances of double-loop learning identified in the preceding section. These learning-based recommendations were subsequently institutionalized and integrated into policy and practice in Bangladesh.

The first major example of local-level social learning that was scaled-up was related to the poor quality of cyclone early warnings. As a consequence of this finding, the representation of stakeholders in the Committee for Speedy Dissemination of Disaster Warning Signals (CSDDWS) was substantially diversified. As well, the roles and responsibilities of the Bangladesh Meteorological Department and the CSDDWS were more clearly defined to make early warnings more easily understandable and actionable (Table 4.4).
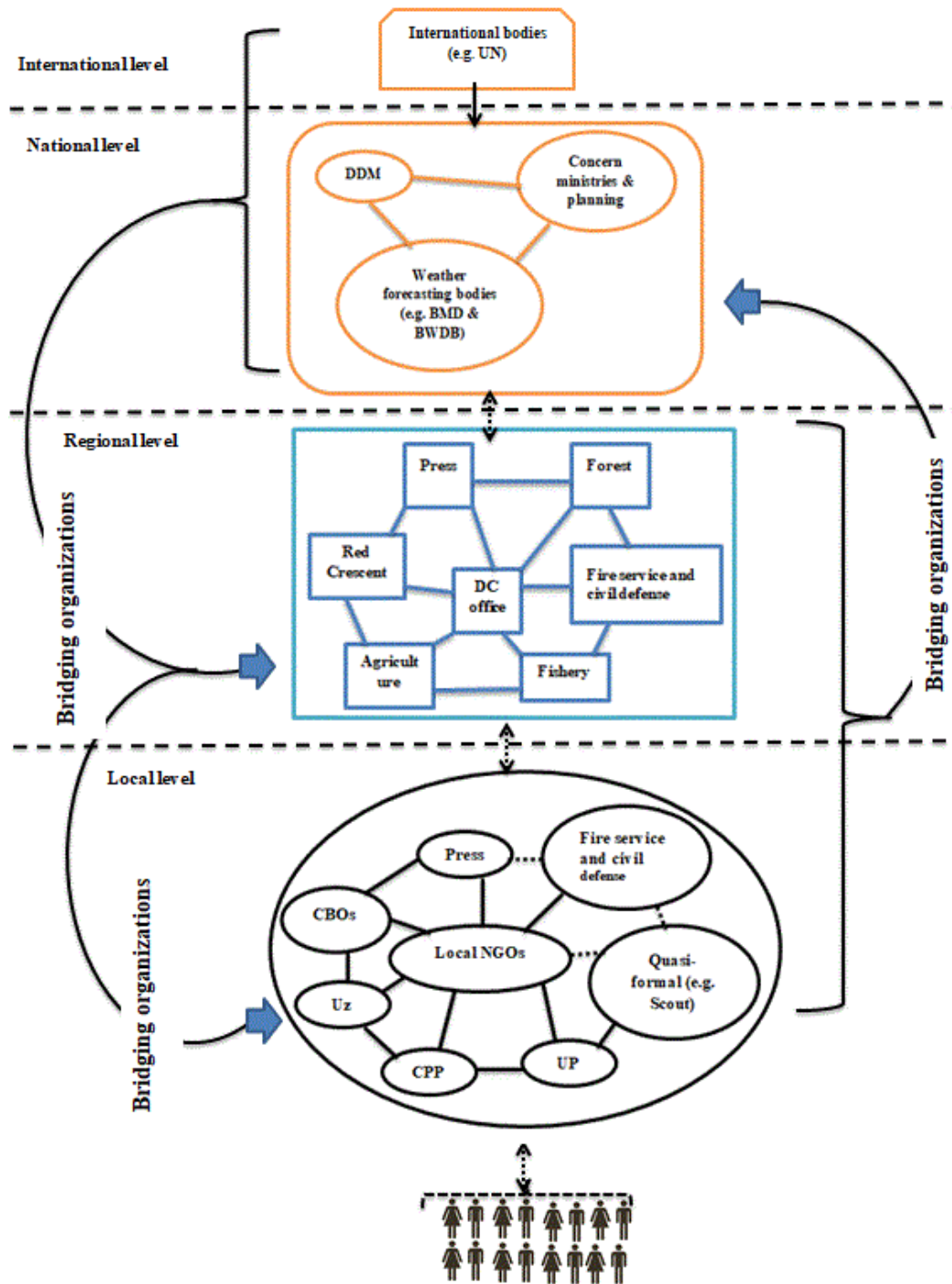
Fig. 4.4: Schematic diagram depicting that bridging organizations bring about global experience and facilitate scaling-up of local learning to make governance adaptive

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Table 4.4: Horizontal and vertical interplay, learning and policy modification

Major social learning from Cyclone Sidr	Recommended coordination mechanisms	Change in SOD and disaster management practice
Nature of risk communication is problematic; hence early warning systems for coastal cyclones and storm surges should be revisited to make them easily understandable to community members.	- Operational effectiveness of SOD needs improvement; - More representation in CSDDWS decision making is needed	In the 1997 and 2010 versions of SOD, CSDDWS consisted of 11 members. The representation of stakeholders was increased to 26 members in the 2019 version of SOD.
	Roles and responsibilities of BMD and CSDDWS need to be specified	Dissemination of early warning at the local community level is carried out presently in a more coordinated way between BMD and CSDDWS. BMD offers the initial detection of cyclones and issues warnings for sea and river ports whereas CSDDWS issues warnings for land-based community members as well as recommended actions.
More efficient institutional coordination is required to better manage future crises	Sector based cluster system for effective coordination among different government entities	Cluster approach was not evident in the 1997 version of SOD, but was added in the 2010 version and more clearly articulated in the 2019 version. A separate Sub-section (7.3; p.310) was added in the 2019 version on cluster-based humanitarian response systems.

Major social learning from Cyclone Sidr	Recommended coordination mechanisms	Change in SOD and disaster management practice
	Local level GO-NGO collaboration for better utilization of resources	The role of humanitarian institutions (e.g., Red Crescent Society and NGO) at local levels for disaster management was better articulated in the 2019 version. The role of private and business sectors was also highlighted.
	Civil-military cooperation for efficient response and rescue	A separate Sub-section (7.2; p, 310) on civil-military coordination was added to the 2019 version of SOD.
Relief and early recovery initiatives must comply with human rights principles	Unified approaches for damage and needs assessments for smooth operation of relief and response.	A separate committee is formed comprising of representatives from different government entities to assess, measure, and monitor disaster loss and damage and to determine emergency needs (Sub-section 3.1.15 of the 2019 SOD).
	Involvement of local authority and community in determining relief package and to ensuring equity and justice.	The 2019 version of SOD included guidelines that better link local authorities with humanitarian agencies (e.g., NGOs and private sectors) for fair and equitable distribution of relief goods and services (appendix 8 of the 2019 version of SOD).

The second major social learning theme identified in the study area was related to efficient institutional coordination for better management of future crises. We identified noticeable institutional re-structuring in the 2019 version of the SOD; this was consistent with the recommendations drawn from the NLLW. These modifications included: i) a separate sub-section (7.3; p.310) on cluster-based humanitarian response systems, ii) better articulation of the roles of humanitarian institutions (e.g., the Red Crescent Society and NGOs) at the local level, iii) emphasizing the importance of the private sector, and iv) the incorporation of a separate sub-section (7.2; p, 310) on civil-military coordination (Table 4.4).

The third major social learning theme identified in the research was that relief and early recovery initiatives must comply with human rights principles. A separate committee was formed from representatives of various government departments to assess and monitor disaster loss and damages. The 2019 version of the SOD includes guidelines that better connect local authorities with humanitarian bodies to ensure fair and equitable distribution of relief (see appendix 8 of the 2019 SOD) (Table 4.4).

4.3.3.2 Knowledge Management, Nurturing Institutional Memory, and Innovation

One of the major examples of double-loop learning observed was the acknowledgement of the need for better knowledge management and learning-based interventions. For instance, phase II (2010-2015) of the CDMP project was built on learning from phase I (2005-2010), which recognized knowledge management as an important component: "Knowledge management will be as important to capture future efforts in institutional mainstreaming as it is for current community-level interventions" (UNDP, 2010, p.12). Nurturing and restoring institutional learning and memory are critical, but these are often neglected due to a lack of memory-retention mechanisms and a sense of local ownership. In response to a question regarding the process of institutionalizing learning, government officials stated that due to an inadequate workforce they struggle to perform even routine duties, let alone DM-related activities. Moreover, projects are often carried out on a short-term, ad hoc basis, a practice that is not conducive to building institutional learning and memory. Lack of leadership was also identified as a major reason for poor institutionalization of learning and social memory.

The 'anti-learning culture' of government institutions was identified as a major barrier to institutional learning. In Bangladesh's formal public institutions, there are few or no incentives for sustained learning. For instance, after the 2004 flood a five-day national workshop was held

involving several government departments, yet the opportunity to identify lessons learned was ignored. One government official stated that "whatever learning takes place here [is] mostly at [the] individual level, not at [the] institutional level". In order to maintain their hegemonic role, national and other upper-level institutions also frequently ignore recommendations offered by lower-level institutions (e.g., *Upazila* and/or Union-level committees).

A retired senior bureaucrat, in response to a follow-up question, raised the issue of whether the existing form of bureaucracy is a barrier to institutionalizing learning. Rather than giving a straight-forward answer, he listed several reasons that hindered the institutionalization of learning. First, in government ministries there were initiatives to integrate disasters as part of national development planning. However, the bureaucrats at the Planning Ministry thought that it would compromise their authority and would require additional work; consequently, they showed little interest. Second, there was no permanent and independent body for pursuing mainstreaming DM and institutionalizing learning. Third, there was a lack of readiness among incumbents. Citing examples from India, he stated that there is a compulsory course on DM in the Indian Civil Service that creates readiness among them, but which is absent in the bureaucracy of Bangladesh, where DM is not part of their training modules or entrance requirements. Ironically, one of the main responsibilities of incumbent bureaucrats is to manage disasters, crises, and social safety-net programs at the local and regional levels.

Lack of coordination among different ministries and power differentials among bureaucrats and civil society organizations (e.g., national and international NGOs) are also major barriers to learning-based improvement and the institutionalization of learning. A failure to formulate the third phase of the CDMP project is a good example. The CDMP project (phases I and II) was one of the largest and most comprehensive DM projects ever implemented in Bangladesh or globally. The total budget for the project was US $70 million. This project generated voluminous learning products – at both community and policy levels. The emerging goal of the third phase was to institutionalize learning, but this phase was not carried out. Even a senior bureaucrat recognized that the CDMP project played a key role in assisting government in formulating and updating legal frameworks and building the capacity of other national-level organizations, such as the Bangladesh Meteorological Department. However, due to the lack of inter-ministerial coordination and cooperation among bureaucrats and civil society organizations,

such learning could not be institutionalized. One representative from an international-level NGO who was involved in the planning and implementation of the CDMP project noted:

> *In phase III, we were trying to engage other ministries where the disaster ministry can play a coordinating role and where other ministries should be given equal opportunity to implement. Unfortunately, there is a lack of foresightedness, each ministry thinks it is their own 'property'. They are not flexible and open*.

The presence of a strong engineering coalition and associated vested interest groups within the government structure exerts pressure to develop relief operations and structural mitigation policies and programs, rather than focusing on community capacity building and enhancing preparedness. After a thorough examination of the programmatic interventions by the Department of Disaster Management (DDM) and the Ministry of Disaster Management and Relief (MoDMR), we confirmed that relief and structural mitigation interventions consistently receive prime attention. For instance, three main programs of the DDM and MoDMR are focused on: i) social safety nets, ii) humanitarian assistance, and iii) risk reduction and resilience building through structural interventions. One senior bureaucrat stated: "The biggest project of the ministry is constructing culverts".

Our research revealed that the gaps highlighted above are largely addressed by key bridging organizations that play a significant role in nurturing and restoring institutional learning and memory for DM. For instance, in 2017 the National Alliance for Humanitarian Actors in Bangladesh (NAHAB), led by the Dhaka Ahsania Mission (DAM), began promoting collaboration among local and national NGOs. Among their objectives was to restore and nurture institutional memory through knowledge management and collaboration with the DDM. One strategy was to compile and build on previous work (e.g., Community Risk Assessment profiles developed by the CDMP project) by building and maintaining a national database. This is evidence of NAHAB's critical role as a bridging organization, which validates the notion that such initiatives help bring multilevel institutions together to generate more successful outcomes.

Another success story is the National Alliance for Risk Reduction and Response Initiatives, formed in response to Cyclone Sidr and comprised of 10 international NGOs working in Bangladesh. Recognizing that resilience is often conceptualized in different ways, this consortium formulated a common resilience framework based on previous global experiences

and the local context. The goal of the consortium was to use this platform for sharing knowledge and innovative ideas.

Apart from knowledge management, findings from our investigation showed that bridging organizations partner with government departments and thus play a significant role in promoting innovation in DM, especially in the area of early warning. For instance, community members can get real-time early warning of cyclones via Interactive Voice Response on their cell phones, while fishers, who are often are unable to receive warnings while out at sea, are provided with GPS and GSM (The Global System for Mobile Communications) handset devices to significantly reduce their vulnerability to cyclones (See Table S5 in supplementary materials).

4.4 Discussion and Conclusion

We argue that building and strengthening community resilience to extreme weather events like cyclones requires an adaptive, innovative, and forward-thinking approach. Applying an AG framework to the case of Bangladesh, we documented three novel contributions to the community resilience literature. First, the presence of nested and multiple institutional structures at the local level helps overcome the institutional fit problem and facilitate the resilience-building process. Second, social learning from disaster-shocks varies widely between institutional levels, and consequently the development of forward-looking resilience actions requires the adoption of multi-loop social learning at multiple institutional levels. Thirdly, the role of bridging organizations in documenting and scaling-up lessons learned from episodic extreme weather events is crucial to future resilience-building. These observations have profound implications for the establishment of institutional frameworks and policies for reducing risks and strengthening community resilience to future climate-induced disasters.

Globally, the recent trend in DRR and DM policies clearly shows a heavy emphasis on the decentralization of disaster governance (Ainuddin et al., 2013; Hermansson, 2019). It is assumed that the delegation of power and responsibilities to local authorities is likely to make governance more adaptive and flexible (Armitage et al., 2009; Berkes, 2009). Such moves also require strengthening the capacity of local institutions (Berkes, 2007). Our evidence from Bangladesh's coastal communities suggests that merely delegating responsibilities, without the accompanying authority and resources, creates temporal, functional, and spatial mismatches – a major problem with disaster governance in many developing countries (Choudhury et al., 2019; Maes et al., 2018).

Our findings on multi-loop social learning contribute to the DM literature in two key areas. Firstly, our findings confirm that strengthening community resilience to disaster-shocks requires a multilevel governance system (Adger et al., 2005). For example, providing early warning of cyclones requires the involvement of both high-level agencies, like meteorological departments who can detect the threat, and lower-level institutions, to disseminate the warnings.

Secondly, we observed that local-level institutions are more likely to experience single- and double-loop learning, while triple-loop learning is only evident in national/international-level institutions. The reason behind these differences in loop learning according to the level of institutions is that local and regional institutions are generally engaged with pragmatic local and regional-level DM activities (e.g., response, evacuation, and relief distribution), designed and developed by upper-level institutions. In contrast, national and international NGOs design projects based on learning from local experience and in response to emerging global discourses on DM. Our findings concur with Mian's (2014) study on flood disasters in Pakistan and Mutahara et al.'s (2018) study on delta management in Bangladesh, both of which found that learning by local and regional-level institutions is largely characterized by single-loop, with some examples of double-loop, but with no evidence of triple-loop learning.

Different types of loop learning have varied implications (e.g., on-the-ground activities, strategies, and approach) for disaster recovery, resilience, and management. For instance, single-loop learning emanates from dealing with the crisis and post-crisis situation, such as response, evacuation, and recovery, and is concerned with whether such activities carried out according to the prevailing institutional protocol are successful. Single-loop learning is thus likely to improve on-the-ground protocols and activities for efficient DM. Double-loop learning involves reflection on the strategies that are used for recovery and DM. For example, it is evident from the findings that relief is not an appropriate solution for a sustainable recovery from disaster losses – what is required is to connect people with the development process. Such learning thus is likely to lead to the adoption of new strategies and protocols that are better suited to meeting established DRR and DM goals.

In contrast, triple-loop learning involves reflecting on the underlying norms and values that guide action. Such learning is likely to trigger a paradigm shift in DM and a consequent change in overall approaches, strategies, and on-the-ground activities for DRR and DM. For instance, focusing on the strength and resilience of the community instead of on its weaknesses

and vulnerability of so-called 'passive' local people has resulted in a change in strategies and approaches, such as strengthening capacity (e.g. skill-sets and leadership), empowerment, risk-informed investment, and multi-sectoral collaboration, rather than confining DM activities to only post-disaster responses.

The above analysis and discussion highlights the necessity of considering multiple interconnected levels of analysis to develop a comprehensive perspective of social learning to enhance community resilience. These connections among different levels of loop-learning implies an iterative and feedback relationship between different loops (Pahl-Wostl, 2009). We identified two major drivers behind such iterative processes: i) successive disaster occurrences, and ii) bridging organizations that follow a global approach to policy and practice and scale-up local experiences and learning for higher-level institutionalization. For example, in the wake of Cyclone Sidr the results of the UNDP-facilitated NLLW recommended the adoption of a cluster-based approach to DRR as developed by the United Nations Office for the Coordination of Humanitarian Affairs (Hendriks and Boersma, 2019).

The above observations in Bangladesh conform to the findings of the Johannessen and Hahn (2013) study on flood risk in Sweden, confirming that a multilevel learning strategy that incorporates international lessons along with national-level coordination can produce an adaptive and flexible disaster governance regime. However, more emphasis needs to be placed on the importance of bridging organizations in documenting lessons learned from nature-triggered disasters and scaling-up these lessons into national-level policy and practice. Mian (2014), reporting on floods in Pakistan, revealed that in the absence of such organizations and collaboration, community learning alone was insufficient to make the disaster governance regime adaptive. Similar to Cash et al.'s (2013) observations regarding innovation by NGOs following Cyclone Sidr, we documented that bridging organizations play a vital role in managing knowledge, nurturing institutional memory, and promoting innovative ideas in order to make DRR initiatives more responsive and resilient.

From an AG perspective, disaster-shocks provide valuable opportunities for change and transformation in policy and practice (Birkmann et al., 2010; Olsson et al., 2006). Cyclone Sidr was just such an opportunity for Bangladesh. In this case, learning was not confined to mere observation, but was also translated into concrete action (Birkland, 2009). However, it should be emphasized that this process does not always take place, such as in the case of the 2004 floods in

Bangladesh where lessons learned were not translated into any meaningful action in time for Cyclone Sidr three years later.

It is evident that institutional capacity building, collaboration, and learning facilitate AG for building and strengthening community resilience. However, a fundamental change in governance strategies and a change in institutional culture are required for more successful AG (Young, 2017). Our findings suggest that existing forms of bureaucracy, the nature of local politics, and the lack of power sharing limit the success in AG. In such instances, local level NGOs are working collaboratively to foster the capacity of state-led local institutions. At the same time, national level NGOs and donor agencies, as pressure groups, are exerting force on government entities to change their underlying attitude and culture – i.e., to be receptive to new learning and in turn making the disaster governance regime more flexible and adaptive. Other studies have also documented that NGOs play a key role in mainstreaming DM and learning-based improvement in Bangladesh as well as in other developing country contexts (Deen, 2015; Seddiky et al., 2020).

We conclude that cross-fertilization among disaster governance, community resilience, and AG literature is essential to fostering effective DM. Furthermore, further research is required on how local feelings of ownership affect DM initiatives, how local learning can be more effectively scaled-up to the national level, and how local institutions can develop meaningful collaborative partnerships with upper-level institutions to facilitate these processes.

References

Adger, W. N., Hughes, T. P., Folke, C., Carpenter, S. R., & Rockström, J. (2005). Social-ecological resilience to coastal disasters. *Science*, *309*(5737), 1036–1039. https://doi.org/10.1126/science.1112122

Ainuddin, S., Aldrich, D. P., Routray, J. K., Ainuddin, S., & Achkazai, A. (2013). The need for local involvement: decentralization of disaster management institutions in Baluchistan, Pakistan. *International Journal of Disaster Risk Reduction*, *6*, 50–58. https://doi.org/10.1016/j.ijdrr.2013.04.001

Argyris, C., Schön, D.A. (1997). *Organizational learning: A theory of action perspective*.

Reading, MA: Addison-Wesley.

Armitage, D., Marschke, M., & Plummer, R. (2008). Adaptive co-management and the paradox

of learning. *Global Environmental Change*, *18*(1), 86–98.
https://doi.org/10.1016/j.gloenvcha.2007.07.002

Armitage, D. R., Plummer, R., Berkes, F., Arthur, R. I., Charles, A. T., Davidson-Hunt, I. J.,
Diduck, A. P., Doubleday, N. C., Johnson, D. S., Marschke, M., McConney, P., Pinkerton,
E. W., & Wollenberg, E. K. (2009). Adaptive co-management for social-ecological
complexity. *Frontiers in Ecology and the Environment*, *7*(2), 95–102.
https://doi.org/10.1890/070089

Azungah, T. (2018). Qualitative research: deductive and inductive approaches to data
analysis. *Qualitative Research Journal*. 18, 383–400. https://doi.org/10.1108/QRJ-D-18-
00035

Bateson, G. (1972). *Steps to an ecology of mind: Collected essays in anthropology, psychiatry,
evolution and epistemology*. London: Intertext.

Baxter, J., & Eyles, J. (1997). Evaluating qualitative research in social geography: establishing
'rigour'in interview analysis. *Transactions of the Institute of British geographers*, *22*(4),
505-525. https://doi.org/10.1111/j.0020-2754.1997.00505.x

Berkes, F. (2017). Environmental governance for the anthropocene? Social-ecological systems,
resilience, and collaborative learning. *Sustainability*, *9*(7), 1232.
https://doi.org/10.3390/su9071232

Berkes, F., & Ross, H. (2013). Community resilience: toward an integrated approach. *Society
and Natural Resources*, *26*(1), 5–20. https://doi.org/10.1080/08941920.2012.736605

Berkes, F. (2009). Evolution of co-management: role of knowledge generation, bridging
organizations and social learning. *Journal of Environmental Management*, *90*(5), 1692–
1702. https://doi.org/10.1016/j.jenvman.2008.12.001

Berkes, F. (2007). Understanding uncertainty and reducing vulnerability: lessons from resilience
thinking. *Natural Hazards*, *41*(2), 283–295. https://doi.org/10.1007/s11069-006-9036-7

Birkland, T. A. (2009). Disasters, lessons learned, and fantasy documents. *Journal of
Contingencies and Crisis Management*, *17*(3), 146–156. https://doi.org/10.1111/j.1468-
5973.2009.00575.x

Birkmann, J., Buckle, P., Jaeger, J., Pelling, M., Setiadi, N., Garschagen, M., Fernando, N., &
Kropp, J. (2010). Extreme events and disasters: a window of opportunity for change?
Analysis of organizational, institutional and political changes, formal and informal

responses after mega-disasters. *Natural Hazards*, *55*(3), 637–655.
https://doi.org/10.1007/s11069-008-9319-2

Blackburn, S. (2014). The politics of scale and disaster risk governance: barriers to
decentralisation in Portland, Jamaica. *Geoforum*, 52, 101–112.
https://doi.org/10.1016/j.geoforum.2013.12.013

Cash, D. W., Adger, W. N., Berkes, F., Garden, P., Lebel, L., Olsson, P., Pritchard, L., & Young,
O. (2006). Scale and cross-scale dynamics: governance and information in a multi-level
world. *Ecology and Society*, *11*(2), art8. https://doi.org/10.5751/ES-01759-110208

Cash, R. A., Halder, S. R., Husain, M., Islam, M. S., Mallick, F. H., May, M. A., Rahman, M., &
Rahman, M. A. (2013). Reducing the health effect of natural hazards in Bangladesh. *The
Lancet*, *382*(9910), 2094–2103. https://doi.org/10.1016/S0140-6736(13)61948-0

Choudhury, M.-U.-I., Uddin, M. S., & Haque, C. E. (2019). "Nature brings us extreme events,
some people cause us prolonged sufferings": the role of good governance in building
community resilience to natural disasters in Bangladesh. *Journal of Environmental
Planning and Management*, *62*(10), 1761–1781.
https://doi.org/10.1080/09640568.2018.1513833

Clement, F. (2010). Analysing decentralised natural resource governance: proposition for a
"politicised" institutional analysis and development framework. *Policy Sciences*, *43*(2),
129–156. https://doi.org/10.1007/s11077-009-9100-8

Crona, B. I., & Parker, J. N. (2012). Learning in support of governance: theories, methods, and a
framework to assess how bridging organizations contribute to adaptive resource
governance. *Ecology and Society*, *17* (1), 32. https://doi.org/10.5751/ES-04534-170132

Cumming, G. S., Cumming, D. H. M., & Redman, C. L. (2006). Scale mismatches in social-
ecological systems: causes, consequences, and solutions. *Ecology and Society*, *11*(1), 14.
https://doi.org/10.5751/ES-01569-110114

Deen, S. (2015). Pakistan 2010 floods. Policy gaps in disaster preparedness and response.
International Journal of Disaster Risk Reduction, *12*, 341–349.
https://doi.org/10.1016/j.ijdrr.2015.03.007

Deverell, E. (2009). Crises as learning triggers: exploring a conceptual framework of crisis-
induced learning. *Journal of Contingencies Crisis Management*. *17*(3), 179–188.
https://doi.org/10.1111/j.1468-5973.2009.00578.x

Dietz, T., Ostrom, E., & Stern, P. C. (2003). The struggle to govern the commons. *Science*, *302*(5652), 1907–1912. doi: 10.1126/science.1091015

Djalante, R., Holley, C., & Thomalla, F. (2011). Adaptive governance and managing resilience to natural hazards. *International Journal of Disaster Risk Science*, *2*(4), 1–14. https://doi.org/10.1007/s13753-011-0015-6

DMB-Bangladesh. (2010). *National Plan for Disaster Management 2010-2015*. https://modmr.gov.bd/sites/default/files/files/modmr.portal.gov.bd/policies/c0400c48_11eb _4a8f_a27a_2ae7bbb8f0a4/Nataional_Plan_for_Disaster__2010_2015__Final_Version-.pdf

Faulkner, L., Brown, K., & Quinn, T. (2018). Analyzing community resilience as an emergent property of dynamic social-ecological systems. *Ecology and Society*, *23*(1), 24. https://doi.org/10.5751/ES-09784-230124

Fereday, J., & Muir-Cochrane, E. (2006). Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. *International journal of qualitative methods*, *5*(1), 80-92. https://doi.org/10.1177/160940690600500107

Folke, C., Pritchard, L., Berkes, F., Colding, J., & Svedin, U. (2007). The problem of fit between ecosystems and institutions: ten years later. *Ecology and Society*, *12*(1), 30. https://doi.org/10.5751/ES-02064-120130

Folke, C., Hahn, T., Olsson, P., & Norberg, J. (2005). Adaptive governance of social-ecological systems. *Annual Review of Environment and Resources*, *30*(1), 441–473. https://doi.org/10.1146/annurev.energy.30.050504.144511

Gera, W. (2018). Scalar politics in Philippine urban disaster management: reframing metropolitan governance for local resilience and sustainability. *Erdkunde*, *72*(4), 287–312. https://www.jstor.org/stable/26554735

Hendriks, T. D., & Boersma, F. K. (2019). Bringing the state back in to humanitarian crises response: disaster governance and challenging collaborations in the 2015 Malawi flood response. *International Journal of Disaster Risk Reduction*, *40*, 101262. https://doi.org/10.1016/j.ijdrr.2019.101262

Hermansson, H. (2019). Challenges to decentralization of disaster management in Turkey: the role of political-administrative context. *International Journal of Public Administration*, *42*(5), 417–431. https://doi.org/10.1080/01900692.2018.1466898

Johannessen, Å., Hahn, T. (2013). Social learning towards a more adaptive paradigm? Reducing flood risk in Kristianstad municipality, Sweden. *Global Environmenal Change*. *23*, 372–381. https://doi.org/10.1016/j.gloenvcha.2012.07.009

Lee, K. N. (1993). Greed, scale mismatch, and learning. *Ecological Applications*, *3*(4), 560–564. https://www.jstor.org/stable/1942079

Lewis, D., & Hossain, A. (2019). Local political consolidation in Bangladesh: power, informality and patronage. *Development and Change*, *0*(0), 1–20. https://doi.org/10.1111/dech.12534

Maes, J., Parra, C., Mertens, K., Bwambale, B., Jacobs, L., Poesen, J., Dewitte, O., Vranken, L., de Hontheim, A., Kabaseke, C., & Kervyn, M. (2018). Questioning network governance for disaster risk management: lessons learnt from landslide risk management in Uganda. *Environmental Science and Policy*, *85*, 163–171. https://doi.org/10.1016/j.envsci.2018.04.002

Marks, D., & Lebel, L. (2016). Disaster governance and the scalar politics of incomplete decentralization: fragmented and contested responses to the 2011 floods in Central Thailand. *Habitat International*, *52*, 57–66. https://doi.org/10.1016/j.habitatint.2015.08.024

Medema, W., Wals, A., & Adamowski, J. (2014). Multi-loop social learning for sustainable land and water governance: towards a research agenda on the potential of virtual learning platforms. *NJAS - Wageningen Journal of Life Sciences*, *69*(6), 23–38. https://doi.org/10.1016/j.njas.2014.03.003

Mian, S. (2014). Pakistan's flood challenges: an assessment through the lens of learning and adaptive governance. *Environmental Policy and Governance*, *24*(6), 423–438. https://doi.org/10.1002/eet.1659

MoDMR. (2017). *National plan for disaster management (2016-2020): Building resilience for sustainable human development.* https://modmr.gov.bd/sites/default/files/files/modmr.portal.gov.bd/policies/0a654dce_9456 _46ad_b5c4_15ddfd8c4c0d/NPDM(2016-2020)%20-Final.pdf

MoFDM (Ministry of Food and Disaster Management). (2010). *Standing Orders on Disaster*. https://modmr.gov.bd/sites/default/files/files/modmr.portal.gov.bd/policies/b1a0c9e8_cd46_ 41f0_b532_5664a0713496/SOD-2010.pdf

MoFDM. (2019). *Standing Order on Disaster 2019.* https://modmr.gov.bd/sites/default/files/files/modmr.portal.gov.bd/policies/66292989_8f1a_

461d_a2b0_cb5ef8c7bf4f/SOD%202019_Bangla%20Version%20_Final.pdf

Mutahara, M., Warner, J., & Khan, M. S. A. (2019). Analyzing the coexistence of conflict and cooperation in a regional delta management system: tidal river management (TRM) in the Bangladesh delta. *Environmental Policy and Governance*, *29*(5), 326–343. https://doi.org/10.1002/eet.1863

Mutahara, M., Warner, J. F., Wals, A. E. J., Khan, M. S. A., & Wester, P. (2018). Social learning for adaptive delta management: tidal river management in the Bangladesh delta. *International Journal of Water Resources Development*, *34*(6), 923–943. https://doi.org/10.1080/07900627.2017.1326880

Olsson, P., Gunderson, L. H., Carpenter, S. R., Ryan, P., Lebel, L., Folke, C., & Holling, C. S. (2006). Shooting the rapids: navigating transitions to adaptive governance of social-ecological systems. *Ecology & Society*, *11*(1), 18. https://doi.org/10.2307/26267806

Ostrom, E. (2008). Institutions and the environment. *Economic Affairs*, *28*(3), 24–31.

Pahl-Wostl, C. (2009). A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes. *Global Environmental Change*, *19*(3), 354–365. https://doi.org/10.1016/j.gloenvcha.2009.06.001

Paul, B. K. (2009). Why relatively fewer people died? The case of Bangladesh's Cyclone Sidr. *Natural Hazards*, *50*(2), 289–304. https://doi.org/10.1007/s11069-008-9340-5

Pierre, J. (2012). Governance and institutional flexibility. In D. Levi-Faur (Ed.), *The Oxford handbook of governance*. Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199560530.013.0013

Reed, M. S., Evely, A. C., Cundill, G., Fazey, I., Glass, J., Laing, A., Newig, J., Parrish, B., Prell, C., Raymond, C., & Stringer, L. C. (2010). What is social learning? *Ecology and Society*, *15*(4), r1. https://doi.org/10.5751/ES-03564-1504r01

Seddiky, M. A., Giggins, H., & Gajendran, T. (2020). International principles of disaster risk reduction informing NGOs strategies for community based DRR mainstreaming: the Bangladesh context. *International Journal of Disaster Risk Reduction, 48*, 101580. https://doi.org/10.1016/j.ijdrr.2020.101580

Tosey, P., Visser, M., & Saunders, M. N. (2012). The origins and conceptualizations of 'triple-loop' learning: A critical review. *Management learning*, *43*(3), 291-307. https://doi.org/10.1177/1350507611426239

Uddin, N. (2016). Recent trends of local government elections in Bangladesh: an analysis on profile and politics. *Public Affairs And Governance*, *4*(2), 166–184. https://doi.org/10.5958/2321-2136.2016.00014.x

UNDP. (2010). *Comprehensive Disaster Management Programme (CDMP) Phase II (2010-2014).* https://info.undp.org/docs/pdc/Documents/BGD/00058919_BGD_CDMP-II_00073416.pdf. Dhaka

UNDP. (2011). *Early Recoevry facility (ERF).* https://info.undp.org/docs/pdc/Documents/BGD/00061275_BGD_ERF_Award-000612751.pdf. Dhaka

UNDP. (2017). *National Resilience Programme.* https://info.undp.org/docs/pdc/Documents/BGD/ProDoc_NRP.pdf. Dhaka

UNDRR. (2019). *Global assessment report on disaster risk reduction*. https://www.undrr.org/publication/global-assessment-report-disaster-risk-reduction-2019

UNISDR. (2005). *Hyogo Framework for Action 2005-2015: Building the resilience of nations and communities to cisasters*. International Strategy for Disaster Reduction. www.unisdr.org/wcdr

Walch, C. (2019). Adaptive governance in the developing world: disaster risk reduction in the State of Odisha, India. *Climate and Development*, *11*(3), 238–252. https://doi.org/10.1080/17565529.2018.1442794

Whaley, L., & Weatherhead, E. K. (2015). Using the politicized institutional analysis and development framework to analyze (adaptive) comanagement: farming and water resources in England. *Ecology and Society*, *20*(3), 43. https://doi.org/10.5751/ES-07769-200343.

Woodruff, J. D., Irish, J. L., & Camargo, S. J. (2013). Coastal flooding by tropical cyclones and sea-level rise. *Nature*, *504*(7478), 44–52. https://doi.org/10.1038/nature12855

Yin, R. (2014). *Case study research, design and methods*. SAGE Publications, Inc.

Young, O. R. (2002). *The institutional dimensions of environmental governance: Fit, interplay, and scale*. The MIT press.

Young, O. (2006). Vertical interplay among scale-dependent environmental and resource regimes. *Ecology and Society*, *11*(1), 27. https://doi.org/10.5751/ES-01519-110127

Young, O. R. (2017). Beyond regulation: innovative strategies for governing large complex systems. *Sustainability*, *9*(6), 938. https://doi.org/10.3390/su9060938

Supplementary Materials S 4.1

List of Abbreviations

BDRRN   Barguna Disaster Risk Reduction Network

CDMP   Comprehensive Disaster Management Programme

CODEC   Community-Based Development

CPP   Cyclone Preparedness Program

CRA   Community Risk Assessment

CSDDWS   Committee for Speedy Dissemination of Disaster Warning Signals

DC   District Commissioner

DDM   Department of Disaster Management

DRR   Disaster Risk Reduction

GPS   Global Positioning System

GSM   Global System for Mobile Communications

MoDRM   Ministry of Disaster Management and Relief

MoFDM   Ministry of Food and Disaster Management

NAHAB   National Alliance for Humanitarian Actors Bangladesh

NARRI   National Alliance for Risk Reduction and Response Initiatives

NSS   Nazrul Smriti Sangsad

RDF   Rural Development Foundation

SAP-B   South Asian Partnership (SAP)-Bangladesh

SOD   Standing Order on Disaster

UDMC   Union Disaster Management Committee

UNDP   United Nation Development Programme

UNICEF   United Nations International Children's Emergency Fund

UNO   Union Nirbahi Officer

UP   Union Parishad

UzDMC   Upazilla Disaster Management Committee
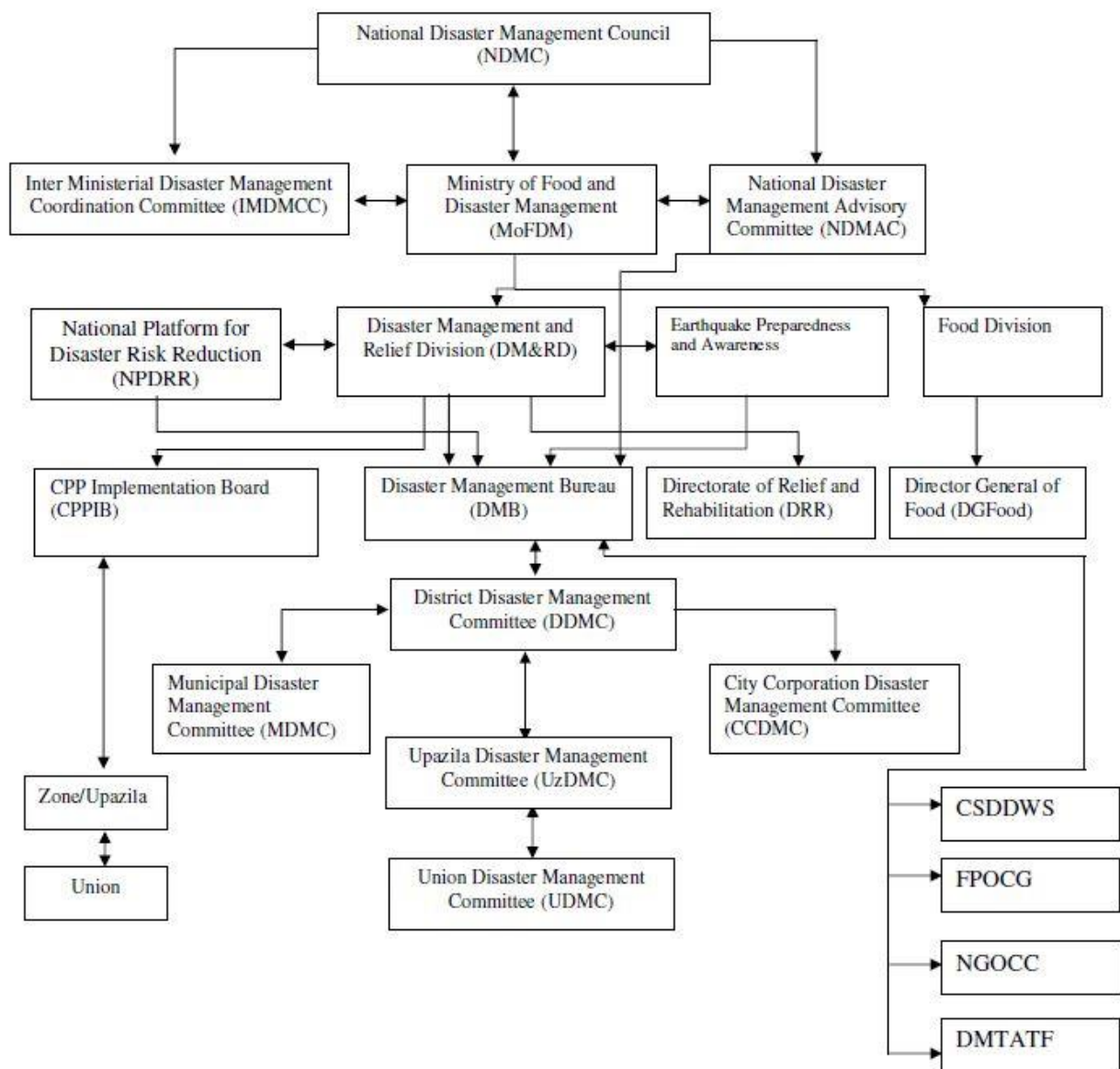
Fig. 4.S1: Institutional arrangement for disaster management in Bangladesh

Source: DMB-Bangladesh, 2010. National Plan for Disaster Management 2010-2015.

https://modmr.gov.bd/sites/default/files/files/modmr.portal.gov.bd/policies/c0400c48_11eb_4a8f

_a27a_2ae7bbb8f0a4/Nataional_Plan_for_Disaster__2010_2015__Final_Version-.pdf

Table 4. S1: List of government officials interviewed (n=28)

Local	Number	Regional	Number	National	Number
Union Parishad (UP): UP Chairman -	2	District agriculture officer	1	Disaster Management Bureau	3
Cyclone Preparedness Program (CPP): Assistant Director (1), Volunteers (3 males and 2 females)	6	District fishery officer	1	Meteorological Department	1
Fire Service and Civil Defense	1	Fire Service and Civil Defense	1	Senior level bureaucrats	4
Local forest officer	1	CPP: Deputy Director	1		
Upazilla: UNO, Project Implementation Officer (PIO), Upazilla engineer, and office staff	4	DC office: Additional Commissioner- general and District Disaster Officer	2		
		Executive officer of Water Development Office	1		
Subtotal	13	Subtotal	7	Subtotal	8
Total= 28					

Table 4. S2: List of respondents from non-government and community-based institutions (n=23)

Local and regional	Number	National/international	Number
Press club	2	ActionAid- Bangladesh	1
Faria Lara Foundation	1	Bangladesh Disaster Preparedness Centre (BDPC) -	1
Red Crescent	2	BRAC	1
Nazrul Smriti Sangsad (NSS)	1	CARE-Bangladesh	1
Scout	1	Dhaka Ahsania Mission (DAM)	1
Songram	1	Oxfam-Bangladesh	2
South Asian Partnership (SAP)-Bangladesh	1	Plan International-Bangladesh -	1
Rural Development Foundation (RDF)	1	Practical Action	1
Jago Nari	1	United Nation Development Programme (UNDP)-Bangladesh	2
Community-Based Development (CODEC)	1		
Subtotal	12	Subtotal	11
Total = 23			

LIST OF KEY QUESTIONS:

KII Key Questions

i) What lessons were learned from past major disasters?

ii) What institutional changes took place following these disasters?

iii) To what extent is institutional flexibility considered in everyday activities?

iv) To what extent learning is part of disaster management practices in your organization?

v) To what extent would you consider learning is part of management practice for improvement?

vi) How do institutional capacities shape learning and action based on learning?

vii) Does this institution prepare any "lesson learned document" after a mega disaster?

viii) To what extent and how "lesson learned document" influence future planning and action? and;

iv) What are the roles of lower-level institutional learning?

Key Questions for Deductive Coding were:

i) How are different types of learning loops connected with various levels of institutions?

ii) What are the broad areas of concern (e.g., gender, risk communication, and evacuation) under the auspices of different learning loops?

iii) How is different learning loops connected with the phases of disaster management?

iv) What are the implications of different learning loops for disaster management and building resilience to disasters?

vi) What are the roles of bridging organizations in making disaster management system adaptive?

vii) what are the problems and barriers of scaling up learning and institutional collaboration?; and

ix) How do power and politics in shaping institutional collaboration and institutionalization of learning?

Key Questions for Documents Analysis:

Social learning:

i)   What is being learned from disaster shock related experiences?

ii) Is the learning *single-loop*, *double-loop* or *triple loop*?

iii) What is the focus of learning (e.g. preparedness, response or recovery)?

iv) Is learning being translated into action?

v) Who learns and what is being learned? and vi)

vi) What are the implications of learning for community resilience?

For **institutional collaboration** thematic area, texts were selected to answer:

i)   How do different NGOs collaborate with government departments? and

ii) What role do bridging organizations play in scaling-up learning and knowledge management?

INSTITUTIONAL MISFIT:

The Arpangashia UP chairman reported that they lack sufficient number shelters for the evacuees during cyclone. With UP's geographical area, they only have five shelters that can accommodate only 4,000-5,000 people. They require 10 more shelters to accommodate additional 10,000 people. This is valid for both Amtali and Taltali sub-districts where current shelter capacity is far below than their current population size (Table S3).

Table 4. S3: Mismatch between shelter capacity and population size

*Upazila*s (sub-districts)	Population (2011 Population Census)	Number of shelters in 2020	Capacity (approximation) of shelters in 2020
Amtali	270,802	68	46,000
Taltali	88,004	56	35,000

 Source: Field data and Bangladesh Bureau of Statistics (http://www.bbs.gov.bd/)

Apart from UPs, other government agencies, such as UNO and DC offices are also deficient in financial and technical resources to reduce disaster risks. For example, even more than a decade after catastrophic Cyclone Sidr (2007) and other moderate cyclonic events [Cyclones Aila (2009), Mahasen (2013), Komen (2015), Roanu (2016), and Mora (2017)], Barguna district authority does not have any Disaster Management (DM) plan. Recently, they are planning to formulate a DM plan with technical assistance from UNICEF.

A vertical institutional linkage among government entities is evident in areas of disaster management skill development among disaster management committee members at the local level. For instance, DC office organizes training for district and *Upazila* level committee members while UNO office organizes training for UDMC members. In addition, UNOs and DCs, as leaders in their jurisdictions, often play a major role during crisis period linking formal and informal institutions. These take place both horizontally and vertically for quick response and recovery. After receiving official warning number 4, UNO and DC office activate a control room from where they provide guidance to UP and other formal and informal institutions. During such period, the DC office calls upon all stakeholders for a meeting and collective decide on necessary actions. The first step they take relates to dissemination of official early warning

engaging local level formal and informal institutions. A flexible approach rather than following a strict bureaucratic protocol is reportedly more effective in addressing such emerging situations. Community-based organization, such as CPP (comprises of male and female volunteers from the community), Fire Service and Civil Defense services also attempt to overcome their constraints by collaborating with other institutions (Table S4).

Table 4. S4: Local institutions, reasons for mismatches and strategies for addressing mismatches

Institutions	Reasons behind mismatches	Strategies for overcoming mismatches during crisis
Upazila, and DC office	-Deficiency in financial and technical capacity - Lack of knowledge on DRR - Pre-occupation with routine activities, such as social service and development - Lack of specific allocation on disaster, mostly infrastructure development	- Mass mobilization (e.g., social-cultural, and political organizations) and resources mobilization - Adopting a flexible approach to deal with crisis - Horizontal and vertical coordination among formal and informal bodies for quick response and recovery - Leadership role by local people's representatives and government officers - Involving other civil society organizations (e.g., press club) and business group
CPP	- Lack of manpower, training, and logistics - Lack of shelter to accommodate people - Lack of coordination from people	Multi-institutional collaboration, such as NGOs
Fire Service and civil defense	- Lack of manpower, training, and logistics - Required to cover large geographical space	Creating resource pull with other jurisdictions

Source: Field data

Table 4. S5: Bridging organization and innovation for early warning

National/international institutions	Purposes	Government bodies	Implication for community resilience
Practical Action	Agro-meteorological service (i.e. linking hydrometeorological information with agricultural information and ICT (Information Communication Technology)	Bangladesh Meteorological Department (BMD), Agricultural Extension Department, Department Fisheries, Bangladesh Water Development Board, and Department of Livestock Services	More localized forecasting on hydrometeorological hazards to enhance farmer's livelihood. Farmers receive warning via voice message and from local radio.
United Nation Development Programme (UNDP)	Provide early warning to hydrometeorological hazards (e.g., cyclones)	Teletalk Bangladesh Ltd. (state-owned mobile phone company), Bangladesh Meteorological Department (BMD), and Flood Forecasting Warning Centre (FFWC)	Introduced Interactive Voice Response (IVR) based (by dialing 10941) early warning system. Approximately 166.14 million mobile phone subscribers in Bangladesh as of February, 2020 (http://www.btrc.gov.bd/content/mobile-phone-subscribers-bangladesh-february-2020).

National/international institutions	Purposes	Government bodies	Implication for community resilience
CARE-Bangladesh, Centre for Global Change, Oxfam-Bangladesh, Campaign for Sustainable Rural Livelihoods, and Airtel Bangladesh Ltd	Digital early warning systems to save the lives and livelihoods of fishing communities in Bangladesh	Department of Disaster Management (DDM), Department of Fisheries under Ministry of Fisheries and Livestock, Bangladesh Telephone Regulatory Commission under Ministry of Telecommunication and BMD	Provide early warning to fishers with GPS enabled GSM handset devices

CHAPTER FIVE

Discussion and Conclusion

5.1 Introduction

The goal of this chapter is to synthesize the research findings from my PhD research, which included six months of primary data collection in the field (August 2018 to January 2019), and to discuss the implications of these findings for the advancement of knowledge, practice, and policy. In doing so, I summarize findings from each research objective; provide a synthesis of overall research findings and emerging themes; discuss contributions to community resilience scholarship, implications of the research findings for policy, and limitations of the study; and conclude with my personal reflections on the overall thesis research process.

5.2 Overview of Findings by Research Objectives

The overarching purpose of this research was to understand how learning at multiple societal levels shapes community resilience to coastal cyclones and associated storm surges in coastal communities of Bangladesh. The specific objectives were to: i) map the processes, outcomes, and surrogates of social learning at the local community level concerning DRR and resilience (see Chapter Two); ii) examine the processes, barriers, and outcomes of transformative learning for community resilience to cyclones (see Chapter Three); and iii) identify and analyze the types, processes of, and barriers against social learning about DRR and resilience by multi-level (i.e. local, regional, and national) and multiple disaster management institutions (e.g. state, non-state, and community-based) (see Chapter Four). Key findings from each objective are summarized in Table 5.1.

Table 5.1: Key findings from each objective.

Objectives	Key findings
Objective 1: Mapping the processes, outcomes, and surrogates of social learning at the local community level concerning DRR and resilience.	I) Considering ILK and social memory as surrogates of social learning, I found that six dimensions of ILK and positive social memory help in generating early warning of incoming cyclones and reducing disaster-risks. The six dimensions of ILK are: i) ecological (nonhuman behavior); ii) phenomenological (anticipation of a probable disaster based on memory); iii) sea/riverine; iv) meteorological; v) celestial; and vi) official

Objectives	Key findings
	(information received from external institutions and electronic and print media).
	II) Social memory is key to translate knowledge into action.
	III) ILK and scientific knowledge are complementary.
	IV) Possession of the various dimensions of ILK is often differentiated according to gender, age, and occupational positions.
	V) Formal institutional interventions sometimes contribute to the development of negative social memory.
	VI) Socially embedded practices and community-based organizations help replenish social memory.
	VII) Alternative possibilities for and local notions of resilience are undermined when ILK is unevenly folded into formal institutions' programmatic interventions for social learning and resilience building, which can paradoxically make communities more vulnerable to environmental extremes.
Objective 2 Examining the processes, barriers, and outcomes of transformative learning for community resilience to cyclones.	I) The relationship between transformative learning and resilience building is complex, involving multiple social-cultural and structural factors (e.g., beliefs, values, power structures), practical considerations (e.g., impact on livelihood, evacuation and relocation logistics), and cognitive factors.
	II) Cultural framing of risk and social-biophysical stresses constrain people's capacity for critical reflection and transformative learning, and as a consequence people may deliberately deny risk and past traumatic experiences.
	III) Learning alone cannot enhance resilience; it must be translated into action.
	IV) Experiential learning can generate a false sense of security, leading to the assumption that the severity of past disasters will not be surpassed in the future.

Objectives	Key findings
	V) Individuals' structural location (e.g., gender and occupation) shapes their learning-based action. VI) The cultivation of forward-thinking attitudes coupled with innovative strategies, such as social networking, can facilitate a transformation in adaptation practices and consequently enhance resilience to climate-related disasters.
Objective 3: Identifying and analyzing the types, processes of, and barriers against social learning about DRR and resilience by multi-level (i.e. local, regional, and national) and multiple disaster management institutions (e.g. state, non-state, and community-based).	I) The financial and technical capacities of institutions at the lowest formal administrative level in Bangladesh do not match with the spatial, functional, and temporal requirements of DRR and DM II) The presence of nested and multiple institutional structures at the local level helps to overcome the institutional fit problem and facilitate the resilience-building process. III) Multi-loop social learning tends to vary according to the level of institutions. For instance, local and regional-level institutions achieve primarily single- and double-loop learning, while national and international level institutions document more double- and triple-loop learning. IV) Enhancing community resilience requires consideration of an iterative feedback relationship among different learning loops. V) Bridging organizations play critical roles in institutionalizing and scaling up social learning from episodic events. VI) Innovation and knowledge management, where bridging organizations play important roles, are essential for enhancing a governance regime's flexibility and adaptability.

5.3 Major Contributions of the Thesis

5.3.1 Theoretical Contributions

This thesis expands our understanding of the role of social and transformative learning in reducing disaster risks and building community resilience to nature-induced shocks. From a

systems perspective, learning in the context of resilience implies social and institutional learning (Berkes, 2007; Pahl-Wostl, 2009; Reed et al., 2010; Vinke-de Kruijf & Pahl-Wostl, 2016). To date, limited published manuscripts have documented and contributed to our understanding of how social and institutional learning from episodic disaster events enhance community resilience. This thesis fills this gap by investigating and documenting learning for building community resilience – social learning processes and outcomes at the community level and multi-loop social learning by multi-level institutions (see Chapter Two and Chapter Four, respectively).

Contributions to community level social learning and resilience are threefold (see Chapter Two). First, literature on social learning, community resilience, and ILK are still not well connected. I connected social learning with community resilience scholarship, considering ILK as a point of convergence, and further linked these fields with disaster resilience literature and knowledge. I argued that local knowledge, beliefs, practices, and social memory are crucial elements in social learning processes for building system (i.e. community) resilience to shocks and stresses. Second, social learning and community resilience, and the connection between them, are often framed normatively (Berkes & Ross, 2013; Cutter et al., 2008; Johannessen & Hahn, 2013), which limits our understanding of on-the-ground processes. Taking a critical stance (i.e. a biopolitical lens) on social learning and community resilience, I analyzed how the power–knowledge–institution matrix shapes social learning processes that in turn foster resilience outcomes. Third, pragmatically oriented and critical scholarship on community resilience are considered competing and diametrically opposite domains (Biermann et al., 2015; Chandler, 2014; Mavelli, 2017). I posit that both lines of scholarship hold similar lines of argument. In this regard, an anonymous reviewer of one of our papers published from this research stated that, at present the "two strands of literature ... often talk past each other," and that this needs to be transformed into "meaningful interaction". Chapter Three was an attempt to pave the way for such meaningful interaction in order to better understand community resilience building processes on-the-ground.

Concerning social learning by multi-level institutions for building community resilience to nature-induced disasters, the role of multi-loop social learning and learning at multiple institutional levels for building resilience has received increasing attention in the environmental governance literature, specifically in natural resources management (Egunyu & Reed, 2015;

Johannessen et al., 2019; Pahl-Wostl et al., 2016; Rodela, 2011) and climate change adaptation literature (Baird et al., 2014; Ensor & Harvey, 2015; Tran & Rodela, 2019; Van Epp & Garside, 2019). However, there is still a significant gap in the literature regarding how such forms of learning contribute to community resilience to episodic events like nature-induced disasters. Adopting an adaptive governance framework, this thesis expands our understanding of how local institutional capacity, multi-loop learning, and multi-level institutional collaboration are critical for enhancing community resilience.

To date, learning in community resilience scholarship has been mainly concerned with social and experiential learning. Varied forms of learning may contribute to resilience differently (Gunderson, 2010). For example, experiential learning primarily contributes to incremental adjustments (i.e. coping and adaptation). Given the shortcomings of incremental change in confronting climate change-induced disaster risks, we (Choudhury and Haque, 2018) argue that in such contexts experiential learning is necessary but not sufficient, and that transformative learning is necessary to reduce disaster-risk and build resilience. Sharpe (2016) first attempted to link transformative learning to adaptation and disaster resilience, where such learning is considered a method to facilitate behavioral change. However, a significant gap exists regarding how transformative learning from disaster-shocks and actions based on such learning alter community resilience. Understanding how such learning takes place in a given socio-cultural-institutional context is also critical. To this end, I connected a sociological and anthropological framing of risks and hazards to transformative learning and community resilience to disaster-shocks.

5.3.2 Empirical Contributions

There is a wide recognition that social learning is critical for strengthening community resilience and reducing disaster-risks (Cutter et al., 2008; O'Brien et al., 2010; Roosli & O'Brien, 2011). However, to date limited empirical research has demonstrated how such learning shapes community resilience, a gap where this thesis has made several contributions. This thesis has empirically documented the connections among ILK, institutions, social learning processes, and community resilience, and especially how the power–knowledge–institution matrix shapes social learning processes at the community level that in turn foster resilience outcomes. Findings suggest that formal institutions tend to exclude ILK from social learning and often consider people as subjects of institutional power and objects of scientific knowledge, rather than as

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active agents. This undermines local notions of resilience and is likely to make communities more vulnerable in the longer term.

A wide array of studies have demonstrated the contributive role of ILK in strengthening community resilience to and reducing risks of disasters (Gómez-Baggethun et al., 2012, 2013; Kelman, Mercer, & Gaillard, 2012; Thomalla & Larsen, 2010; Setten and Lein, 2019). This thesis has supplemented these studies and documented that the six dimensions of ILK facilitated the generation of early warnings and the reduction of losses and damages. However, findings from this thesis further documented that the possession of different dimensions of ILK is not symmetrically distributed across the community – rather it varies in terms of age, gender, and occupation. This highlights the importance of social learning processes and community-wide learning for building resilience.

Social memory (SM) is often considered as part of local knowledge, and the connection between ILK and social memory is not well understood. This thesis elaborated the interplay of SM and ILK on a temporal scale and demonstrated that social memory is key to translating knowledge into action. Despite having a rich stock of ILK, people could suffer losses and damages due to a deficit of SM. Moreover, rather than romanticizing ILK as is sometimes done, we triangulated some of the dimensions of ILK against established scientific findings and found that they are complementary to one another.

A few review studies underscore the importance of social learning by institutions for DRR and resilience (Murti & Mathez-Stiefel, 2019; O'Brien et al., 2010; Zhang et al., 2020); others have attempted to conceptually connect adaptive governance with community resilience (Djalante et al., 2011, 2012, 2013). However, only limited empirical studies are available to support such assertions (for an exception see Mian, 2014). This thesis helps to fill this gap by documenting multi-loop social learning at multiple institutional levels and exploring the role of such learning in shaping community resilience to cyclone disasters, specifically by focusing on the implications of multi-loop learning in risk reduction and resilience. This highlights both the implications of different types of loop learning for disaster management and community resilience, as well as the importance of considering multiple levels of analysis to obtain a comprehensive perspective of social learning by institutions. The role of bridging organizations is highlighted in linking institutions at different levels, nurturing institutional memory, and facilitating innovation to make the governance system flexible and adaptive. Importantly, there is

scant knowledge of and literature on the role of social learning in disaster management, DRR, and resilience in Bangladesh, and this PhD research is the first comprehensive attempt to document and advance such knowledge in this geographic and political context.

Concerning transformative learning, findings from this thesis (Chapter Three) document the processes, barriers, and outcomes of transformative learning that can facilitate a transformational change in adaptation practices for building community resilience, especially to nature-induced disaster-shocks. Considering resilience as a learning processes at multiple levels, this thesis has also documented how learning and change at individual levels shape resilience at the community level. In particular, our empirical findings demonstrate how social-cultural and structural factors (e.g., beliefs, values, power structures), practical considerations (e.g., impact on livelihood, evacuation and relocation logistics), and cognitive factors either facilitate or constrain drawing lessons (i.e. learning) from disaster experience and translating experiential learning into practice.

Lastly, this study has demonstrated empirically how learning at individual, community, and multiple institutional levels shapes community resilience. Further, evidence from this research has illustrated how each societal level of learning feeds back to one another in shaping community resilience.

5.3.3 Methodological Contributions

This thesis adopts a Transformative-Interpretive paradigm (Chapter Two and Three) to investigate coastal community resilience to cyclones and associated storm surges, and specifically to explore the connection between (social and transformative) learning and community resilience. This is a novel approach to investigating community resilience. Importantly, this approach fits well with 'resilience thinking', i.e. focusing on the strengths that reside within communities rather than on their weaknesses or vulnerability. Further, this approach foregrounds systemic and transformative barriers and changes from the point of view of the marginalized people who bear the brunt of disasters.

5.4 Overarching and Emerging, Interconnected Themes

5.4.1 Connections Among Different Societal Levels of Learning for DRR and Resilience

Investigating resilience requires consideration of multi-scale and nested levels (e.g., individual, community, institutions) of analysis (Folke et al., 2002; P. Olsson et al., 2006). In particular,

resilience at the community level to climate-induced shocks and stresses is shaped by processes and drivers at multiple scales and levels (Berkes & Ross, 2016). Considering the inseparable linkage between learning and resilience, it is argued that community resilience is a learning process at multiple societal levels (Choudhury & Haque, 2018; O'Brien et al., 2010). Yet there are limited studies documenting how learning at multiple societal levels shapes community resilience and how learning at different societal levels is connected. In this section, I document and explain how learning at multiple societal levels shapes community resilience, and how these levels are connected and feed back to one another. This is represented graphically in Fig. 5.1.
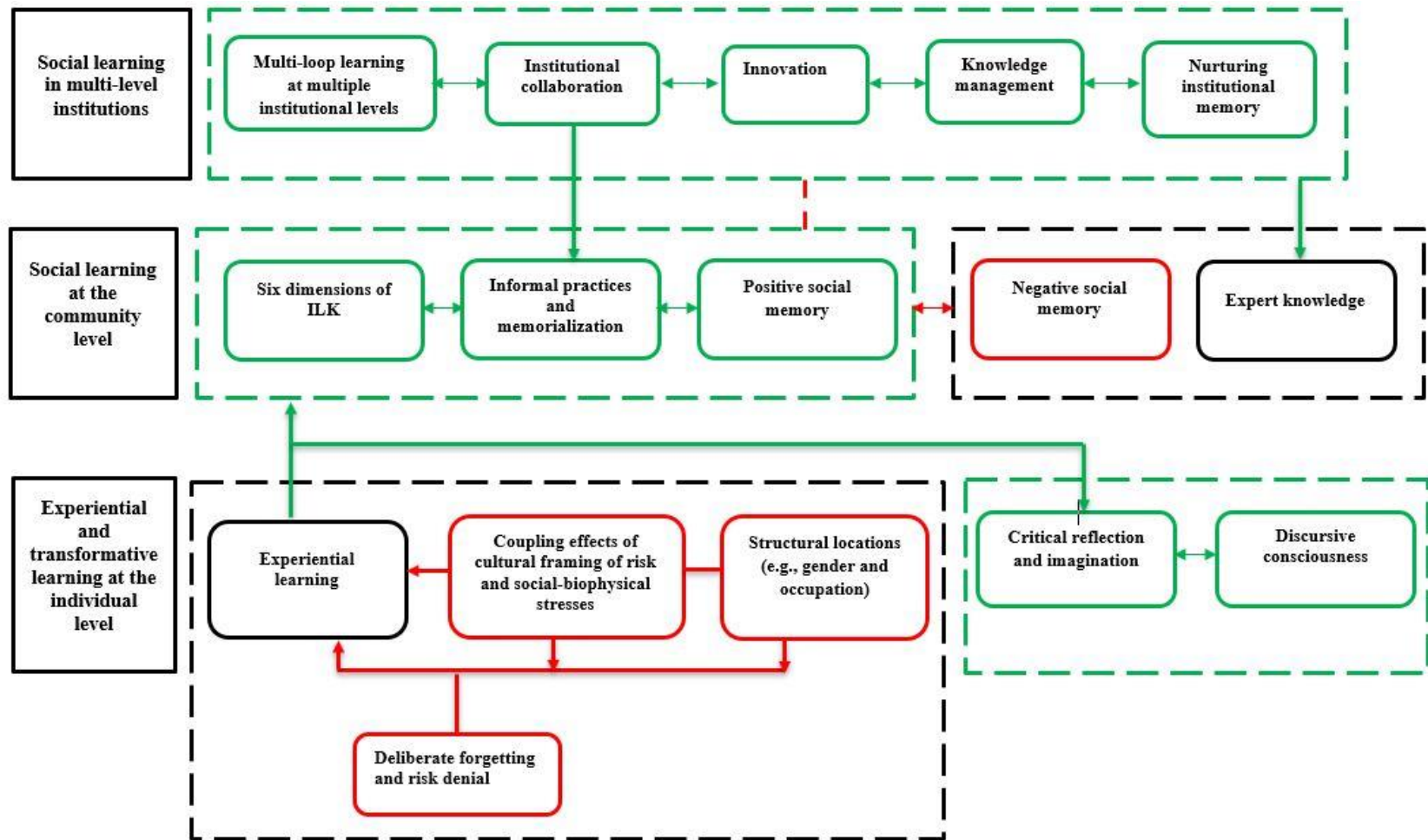
- **Green boxes and lines indicate positive effects on community resilience.**
- **Red lines and boxes indicate negative effects.**
- **Black boxes indicate effects that are positive in the short-term but that could be negative in the longer-term.**
- **The dotted red line indicates a disconnection between ILK and social memory, and the formal institutional practices and interventions that they could inform.**

Fig. 5.1: Learning at multiple societal levels and community resilience.

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Building resilience and reducing risks at the community level requires the involvement of institutions at multiple levels, commonly termed multi-level governance (Adger et al., 2005; Bakkour et al., 2015; Walch, 2019). I documented five key components of social learning at multiple institutional levels: i) multi-loop learning at multiple institutional levels, ii) institutional collaboration, iii) innovation, iv) knowledge management, and v) nurturing institutional memory (see Chapter Four). These five components are found to influence one another positively; they are mutually reinforcing and, in turn, enhance resilience and reduce disaster risk at the community level (Fig. 5.1). Varied levels of loop learning, for example, contributes to risk reduction and resilience building differently: single-loop learning contributes principally to disaster response and evacuation, while double-loop learning facilitates better institutional collaboration, knowledge management, and institutional capacity building. As the level and nature of loop learning tends to be different according to institutional level, collaboration among multiple institutions of varying levels establishes vital connections and facilitates the iterative feedback relationships among multiple learning loops required to build and enhance community level resilience (Fig. 5.1).

Several recent studies have attempted to apply an adaptive or multi-level governance framework to investigate resilience to nature-induced disasters (cf. Bakkour et al., 2015; Lam & Kuipers, 2019; Walch, 2019). However, these studies fall short in terms of demonstrating the role of bridging organizations in connecting multiple institutions working at varying levels, scaling up learning from local and regional institutional levels, and introducing novel ideas from global experience. I documented that bridging organizations play critical roles in innovation, knowledge management, and nurturing institutional memory and documenting learning for episodic events like nature-induced disasters. These in turn enhance community resilience to cyclones and associated risks.

Multi-level and multiple (e.g., state and non-state) formal institutions often take a top-down or vertical approach to social learning in order to build local community resilience to disaster-shocks, and in such approaches social learning by community people is largely excluded from the process. In particular, the role of ILK and social memory and practices are relegated to a subjugated position in an effort to build resilience. Such lack of attention to local strengths (i.e. ILK, memory, and practices) together with externally defined notions of resilience paradoxically make communities more vulnerable in the longer term by promoting a victim mentality. Thus, it

appears that the underlying premise that guides formal institutions' programmatic interventions for resilience building remains vulnerability reduction oriented, which is supposed to be identifying and strengthening local capacities (Chandler, 2019; Imperiale & Vanclay, 2020b, 2020a). This also implies that the needed paradigmatic shift in the approach to managing disasters and reducing risk has mostly taken place on paper rather than in actual on-the-ground interventions (i.e. a mismatch between professed approach and practice).

In recent years, there has been a great deal of interest among planners and policy makers in considering ILK in local-level disaster planning and management (Kelman et al., 2012; Melo Zurita et al., 2015). To this end, disaster management has been decentralized to engage local-level institutions across the globe, assuming that these institutions are closer to the communities and, as a consequence, are better able to take local knowledge and opinion into account in disaster management and planning (Bae et al., 2016; Marks & Lebel, 2016). Evidence from my study in coastal Bangladeshi communities suggests that formal institutions do sometimes take a community-based approach and consider ILK in local level planning. In such cases, local knowledge is often merely considered 'data' that need to be integrated into the planning process, rather than regarding and acting on it as knowledge in its own right to promote local notions of resilience (Nadasdy, 1999). Moreover, formal institutions utilize local platforms (i.e. *adda*) and other informal community spaces (e.g., courtyard and marketplaces) principally to disseminate scientific-technocratic knowledge.

Taking ILK and social memory as surrogate measures of social learning, I found that the six dimensions of ILK and positive social memory helped in DRR and building resilience (see Chapter Two). Inbuilt social mechanisms and practices in communities facilitated refreshing social memories and disseminating memory and learning community wide (Berkes & Folke, 1998). Learning from disaster-shocks also contributed to coping and adaptation processes. However, people were sometimes reluctant to take preparatory measures due to having a negative social memory, which partly resulted from formal institutional measures to reduce risk and build resilience, i.e. an unintended negative consequence of formal institutional measures. As mentioned above, lack of attention to local strengths that reside within communities results in failures to address community vulnerability issues. Moreover, climate change-induced shocks involve surprises as community people are sometimes unable to provide early warning using their ILK.

Given the current disjunctions between multi-level institutional learning and social learning by community people, there is an urgent need for robust synergies between the two levels of learning for building resilience. One possible way to advance and enhance such synergies is to facilitate the process of knowledge co-production and co-learning (Armitage et al., 2011; Hill et al., 2020; Xavier et al., 2018). While such initiatives are widely acknowledged in resilience scholarship and have recently received currency in climate change adaptation literature (Berkes, 2017; Galappaththi et al., 2021; Robinson & Berkes, 2011; Singh et al., 2021), they are yet to receive sufficient attention in the areas of disaster management and risk reduction. Such an approach has immense potential to facilitate the design and implementation of more robust and hazard- and place-specific resilience programming (Nygren, 2009; Weichselgartner & Kelman, 2015). Recognizing the complementary nature of ILK and scientific knowledge points to the practical potential for co-learning and co-production of knowledge. Moreover, evidence suggested that local and indigenous communities' proactive adoption of practices to adapt to environmental changes embodies collaborative elements toward the integration of ILK with scientific knowledge (Hilhorst et al., 2015). For instance, community people have historically adopted scientific and technological knowledge and combined it with their own local knowledge to generate accurate early warning for cyclones and storm surges along the Indian subcontinental coasts, including Bangladesh.

Recognizing the complex process of knowledge production and integration, Raymond et al. (2010) argued for a 'problem-focused' approach and highlighted the importance of a continuous process of reflection and modification. However, such a process must be locally led and sensitive to power, as lack of attention to power imbalances often undermine ILK in the process of participation and knowledge integration (Puppim de Oliveira & Fra.Paleo, 2016). As Robinson and Berkes (2011) proposed, there are three ways through which the interaction between formal institutions and communities can be carried out: i) an institutional mechanism to link various levels of institutions; ii) involvement of various stakeholders at all levels of institutions; and iii) deliberation.

Much of the learning discussed above is primarily a form of experiential learning, including ILK and social memory. Learning from past disaster experience, social memory, and ILK facilitate actions (mostly coping and adaptation) required to enhance community resilience to nature-induced disasters. However, building community resilience to climate-induced shocks

requires going beyond experiential learning to include, for example, the transformation of individuals' perspectives, leading to transformed behaviors and adaptation practices. A deeper investigation of experiential and transformative learning reveals that the relationship between learning, action, and resilience is a rather complex process (see Chapter Three). Concerning experiential learning, people often deliberately forget past learning and deny risk due to cultural-structural factors (e.g., beliefs, values, power structures), practical considerations (e.g., impact on livelihood, evacuation and relocation logistics), and cognitive factors. The cultivation of forward-thinking attitudes – imagining a better future and altering behavioral orientations toward risk accordingly – coupled with innovative strategies, such as social networking, can successfully enhance resilience to climate-induced disasters. In a similar vein, Tschakert et al. (2016) differentited between reactive (i.e. learning after shocks) and anticipatory learning (i.e. forward-looking). They argue that the later is key in dealing with the compelxity of risks and uncertianty and in undertaking proactive action.

Lastly, it is alleged that resilience scholarship has put emphasis on systems and their properties over actors and their agency (Davidson, 2010, 2013; Hatt, 2013; L. Olsson et al., 2015). Some scholars have attempted to incorporate dynamics of human agency in investigations of resilience at the community and SES levels (Armitage et al., 2012; Brown & Westaway, 2011; Choudhury & Haque, 2016; Coulthard, 2012; Galappaththi et al., 2021; Grêt-Regamey et al., 2019; Lyth et al., 2018). Most of these authors have attempted to demonstrate how factors at the actors' level (i.e. individual actions and skills) feed back to the community level SES. For instance, Coulthard (2012) investigated how adaptation practices, in the form of the exercise of agency, shape fishing community resilience. Grêt-Regamey et al. (2019) also documented that the functional diversity (e.g., skills, abilities, management capacity) and richness of actors (i.e. diversity of actors) determine the trajectory of SES resilience. My study puts human agency at the center of investigation to underscore the relationships among learning, action, and resilience, and demonstrates that different forms of consciousness driving intended or actual actions (coping, adaptation, and transformation) are facilitated and constrained by numerous social, cultural, structural, and institutional factors. This in turn leads to differential outcomes for community resilience to disasters, such as cyclones and storm surges (see Fig. 5.1).

5.4.2 Situated Factors, Learning, and Place-Based Community Resilience

In the context of building community resilience to cyclones and associated storm surges, a number of interrelated situated or place-based attributes shape the connections between direct and indirect experience and learning (lesson drawing), and between learning and action (human responses). I deal here with three key such attributes: social and cultural factors that shape cognitive and behavioral processes for resilience; situated or place-based knowledge and social practices; and people's attachment to place. Scholarship on these three factors is diverse and varied, and I posit that this rich diversity has the potential to contribute toward the advancement of place-based community resilience scholarship.

In recent years, there has been a social and cultural turn in resilience scholarship (cf. Brown, 2014; Cote & Nightingale, 2011; Lyon & Parkins, 2013; Shah et al., 2017; Stone-Jovicich et al., 2018; Webb, 2018). The social turn has taken place mostly in scholarship on SES resilience and its extension, community resilience, due to an alleged lack of attention to the social dimension of resilience (Hatt, 2013; Lyon & Parkins, 2013; Vaneeckhaute et al., 2017). Armitage et al. (2012) argue that one reason for this lack of attention is the ease of modelling the ecological component compared to the social component of SESs. Several studies have recently attempted to fill this gap by attending to various sociological dimensions, such as power and politics (Brown, 2014); human wellbeing (Armitage et al., 2012); equity and justice (Matin et al., 2018); and actors (human agency) and their subjectivity (Davidson, 2010). The cultural dimension of resilience has received currency in disaster resilience scholarship, where authors argue that culture shapes people's attitudes and responses toward risks and hazards, which consequently influences resilience (Mori et al., 2019; Morris & Kadetz, 2018; Taiban et al., 2020; VanLandingham, 2018; Webb, 2018).

Despite the fundamental linkage between learning and community resilience, to date only limited attention has been paid to investigating how social and cultural factors mediate their relationship. My study underscores the complexity of the relationship between learning and community resilience, which is often shaped by social, cultural, and cognitive factors. Findings from my research suggest that lessons drawn from disaster experience are shaped by the coupling effect on individuals of the cultural framing of risk and social-biophysical stresses (e.g., power and climate-induced shocks and stresses). Learning and knowledge alone are not sufficient to alter resilience: learning must be translated into action. However, such learning-based action

does not take place in social vacuum; rather, social, cultural, and institutional contexts shape the translation of learning into action. Focusing on human agency helps underscore the role of social-cultural-institutional factors that shape capacity for critical reflection and action required to build resilience. It is also shaped by individuals' structural locations (e.g., gender and occupation) and socially and culturally embedded practices. Further research needs to be carried out on the role of cultural factors that shape resilience outcomes.

The other crucial place-based attributes for building community resilience are ILK and memory from past disasters (Berkes, 2007; Berkes & Ross, 2013; Galappaththi et al., 2021; Rahman et al., 2018). Such knowledge is longitudinal and emerges at the local level through iterative processes of trial and error, empirical observation, and experimentation (Berkes, 2018). ILK is often termed 'place-based', 'place', or 'situated' knowledge (Charles et al., 2020; Leith & Vanclay, 2016; Rodina et al., 2017). It is argued that such knowledge is more valid at the local level compared to abstract scientific knowledge (Agrawal, 1995). Critical scholarship on disasters has also highlighted the importance of situated knowledge for building local notions of resilience (Barber & Haney, 2016; García López, 2020). I contend that further cross-fertilization among these critical and pragmatically oriented strands of resilience scholarship is urgently needed to make resilience more workable on-the-ground.

As Faulkner et al. (2018) argue, resilience is not something 'out there' to be objectively measured and analyzed, but rather it is an 'emergent property'. Recognition of situated knowledge is critical for building place-based community resilience to shocks and stresses. It is also crucial for building local versions of resilience (Weichselgartner & Kelman, 2015). Findings from my study support these assertions. In my study context, I found six dimensions of ILK that played a significant role in terms of generating early warning and reducing the risk of cyclonic disaster-shocks. However, despite a rich stock of ILK, community people struggle to translate knowledge into action due to deficits in social memory. In other contexts, the dimensions and contents of ILK that facilitate building resilience to cyclones have been found to be different (Madhanagopal & Pattanaik, 2019). Berkes and Ross (2013) highlight that the attributes of resilience tend to be different in terms of the shocks experienced (e.g., flood, cyclone, fire), and depending on their location, shocks and stress are different for place-based communities. Further research is therefore required on documenting hazard-specific ILK and its role in specific resilience-building contexts.

People's attachment to or connection with place is widely recognized and identified as an important attribute of community resilience (Berkes & Ross, 2013; Lyth et al., 2018; Maclean et al., 2014). Such connection can be related to livelihoods, risks and hazards, identity, culture (customs, beliefs, and values), emotions, and skills, among others (Bonaiuto et al., 2016; Cretney & Bond, 2017; Lyth et al., 2018; Marshall et al., 2012). All of these components have implications for community resilience. People's attachment to place is an important attribute that shapes their responses to climate-induced shocks and stresses. People-place connections can either facilitate or impede adaptive and transformational responses to climate change-induced shocks (McElduff & Ritchie, 2018). However, community resilience scholarship often depicts such connections normatively (Maclean et al., 2014; Uddin et al., 2020). Findings from my study suggest that an attachment to place in terms of livelihoods and skills facilitated the maintenance of the basic properties of resilience, but impeded transformational adaptation. Other studies also suggest that attachment does not always positively shape adaptation and resilience (Adger et al., 2012; Marshall et al., 2012) Specifically, in terms of the aspects of risk-coping and adaptive behavior, place attachment is found to be a double-edged sword (Scannell et al., 2017; Scannell & Gifford, 2017).

The above discussion of three key attributes of community resilience to coastal cyclones and associated storm surges (i.e. learning, ILK, and people-place connection) highlights the fact that the role of such attributes in building resilience is much more complex than what is commonly documented and argued in the literature. Recently, a few authors have also documented this complexity to some extent. For instance, in the context of tsunami, Plümper et al., (2017) documented that learning could be negative, and false learning could make people ill-prepared. Social capital and networks (Aldrich, 2011, 2017) and diversity (Cochrane & Cafer, 2017) have also been found to be double-edge swords. In such cases other situated factors, such as power and local culture, influence the role of attributes in shaping resilience. Further research would continue to unmask this complexity and improve our understanding of community resilience to disaster-shocks.

5.4.3 Scale Issues in Risk, Hazard, and Disaster Governance and Multi-level Institutions

Management and governance of risks, hazards, and nature-induced disasters require special attention to the issue of scale (Baker & Refsgaard, 2007; Kienberger et al., 2013). Lebel et al. (2005) argue that scale emerges from the interaction of social and biophysical processes. The

distribution, perception, and nature of risks, as well as vulnerability and resilience tend to be different in terms of scale – both spatial and temporal (Adger et al., 2005; Cutter & Derakhshan, 2018; Cutter & Finch, 2008; Pilkington & Mahmoud, 2017). Notably, scale is often narrowly defined in the risk and hazard literature, especially in terms of spatial dimensions. Other dimensions of scale (e.g., knowledge, management, time), scale-mismatches, and cross-scale dynamics have not yet received sufficient attention. Lack of conceptual clarity and attention to appropriate scale and their dynamics often limits the effective management and governance of risks and disasters. I concur with Cash et al. (2006, p. 2) and define scale as "the spatial, temporal, quantitative, or analytical dimensions used to measure and study any phenomenon," where levels are "the units of analysis that are located at different positions on a scale".

There is an ongoing debate regarding the appropriate scale for measuring, managing, and governing risk, vulnerability, and disasters (Fekete et al., 2010; Hamilton et al., 2019; Mabon & Kawabe, 2017). Several quarters have raised concerns regarding politics around scale, commonly referred as 'scalar politics' (Blackburn, 2014; Gera, 2018). One main line of argument of these scholars is that scale is a social construct, and choice of scale is inherently political and involves social and political processes of exclusion and inclusion (Lebel et al., 2005). Adger et al. (2005) argue that the distribution of risks and resources tend to be different in terms of scale. Managing environmental issues requires understanding the scale of human actions and the social processes through which these scales are constructed. Based on this line of argument, authors have argued that the decentralization of risk and disaster governance and community-based risk reduction and resilience building are not panaceas (Blackburn, 2014). Findings from my study validate such arguments and document that disaster management has been decentralized at the lowest administrative level (i.e. UP level) in Bangladesh without the necessary accompanying authority and resources. Other studies in the developing country context also concur with these findings (Choudhury et al., 2019; Maes et al., 2018).

Two important points worth noting here are: first, when discussing scale in cases of risk and hazard management, authors have mostly focused on spatial scale while sidestepping other important scales (e.g., temporal and management) necessary for effective disaster management; and second, the importance of cross-scale dynamics and multi-level institutions in overcoming scale mismatches or problems of fit is often ignored. As climate change can generate risks across

scales and sectors, investigation of cross-scale dynamics is necessary for building place-based community resilience (Keys et al., 2019).

My study focused on three types of scale mismatches at the local and regional level: spatial, temporal, and functional. I examined whether institutions at different levels of a jurisdictional scale align appropriately with the spatial, temporal, and functional scales of disaster management. I documented a significant mismatch among and between scales, and found that to overcome such mismatches at the local and regional levels it was vital that there be: i) nested and multiple institutional structures at the local level; ii) institutional flexibility; and iii) cross-scale interaction, i.e. horizontal (across space) and vertical (across institutions) collaboration and learning, by multi-level and multiple types of institutions. In similar vein, Baker and Refsgaard (2007), in the context of Hurricane Katrina, concluded that institutional development is the key to overcome scale mismatches, particularly highlighting that institutional flexibility and connectivity are critical. Other studies have noted that horizontal and vertical institutional linkages facilitate timely and efficient disaster response and recovery (Choudhury et al., 2019). To move beyond such normative descriptions of cross-scale linkages, Adger et al. (2005) documented that cross-scale networks and interactions may create winners and losers. Further research is required on the dynamics of cross-scale and cross-level institutional interactions in the context of DRR and disaster management, especially from a political economy perspective.

Two other important scales that often do not align with the scale of management are knowledge and norms (Birkmann & von Teichman, 2010; Cash et al., 2006; Markkula et al., 2019). Such scale mismatches have not yet received sufficient attention in the context of risk and disaster management. Formal institutions' planning and programmatic interventions for risk reduction and resilience building at the local community level are based upon abstract and scientific knowledge, which often has less relevance to the local-level context. Frequently, locally relevant ILK is excluded from local-level disaster management and planning. Findings from my study reveal that such mismatches have serious negative implications for building community resilience and DRR. Mismatches regarding norms also take place when local and cultural behavioral norms do not fit with formal institutional expectations and procedures. For instance, it was evident that despite training from formal institutions on evacuation and

preparedness, community people are still more likely to respond in a manner that corresponds with their local cultural and societal norms and expectations.

5.5 Lessons Learned and Policy Implications

A few key lessons can be drawn from the findings of this research that have direct policy implications for disaster prone communities in general and coastal communities in particular, in Bangladesh and elsewhere. First, formal institutions in many regions are increasingly taking responsibility for reducing risk and enhancing resilience at the local level (Espia & Fernandez, 2015; McEwen et al., 2018; Xu et al., 2018; Xu et al., 2017). The goal of such interventions is to reduce dependency on external assistance and build local capacity (Imperiale & Vanclay, 2020b). Lessons learned from the community-level investigation is that formal institutional interventions to reduce disaster-risk and enhance resilience can be counterproductive if such interventions are not aligned with local knowledge and practices. Communities have inbuilt social mechanisms that buffer against perturbations that remain unrecognized by these formal institutions. The goal of policy formulation should be to develop institutional capacity to identify and build upon these local social mechanisms and reduce communities' dependence on external assistance, which was also registered as an outcome of multi-level institutional learning.

Recently, there has been a global policy shift toward decentralization or localization of disaster management, including in Turkey (Hermansson, 2019), India (Rumbach, 2016), South Korea (Bae et al., 2016), and Indonesia (van Voorst, 2016). The Sendai Framework for Disaster Risk Reduction (2015-30) highlights the importance of local-level institutions for risk reduction and resilience (UNISDR, 2015). Disaster management policy documents in Bangladesh, such as the National Plan for Disaster Management (2010–2015 and 2016–2020) (DMB-Bangladesh, 2010; MoDMR, 2017) and the Standing Orders on Disaster (MoFDM, 2010, 2019) have followed this trend. Specifically, the Standing Orders on Disaster highlights the roles and responsibilities of local-level institutions in every phase of disasters. Evidence from this and other research (e.g., Maes et al., 2018) document that such delegation of responsibilities has taken place without the proper transfer of decision-making power and authority or strengthening local-level technical and financial capacity necessary to carry out intervention programs (i.e. spatial, temporal, and functional mismatches). In such cases, the presence of nested and multiple institutions at the local level and horizontal and vertical linkages among institutions can help overcome such mismatches. Further policy formulation both in Bangladesh and internationally

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should focus on nurturing the diversity of local institutions and the enabling factors that help establish better linkages among the multi-level institutions.

The intent of disaster policy making is to bring about systemic changes in order to have positive impacts on the lives of local community people who regularly bear the brunt of disasters. Lessons learned from multi-loop learning at multiple institutional levels suggest that such a systemic change requires that disasters are not considered stand-alone phenomena to deal with, but rather that comprehensive planning is required for effective disaster management and resilience building. *Comprehensive* here implies consideration of all risks and all hazards, and involving all sectors at all levels and scales along with local communities. Such comprehensive planning and a consequent policy instruments can facilitate the structural transformation required to facilitate the uptake of proactive and transformative measures by community people (see Nyborg et al., 2016).

Coastal communities in Bangladesh and across the globe are usually resource-dependent. Recovery from disaster losses by such communities largely depends on access to and availability of resources, especially fishery resources. My study area communities largely depend on catching Hilsa (*Tenualosa ilisha*). Fishers acknowledged that government restrictions on catching Hilsa during its breeding period have increased its availability and harvest in the last few years. During this restricted period, government supports are available to registered fishers. However, the increased domination of coastal fishing by large fishing companies has forced local fishers to venture farther and farther out to sea, which has increased their risks from cyclones and sea disturbances. Further policy and institutional interventions are required to increase fishers' access to fishery resources and to manage these resources in a sustainable manner in the coastal areas of Bangladesh.

5.6 Limitations of the Study

The field research of the present study was conducted in the area impacted by the last major cyclonic disaster (i.e. Cyclone Sidr in 2007) in Bangladesh. In the context of climate change, future events could potentially be more extreme. It was observed that Cyclone Sidr made its landfall at a time of low tide in combination with the low spring tide. Hence, the current resilience thresholds and associated responses, such as coping and adaptation, may not be effective if future cyclones are more extreme than Sidr or if a similar-sized cyclone coincides with high tide and the high spring tide.

The coastal area of Bangladesh covers some 1831.31 sq. km and includes 19 districts. These regions vary in terms of their proximity to the Bay of Bengal, and as a result their exposure to cyclonic risk varies. There are also cultural differences among these regions, such as the presence of local dialects and food habits. I conducted this thesis research in six villages from two *Upazilas* of Barguna district. Therefore, my study region may not represent the entire coastal region of Bangladesh, and consequently my findings may not be equally generalizable to other coastal regions.

5.7 Areas of Further Research

First, disasters have a gender dimension, as women tend to experience disasters differently than men. This is primarily attributed to differences in gender roles, occupations, and family endowments (Akerkar and Fordham, 2017; Ashraf and Azad, 2015; Gaillard et al., 2017). As a result, experience and learning tend to be different for males and females. This thesis partially addresses this gendered aspect of experience and learning from disaster-shocks. For instance, Chapter Two documents that the distribution of different dimensions of ILK tends to be different for males and females. Similarly, Chapter Three underscores that societal norms, values, and belief systems shape women's evacuation decisions. Moreover, men and women tend to face differential barriers in translating learning into action. However, the gender dimension of disaster experience and taking action from learning require further research, as there still remain significant gaps in our current understanding of these issues.

Second, in two comprehensive reviews on the trends and themes of, and emerging perspectives on social learning in natural resources management scholarship, Rodela (2011, 2013) documented that social learning tends to take individual-, network-, and system-centric approaches. She also pointed out that social learning research tends to align itself with different theoretical traditions, such as democracy (e.g., Jurgen Habermas' deliberative democracy theory), individual learning (e.g., Jack Mezirow's transformative learning theory), group learning (e.g., Etienne Wenger's communities of practice concept), and systems science (e.g., Buzz Holling and Carl Folke's SES theory). In dealing with social and transformative learning from disaster-shocks, this thesis (Chapters Two and Four) partly adopted a system-centric approach and drew on systems science theories, and partly took an individual-centric approach (Chapter Three). However, further research needs to be carried out adopting other approaches and theoretical frameworks to investigate the role of social learning in shaping community resilience

and DRR. This is needed because the findings from this thesis suggest that different types of learning tend to have different implications for DRR and community resilience.

Third, there is a growing cross-fertilization between environmental education research and community and disaster resilience scholarship. For instance, Marianne Krasny and Ryan Plummer and their collaborators (Krasny et al., 2010b, 2010a; Krasny & Roth, 2010; Tidball et al., 2010) underscore the imporatnce of enviornmental education and learning for SES resilience, mostly in the urban disaster context. Formal institutions play a key role in such enviornmetal education and learning for resilience. This thesis documented the role of formal institutions in the social learning process; however, bringing the litertaure on environmetal education into my analysis was beyond the scope of the research. Further research therefore should aim to fill this gap and enhance our undersnatnding of the critical role of enviornmental education in the resilience building process.

Lastly, an emerging theme from this thesis is the context specificity of resilience attributes, specifically the role of culture in influencing resilience attributes, such as learning, people-place attachment, and indigenous and local knowledge. A significant gap still exists in our understanding of how culture and its components shape local community resilience. In this respect, Pahl-Wostl et al. (2008) recognize the importance of culture in social learning processes. Most studies on social learning have been carried out in the European or North American contexts. Therefore, conducting research in diverse cultural contexts, as well as drawing insights from the sociological and anthropological framing of risk, disaster, and resilience will help improve our understanding of the connection between social learning and community resilience to disaster-shocks.

5.8 Reflection on the Thesis Processes and Concluding Thoughts

When I started my Master's program in 2013 at the Natural Resources Institute, University of Manitoba, my supervisor, Dr. C. Emdad Haque, asked me to think 'outside the disciplinary box'. Since then and throughout my PhD journey that started in 2016, I have worked to engage myself in interdisciplinary thinking. Becoming an interdisciplinary researcher is a transformative process – initially challenging for early career researchers like me. It is also a journey where PhD studies are a starting point and first step. Having a disciplinary background in Sociology, I have had a tendency to look into issues more critically than pragmatically. However, I have come to feel that often critical scholarship in general, and on community resilience in particular, is overly

political and with little practical implications, while the pragmatic scholarship on community resilience often underemphasizes the political aspects and implications of their research. I have learned to remain open to all available lines of arguments and to draw on insights that work best for on-the-ground solutions and that help better address the pressing issues at hand.

Interdisciplinary research requires drawing from, borrowing, and integrating insights from multiple disciplinary and interdisciplinary sources, which is sometimes carried out without much awareness to the issue of fallacy (i.e. error in reasoning due to wrong assumptions). The uncritical extrapolation from one level and type of unit of analysis to another (e.g., higher to lower or vice versa) can cause such fallacy, which is evident in disaster resilience and social learning scholarship. For example, authors sometimes attempt to draw conclusions about social learning from analyses at the individual level, and vice versa (see Rodela, 2011, 2013), and Berkes and Ross (2016) have identified such extrapolation in the disaster management literature. I think an awareness to such fallacy is vital for any interdisciplinary endeavor. Before borrowing a concept from another discipline, one needs to think about the context (e.g., types and nature of unit of analysis) from where the concept originated or developed. Consideration should also be given to the extent that meaning and application can be extended, i.e. whether concepts from one field can be applied to another literally or metaphorically.

While I was walking with my research assistant on an earthen road in a village in the study area, on the way to conduct another interview after just finishing one, I told him that this region is particularly good for conducting research on gender and its related aspects. The reason for expressing this stemmed from the observation that, in rural areas of Bangladesh, women are typically conservative and maintain a social distance from men other than their family members. During the data collection process, I noticed that women in my study area were very spontaneous and actively participated in the research process in interviews and focus groups. After hearing this, my research assistant replied: "It was not like this before Sidr … this change took place after Sidr". I asked him "Why and how?", and he replied: "After Sidr, many NGOs and relief organizations came into our region who wanted women to take relief on behalf of their households … even NGO projects [on DRR] involved many women". I realized then how nature-induced disasters can trigger or open a window for societal transformation as well as profound changes in people's cognition. I drew a few lessons from this observation. First, I conducted my PhD thesis fieldwork in the community eleven years after Sidr had made its

landfall. My stay in the coastal communities was only for six months, and a longer duration ethnographic study could help unveil and document such changes triggered by Cyclone Sidr. Second, my research assistant was able to share his insights and observations with me as he originated from the local community. He also worked with several climate change adaptation projects implemented by an NGO. Thus he was able to understand both the local context and the nature of my work. Anyone wishing to recruit a field research assistant should consider someone from the local community who also understands the nature of the work the researcher is carrying out. My research assistant was a great gate keeper for me!

During my field research, I worked to navigate to navigate my positionality between being an insider, as someone who grew up in Bangladesh and in a similar culture, and being an outsider, given that I was not from the specific research area or communities. My intent was to investigate learning from and resilience to cyclones while taking an insider perspective. To this end, I documented people's narratives on disaster-shocks as much as possible. To facilitate this process, I maintained a low profile during my stay in the community, socialized over a cup of tea with community people in the village tea shop, and took my lunch in local village restaurants. After a couple of weeks, I started communicating with people via their local dialects. Taking an insider perspective helped me better understand and capture the cognitive and behavioral aspects of risk, resilience, and learning. However, as an outsider I had never experienced a severe cyclone first-hand and had not lived in the coastal region before for more than a week. And as an outsider I observed that even ten years after Cyclone Sidr people are still living in vulnerable conditions and would likely be affected similarly or worse by a similar magnitude cyclone, unless they act based on learning from Sidr and other recent events. Such a balance between an insider and an outsider perspective helped me develop deeper insights into the processes and dynamics of learning and resilience. Moreover, through my research I tried to create a space for people to share their stories, experiences, learning, grief, and daily struggle for survival. While interviewing one CPP volunteer, I asked: Did anyone want to know about your experience and observations? He replied in the negative. During my data analysis and thesis drafting processes I worked to maintain both perspectives to present a more complete picture of the story.

Some of the learning I took from my Master's thesis research helped in my PhD research process. First, for my MNRM thesis I collected so much qualitative data that it was hard to analyze and interpret. In the end, much of the data was not needed to write the thesis. For my

PhD research, from the beginning I planned to write a 'sandwich thesis' (i.e. a grouped manuscript thesis). I therefore planned accordingly so that I could be efficient. After a couple of weeks in the community, I began to see the trends in the data and tried relating them with my research objectives. I concentrated on collecting the data and related aspects that I needed to write manuscripts/chapters. This strategy helped to reach a point of data saturation more quickly. Second, when I prepared the chapter outline of my MNRM thesis, one of my committee members commented: "You are trying to fill all the boxes you have created" and suggested to instead "write about only what is important for the argument in the chapter". It was a great lesson to learn, which has certainly helped streamline my lines of argument not only for this thesis but also for other published works.

I found that writing a sandwich thesis has advantages as well as some challenges. One main advantage I found is that constructive comments from anonymous peer-reviews helps to improve the quality of thesis manuscripts immensely. This was the case for Chapter Two, which was published in *Ecology and Society* and revised twice in response to feedback from the reviewers and the journal's chief and subject editors. However, a key challenge can be finding a balance between reviewers' comments and the scoping of the individual manuscript and overall thesis goal. Each manuscript has its own line of argument that fits into the overall framing of the thesis, but sometimes reviewers' comments may suggest taking the manuscript in a different direction that does not fit well into the overall purpose and scope of the thesis.

To conclude and reiterate, this thesis investigated learning at multiple societal levels (i.e. individual, community, and institution) that assists shaping community resilience and reduces disaster risk of coastal dwellers to cyclones and associated storm surges. Further research should examine in-depth the feedback relationships among various levels of learning in the context of other disaster-shocks (e.g., floods, heatwaves, droughts).

References

Adger, W. N., Barnett, J., Brown, K., Marshall, N., & O'Brien, K. (2012). Cultural dimensions of climate change impacts and adaptation. *Nature Climate Change*, *3*(2), 112–117. https://doi.org/10.1038/nclimate1666

Adger, W. N., Arnell, N. W., & Tompkins, E. L. (2005). Successful adaptation to climate change across scales. *Global Environmental Change*, *15*(2), 77–86. https://doi.org/10.1016/j.gloenvcha.2004.12.005

Adger, W. N., Brown, K., & Tompkins, E. L. (2005). The political economy of cross-scale networks in resource co-management. *Ecology and Society*, *10*(2), 9 https://doi.org/10.5751/ES-01465-100209

Adger, W. N., Hughes, T. P., Folke, C., Carpenter, S. R., & Rockstrom, J. (2005). Social-ecological resilience to coastal disasters. *Science*, *309*(1036), 1036–1039. https://doi.org/10.1126/science.1112122

Agrawal, A. (1995). Dismantling the divide between indigenous and scientific knowledge. *Development and Change*, *26*(3), 413–439. https://doi.org/10.1111/j.1467-7660.1995.tb00560.x

Akerkar, S., & Fordham, M. (2017). Gender, place and mental health recovery in disasters: addressing issues of equality and difference. *International Journal of Disaster Risk Reduction*, *23*, 218–230. https://doi.org/10.1016/j.ijdrr.2017.03.014

Aldrich, D. P. (2017). The importance of social capital in building community resilience. In W. Yan & W. Galloway (Eds.), *Rethinking resilience, adaptation and transformation in a time of change* (pp. 357–364). Springer International Publishing. https://doi.org/10.1007/978-3-319-50171-0_23

Aldrich, D. P. (2011). The externalities of strong social capital: post-tsunami recovery in Southeast India. *Journal of Civil Society*, *7*(1), 81–99. https://doi.org/10.1080/17448689.2011.553441

Armitage, D., Béné, C., Charles, A. T., Johnson, D., & Allison, E. H. (2012). The interplay of well-being and resilience in applying a social-ecological perspective. *Ecology and Society*, *17*(4), 15. http://dx.doi.org/10.5751/ES-04940-170415

Armitage, D., Berkes, F., Dale, A., Kocho-Schellenberg, E., & Patton, E. (2011). Co-management and the co-production of knowledge: learning to adapt in Canada's Arctic. *Global Environmental Change*, *21*(3), 995–1004. https://doi.org/10.1016/j.gloenvcha.2011.04.006

Ashraf, M. A., & Azad, M. A. K. (2015). Gender issues in disaster: understanding the relationships of vulnerability, preparedness and capacity. *Environment and Ecology Research*, *3*(5), 136–142. https://doi.org/10.13189/eer.2015.030504

Bae, Y., Joo, Y. M., & Won, S. Y. (2016). Decentralization and collaborative disaster governance: evidence from South Korea. *Habitat International*, *52*, 50–56.

https://doi.org/10.1016/j.habitatint.2015.08.027

Baird, J., Plummer, R., Haug, C., & Huitema, D. (2014). Learning effects of interactive decision-making processes for climate change adaptation. *Global Environmental Change*, *27*(1), 51–63. https://doi.org/10.1016/j.gloenvcha.2014.04.019

Baker, D., & Refsgaard, K. (2007). Institutional development and scale matching in disaster response management. *Ecological Economics*, *63*(2–3), 331–343. https://doi.org/10.1016/j.ecolecon.2007.01.007

Bakkour, D., Enjolras, G., Thouret, J. C., Kast, R., Mei, E. T. W., & Prihatminingtyas, B. (2015). The adaptive governance of natural disaster systems: insights from the 2010 mount Merapi eruption in Indonesia. *International Journal of Disaster Risk Reduction*, *13*, 167–188. https://doi.org/10.1016/j.ijdrr.2015.05.006

Barber, K., & Haney, T. J. (2016). The experiential gap in disaster research: feminist epistemology and the contribution of local affected researchers. *Sociological Spectrum*, *36*(2), 57–74. https://doi.org/10.1080/02732173.2015.1086287

Berkes, F. (2018). *Sacred Ecology* (4th ed.). Routledge. https://doi.org/10.4324/9781315114644

Berkes, F., & Ross, H. (2016). Panarchy and community resilience: sustainability science and policy implications. *Environmental Science and Policy*, *61*, 185–193. https://doi.org/10.1016/j.envsci.2016.04.004

Berkes, F., & Ross, H. (2013). Community resilience: toward an integrated approach. *Society and Natural Resources*, *26*(1), 5–20. https://doi.org/10.1080/08941920.2012.736605

Berkes, F., & Folke, C. (1998). Linking social and ecological systems for resilience and sustainability. In F. Berkes & Carl Folke (Eds.), *Linking social and ecological systems: Management practices and social mechanisms for building resilience* (pp. 1–25). Cambridge University Press.

Berkes, F. (2007). Understanding uncertainty and reducing vulnerability: lessons from resilience thinking. *Natural Hazards*, *41*(2), 283–295. https://doi.org/10.1007/s11069-006-9036-7

Biermann, M., Hillmer-Pegram, K., Knapp, C. N., & Hum, R. E. (2015). Approaching a critical turn? A content analysis of the politics of resilience in key bodies of resilience literature. *Resilience: International Policies, Practices and Discourses*, *3293*, 1–20. https://doi.org/10.1080/21693293.2015.1094170

Birkmann, J., & von Teichman, K. (2010). Integrating disaster risk reduction and climate change adaptation: key challenges-scales, knowledge, and norms. *Sustainability Science*, *5*(2), 171–184. https://doi.org/10.1007/s11625-010-0108-y

Blackburn, S. (2014). The politics of scale and disaster risk governance: barriers to decentralisation in Portland, Jamaica. *Geoforum*, *52*, 101–112. https://doi.org/10.1016/j.geoforum.2013.12.013

Bonaiuto, M., Alves, S., De Dominicis, S., & Petruccelli, I. (2016). Place attachment and natural environmental risk: research review and agenda. *Journal of Environmental Psychology*, *48*, 33–53. https://doi.org/10.1016/j.jenvp.2016.07.007

Brown, K. (2014). Global environmental change I: a social turn for resilience? *Progress in Human Geography*, *38*(1), 107–117. https://doi.org/10.1177/0309132513498837

Brown, K., & Westaway, E. (2011). Agency, capacity, and resilience to environmental change: lessons from human development, well-being, and disasters. *Annual Review of Environment and Resources*, *36*(1), 321–342. https://doi.org/10.1146/annurev-environ-052610-092905

Cash, D. W., Adger, W. N., Berkes, F., Garden, P., Lebel, L., Olsson, P., Pritchard, L., & Young, O. (2006). Scale and cross-scale dynamics: governance and information in a multilevel world. *Ecology and Society*, *11*(2), art8. https://doi.org/10.5751/ES-01759-110208

Chandler, D. (2019). Resilience and the end(s) of the politics of adaptation. *Resilience:International Policies, Practices and Discourses, 7*(3), 1–10. https://doi.org/10.1080/21693293.2019.1605660

Chandler, D. (2014). Beyond neoliberalism: resilience, the new art of governing complexity. *Resilience:International Policies, Practices and Discourses, 2*(1), 47–63. https://doi.org/10.1080/21693293.2013.878544

Charles, A., Loucks, L., Berkes, F., & Armitage, D. (2020). Community science : a typology and its implications for governance of social-ecological systems. *Environmental Science and Policy*, *106*, 77–86. https://doi.org/10.1016/j.envsci.2020.01.019

Choudhury, M-U-I., Uddin, M. S., & Haque, C. E. (2019). "Nature brings us extreme events, some people cause us prolonged sufferings": the role of good governance in building community resilience to natural disasters in Bangladesh. *Journal of Environmental Planning and Management*, *62*(10), 1761–1781. https://doi.org/10.1080/09640568.2018.1513833

Choudhury, M-U-I., & Haque, C. E. (2018). Interpretations of resilience and change and the catalytic roles of media: a case of Canadian daily newspaper discourse on natural disasters. *Environmental Management*, *61*(2), 236–248. https://doi.org/10.1007/s00267-017-0980-7

Choudhury, M-U-I., & Haque, C. E. (2016). "We are more scared of the power elites than the floods": adaptive capacity and resilience of wetland community to flash flood disasters in Bangladesh. *International Journal of Disaster Risk Reduction*, *19*, 145–158. https://doi.org/10.1016/j.ijdrr.2016.08.004

Cochrane, L., & Cafer, A. (2017). Does diversification enhance community resilience? A critical perspective. *Resilience*, *3293*, 1–15. https://doi.org/10.1080/21693293.2017.1406849

Cote, M., & Nightingale, A. J. (2011). Resilience thinking meets social theory: situating social change in socio-ecological systems (SES) research. *Progress in Human Geography*, *36*(4), 475–489. https://doi.org/10.1177/0309132511425708

Coulthard, S. (2012). Can we be both resilient and well, and what choices do people have? Incorporating agency into the resilience debate from a fisheries perspective. *Ecology and Society*, *17*(1), 4. https://doi.org/10.5751/ES-04483-170104

Cretney, R. M., & Bond, S. (2017). Shifting relationships to place: a relational place-based perspective on SES resilience. *Urban Geography*, *38*(1), 8–24. https://doi.org/10.1080/02723638.2016.1139865

Cutter, S. L., & Derakhshan, S. (2018). Temporal and spatial change in disaster resilience in US counties, 2010–2015. *Environmental Hazards*, *7891*, 2010–2015. https://doi.org/10.1080/17477891.2018.1511405

Cutter, S. L., Barnes, L., Berry, M., Burton, C., Evans, E., Tate, E., & Webb, J. (2008). A place-based model for understanding community resilience to natural disasters. *Global Environmental Change*, *18*(4), 598–606. https://doi.org/10.1016/j.gloenvcha.2008.07.013

Cutter, S. L., & Finch, C. (2008). Temporal and spatial changes in social vulnerability to natural hazards. *Proceedings of the National Academy of Sciences*, *105*(7), 2301–2306. https://doi.org/10.1073/pnas.0710375105

Davidson, D. J. (2013). We still have a long way to go, and a short time to get there: a response to Fikret Berkes and Helen Ross. *Society and Natural Resources*, *26*(1), 21–24. https://doi.org/10.1080/08941920.2012.749758

Davidson, D. J. (2010). The applicability of the concept of resilience to social systems: some

sources of optimism and nagging doubts. *Society and Natural Resources*, *23*(12), 1135–1149. https://doi.org/10.1080/08941921003652940

Djalante, R, Holley, C., Thomalla, F., & Carnegie, M. (2013). Pathways for adaptive and integrated disaster resilience. *Natural Hazards*, *69*(3), 2105–2135. https://doi.org/10.1007/s11069-013-0797-5

Djalante, R. (2012). Adaptive governance and resilience: the role of multi-stakeholder platforms in disaster risk reduction. *Natural Hazards and Earth System Science*, *12*(9), 2923–2942. https://doi.org/10.5194/nhess-12-2923-2012

Djalante, R., Holley, C., & Thomalla, F. (2011). Adaptive governance and managing resilience to natural hazards. *International Journal of Disaster Risk Science*, *2*(4), 1–14. https://doi.org/10.1007/s13753-011-0015-6

DMB-Bangladesh, 2010. *National Plan for Disaster Management 2010-2015*. https://modmr.gov.bd/sites/default/files/files/modmr.portal.gov.bd/policies/c0400c48_11eb _4a8f_a27a_2ae7bbb8f0a4/Nataional_Plan_for_Disaster__2010_2015__Final_Version-.pdf

Egunyu, F., & Reed, M. G. (2015). Social learning by whom? Assessing gendered opportunities for participation and social learning in collaborative forest governance. *Ecology and Society*, *20*(4), 44. https://doi.org/10.5751/ES-08126-200444

Ensor, J., & Harvey, B. (2015). Social learning and climate change adaptation: evidence for international development practice. *Wiley Interdisciplinary Reviews: Climate Change*, *6*(5), 509–522. https://doi.org/10.1002/wcc.348

Espia, J. C. P., & Fernandez, P. (2015). Insiders and outsiders: local government and NGO engagement in disaster response in Guimaras, Philippines. *Disasters*, *39*(1), 51–68. https://doi.org/10.1111/disa.12086

Faulkner, L., Brown, K., & Quinn, T. (2018). Analyzing community resilience as an emergent property of dynamic social-ecological systems. *Ecology and Society*, *23*(1), 24. https://doi.org/10.5751/ES-09784-230124

Fekete, A., Damm, M., & Birkmann, J. (2010). Scales as a challenge for vulnerability assessment. *Natural Hazards*, *55*(3), 729–747. https://doi.org/10.1007/s11069-009-9445-5

Folke, C., Carpenter, S., Elmqvist, T., Gunderson, L., Holling, C. S., & Walker, B. (2002). Resilience and sustainable development: building adaptive capacity in a world of transformations. *Ambio*, *31*(5), 437–440. http://www.ncbi.nlm.nih.gov/pubmed/12374053

Gaillard, J. C., Sanz, K., Balgos, B. C., Dalisay, S. N. M., Gorman-Murray, A., Smith, F., & Toelupe, V. (2017). Beyond men and women: a critical perspective on gender and disaster. *Disasters*, *41*(3), 429–447. https://doi.org/10.1111/disa.12209

Galappaththi, E. K., Ford, J. D., Bennett, E. M., & Berkes, F. (2021). Adapting to climate change in small-scale fisheries : insights from indigenous communities in the global north and south. *Environmental Science and Policy*, *116*, 160–170. https://doi.org/10.1016/j.envsci.2020.11.009

García López, G. A. (2020). Reflections on disaster colonialism: response to Yarimar Bonilla's 'The wait of disaster.' *Political Geography*, *78*, 11–14. https://doi.org/10.1016/j.polgeo.2020.102170

Gera, W. (2018). Scalar politics in Philippine urban disaster management: reframing metropolitan governance for local resilience and sustainability. *Erdkunde*, *72*(4), 287–312. https://www.jstor.org/stable/26554735

Gómez-Baggethun, E., Corbera, E., & Reyes-García, V. (2013). Traditional ecological knowledge and global environmental change: research findings and policy implications. *Ecology and Society*, *18*(4). https://doi.org/10.5751/ES-06288-180472

Gómez-Baggethun, E., Reyes-García, V., Olsson, P., & Montes, C. (2012). Traditional ecological knowledge and community resilience to environmental extremes: a case study in Doñana, SW Spain. *Global Environmental Change*, *22*(3), 640–650. https://doi.org/10.1016/j.gloenvcha.2012.02.005

Grêt-Regamey, A., Huber, S. H., & Huber, R. (2019). Actors' diversity and the resilience of social-ecological systems to global change. *Nature Sustainability*, *2*(4), 290–297. https://doi.org/10.1038/s41893-019-0236-z

Gunderson, L. (2010). Ecological and human community resilience to natural disasters. *Ecology and Society*, *15*(2), 18. http://www.ecologyandsociety.org/vol15/iss2/art18/

Hamilton, M., Fischer, A. P., & Ager, A. (2019). A social-ecological network approach for understanding wildfire risk governance. *Global Environmental Change*, *54*, 113–123. https://doi.org/10.1016/j.gloenvcha.2018.11.007

Hatt, K. (2013). Social attractors: a proposal to enhance "Resilience Thinking" about the social. *Society and Natural Resources*, *26*(1), 30–43. https://doi.org/10.1080/08941920.2012.695859

Hermansson, H. (2019). Challenges to decentralization of disaster management in Turkey: the role of political-administrative context. *International Journal of Public Administration*, *42*(5), 417–431. https://doi.org/10.1080/01900692.2018.1466898

Hilhorst, D., Baart, J., Haar, G. van der, & Leeftink, F. M. (2015). Is disaster "normal" for indigenous people? Indigenous knowledge and coping practices. *Disaster Prevention and Management*, *24*(4), 468–483. doi:10.1108/DPM-02-2015-0027

Hill, R., Walsh, F. J., Davies, J., Sparrow, A., Mooney, M., Wise, R. M., & Tengö, M. (2020). Knowledge co-production for indigenous adaptation pathways: transform post-colonial articulation complexes to empower local decision-making. *Global Environmental Change*, *65*, 102161. https://doi.org/10.1016/j.gloenvcha.2020.102161

Imperiale, A. J., & Vanclay, F. (2020a). The mechanism of disaster capitalism and the failure to build community resilience: learning from the 2009 earthquake in L'Aquila, Italy. *Disasters*. https://doi.org/10.1111/disa.12431

Imperiale, A. J., & Vanclay, F. (2020b). Top-down reconstruction and the failure to " build back better " resilient communities after disaster : lessons from the 2009 L'Aquila Italy earthquake. *Disaster Prevention and Management: An International Journal*, *29*(4), 541–555. https://doi.org/10.1108/DPM-11-2019-0336

Johannessen, Å., Gerger Swartling, Å., Wamsler, C., Andersson, K., Arran, J. T., Hernández Vivas, D. I., & Stenström, T. A. (2019). Transforming urban water governance through social (triple-loop) learning. *Environmental Policy and Governance*, *29*(2), 144-154. https://doi.org/10.1002/eet.1843

Johannessen, Å., & Hahn, T. (2013). Social learning towards a more adaptive paradigm? Reducing flood risk in Kristianstad municipality, Sweden. *Global Environmental Change*, *23*(1), 372–381. https://doi.org/10.1016/j.gloenvcha.2012.07.009

Kelman, I., Mercer, J., & Gaillard, J. (2012). Indigenous knowledge and disaster risk reduction. *Geography*, *97*(1), 12–21. https://doi.org/10.1080/00167487.2012.12094332

Keys, P. W., Galaz, V., Dyer, M., Matthews, N., Folke, C., Nyström, M., & Cornell, S. E. (2019). Anthropocene risk. *Nature Sustainability*, *2*(8), 667–673. https://doi.org/10.1038/s41893-019-0327-x

Kienberger, S., Blaschke, T., & Zaidi, R. Z. (2013). A framework for spatio-temporal scales and concepts from different disciplines: the "vulnerability cube." *Natural Hazards*, *68*(3), 1343–

1369. https://doi.org/10.1007/s11069-012-0513-x

Krasny, M. E., Lundholm, C., & Plummer, R. (2010a). Environmental education, resilience, and learning: reflection and moving forward. *Environmental Education Research*, *16*(5–6), 665–672. https://doi.org/10.1080/13504622.2010.505445

Krasny, M. E., Lundholm, C., & Plummer, R. (2010b). Resilience in social-ecological systems: the roles of learning and education. *Environmental Education Research*, *16*(5–6), 463–474. https://doi.org/10.1080/13504622.2010.505416

Krasny, M. E., & Roth, W. M. (2010). Environmental education for social-ecological system resilience: a perspective from activity theory. *Environmental Education Research*, *16*(5–6), 545–558. https://doi.org/10.1080/13504622.2010.505431

Lam, L. M., & Kuipers, R. (2019). Resilience and disaster governance: some insights from the 2015 Nepal earthquake. *International Journal of Disaster Risk Reduction*, *33*, 321–331. https://doi.org/10.1016/j.ijdrr.2018.10.017

Lebel, L., Garden, P., & Imamura, M. (2005). The politics of scale, position, and place in the governance of water resources in the Mekong region. *Ecology and Society*, *10*(2), 18. http://www.ecologyandsociety.org/vol10/iss2/art18/

Leith, P., & Vanclay, F. (2016). Placing science for natural resource management and climate variability: lessons from narratives of risk, place and identity. *Sociologia Ruralis*, *57*(2), 155–170. https://doi.org/10.1111/soru.12124

Lyon, C., & Parkins, J. R. (2013). Toward a social theory of resilience: social systems, cultural systems, and collective action in transitioning forest-based communities. *Rural Sociology*, *78*(4), 528–549. https://doi.org/10.1111/ruso.12018

Lyth, A., Spinaze, A., Watson, P., & Johnston, F. H. (2018). Place, human agency and community resilience–considerations for public health management of smoke from prescribed burning. *Local Environment*, *23*(10), 975–990. https://doi.org/10.1080/13549839.2018.1508205

Mabon, L., & Kawabe, M. (2017). Making sense of complexity in risk governance in post-disaster Fukushima fisheries: a scalar approach. *Environmental Science and Policy*, *75*, 173–183. https://doi.org/10.1016/j.envsci.2017.06.001

Maclean, K., Cuthill, M., & Ross, H. (2014). Six attributes of social resilience. *Journal of Environmental Planning and Management*, *57*(1), 144–156.

https://doi.org/10.1080/09640568.2013.763774

Madhanagopal, D., & Pattanaik, S. (2019). Exploring fishermen's local knowledge and perceptions in the face of climate change: the case of coastal Tamil Nadu, India. *Environment, Development and Sustainability*, *22*(4), 3461–3489. https://doi.org/10.1007/s10668-019-00354-z

Maes, J., Parra, C., Mertens, K., Bwambale, B., Jacobs, L., Poesen, J., Dewitte, O., Vranken, L., de Hontheim, A., Kabaseke, C., & Kervyn, M. (2018). Questioning network governance for disaster risk management: lessons learnt from landslide risk management in Uganda. *Environmental Science and Policy*, *85*, 163–171. https://doi.org/10.1016/j.envsci.2018.04.002

Markkula, I., Turunen, M. T., & Kantola, S. (2019). Traditional and local knowledge in land use planning: insights into the use of the Akwé: Kon guidelines in Eanodat, Finnish Sápmi. *Ecology and Society*, *24*(1), 20. https://doi.org/10.5751/ES-10735-240120

Marks, D., & Lebel, L. (2016). Disaster governance and the scalar politics of incomplete decentralization: fragmented and contested responses to the 2011 floods in Central Thailand. *Habitat International*, *52*, 57–66. https://doi.org/10.1016/j.habitatint.2015.08.024

Marshall, N. A., Park, S. E., Adger, W. N., Brown, K., & Howden, S. M. (2012). Transformational capacity and the influence of place and identity. *Environmental Research Letters*, *7*(3). https://doi.org/10.1088/1748-9326/7/3/034022

Matin, N., Forrester, J., & Ensor, J. (2018). What is equitable resilience? *World Development*, *109*, 197–205. https://doi.org/https://doi.org/10.1016/j.worlddev.2018.04.020

Mavelli, L. (2017). Governing the resilience of neoliberalism through biopolitics. *European Journal of International Relations*, *23*(3), 489–512. https://doi.org/10.1177/1354066116676321

McElduff, L., & Ritchie, H. (2018). Fostering coastal community resilience: mobilising people-place relationships. *50*(2), 186-194. https://doi.org/10.1111/area.12419

McEwen, L., Holmes, A., Quinn, N., & Cobbing, P. (2018). 'Learning for resilience': developing community capital through flood action groups in urban flood risk settings with lower social capital. *International Journal of Disaster Risk Reduction*, *27*, 329–342. https://doi.org/10.1016/j.ijdrr.2017.10.018

MoDMR, 2017. *National plan for disaster management (2016-2020): Building resilience for*

sustainable human development.

https://modmr.gov.bd/sites/default/files/files/modmr.portal.gov.bd/policies/0a654dce_9456

_46ad_b5c4_15ddfd8c4c0d/NPDM(2016-2020)%20-Final.pdf

MoFDM (Ministry of Food and Disaster Management), 2010. *Standing Orders on Disaster*.

https://modmr.gov.bd/sites/default/files/files/modmr.portal.gov.bd/policies/b1a0c9e8_cd46_

41f0_b532_5664a0713496/SOD-2010.pdf

MoFDM, 2019. *Standing Order on Disaster 2019*.

https://modmr.gov.bd/sites/default/files/files/modmr.portal.gov.bd/policies/66292989_8f1a_

461d_a2b0_cb5ef8c7bf4f/SOD%202019_Bangla%20Version%20_Final.pdf

Melo Zurita, M. de L., Cook, B., Harms, L., & March, A. (2015). Towards new disaster

governance: subsidiarity as a critical tool. *Environmental Policy and Governance*, *25*(6),

386–398. https://doi.org/10.1002/eet.1681

Mian, S. (2014). Pakistan's flood challenges: an assessment through the lens of learning and

adaptive governance. *Environmental Policy and Governance*, *24*(6), 423–438.

https://doi.org/10.1002/eet.1659

Mori, M., McDermott, R., Sagala, S., & Wulandari, Y. (2019). Sinabung volcano: how culture

shapes community resilience. *Disaster Prevention and Management: An International

Journal*, *28*(3), 290–303. https://doi.org/10.1108/DPM-05-2018-0160

Morris, J. R. G., & Kadetz, P. (2018). Culture and resilience: how music has fostered resilience

in post-Katrina New Orleans. In Zakour, M. J., Mock, N., & Kadetz, P. (Eds.). *Creating

Katrina, rebuilding resilience: Lessons from New Orleans on vulnerability and resiliency*

(pp. 233–256). https://doi.org/10.1016/B978-0-12-809557-7.00010-7

Murti, R., & Mathez-Stiefel, S. (2019). Social learning approaches for ecosystem-based disaster

risk reduction. *International Journal of Disaster Risk Reduction*, *33*, 433–440.

https://doi.org/10.1016/j.ijdrr.2018.09.018

Nadasdy, P. (1999). The politics of TEK: power and the "integration" of knowledge. *Arctic

Anthropology*, *36*(1–2), 1–18. https://www.jstor.org/stable/40316502

Nyborg, K., Anderies, J. M., Dannenberg, A., Lindahl, T., Schill, C., Schlüter, M., Adger, W. N.,

Arrow, K. J., Barrett, S., Carpenter, S., III, F. S. C., Crépin, A.-S., Daily, G., Ehrlich, P.,

Carl Folke, W., & Zeeuw, A. de. (2016). Social norms as solutions. *Science*, *354*(6308), 42–

43. doi: 10.1126/science.aaf8317

Nygren, A. (2009). Local knowledge in the environment–development discourse: from dichotomies to situated knowledge. *Critique of Anthropology*, *19*(3), 267–288. https://doi.org/10.1177/0308275x9901900304

O'Brien, G., O'Keefe, P., Gadema, Z., & Swords, J. (2010). Approaching disaster management through social learning. *Disaster Prevention and Management: An International Journal*, *19*(4), 498–508. https://doi.org/10.1108/09653561011070402

Olsson, L., Jerneck, A., Thoren, H., Persson, J., & O'Byrne, D. (2015). Why resilience is unappealing to social science: theoretical and empirical investigations of the scientific use of resilience. *Science Advances*, *1*(4), 1–11. https://doi.org/10.1126/sciadv.1400217

Olsson, P., Gunderson, L. H., Carpenter, S. R., Ryan, P., Lebel, L., Folke, C., & Holling, C. S. (2006). Shooting the rapids: navigating transitions to adaptive governance of social-ecological systems. *Ecology & Society*, *11*(1), 18. http://www.ecologyandsociety.org/vol11/iss1/art18/

Pahl-Wostl, C., Craps, M., Dewulf, A., Mostert, E., Tabara, D., Taillieu, T., Pahl-Wostl, C., Taillieu, T., Tabara, D., Mostert, E., & Craps, M. (2016). Social learning and water resources management. *Ecology and Society*, *12*(2), 5. http://www.ecologyandsociety.org/vol12/iss2/art5/

Pahl-Wostl, C. (2009). A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes. *Global Environmental Change*, *19*(3), 354–365. https://doi.org/10.1016/j.gloenvcha.2009.06.001

Pahl-Wostl, C., Tàbara, D., Bouwen, R., Craps, M., Dewulf, A., Mostert, E., Ridder, D., & Taillieu, T. (2008). The importance of social learning and culture for sustainable water management. *Ecological Economics*, *64*(3), 484–495. https://doi.org/10.1016/j.ecolecon.2007.08.007

Pilkington, S., & Mahmoud, H. (2017). Spatial and temporal variations in resilience to tropical cyclones along the United States coastline as determined by the multi-hazard hurricane impact level model. *Palgrave Communications*, *3*(1), 1–7. https://doi.org/10.1057/s41599-017-0016-1

Plümper, T., Quiroz Flores, A., & Neumayer, E. (2017). The double-edged sword of learning from disasters: mortality in the Tohoku tsunami. *Global Environmental Change*, *44*, 49–56. https://doi.org/10.1016/j.gloenvcha.2017.03.002

Puppim de Oliveira, J. A., & Fra.Paleo, U. (2016). Lost in participation: how local knowledge was overlooked in land use planning and risk governance in Tōhoku, Japan. *Land Use Policy*, *52*, 543–551. https://doi.org/10.1016/j.landusepol.2014.09.023

Rahman, A., Sakurai, A., & Munadi, K. (2018). The analysis of the development of the Smong story on the 1907 and 2004 Indian Ocean tsunamis in strengthening the Simeulue island community's resilience. *International Journal of Disaster Risk Reduction*, *29*, 13–23. https://doi.org/10.1016/j.ijdrr.2017.07.015

Raymond, C. M., Fazey, I., Reed, M. S., Stringer, L. C., Robinson, G. M., & Evely, A. C. (2010). Integrating local and scientific knowledge for environmental management. *Journal of Environmental Management*, *91*(8), 1766–1777. https://doi.org/10.1016/j.jenvman.2010.03.023

Reed, M., Evely, A. A., Cundill, G., Fazey, I., Glass, J., Laing, A., Newig, J., Parrish, B., Prell, C., Raymond, C., Stringer, L., & Reed Evely, A. C., Cundill, G., Fazey, I., Glass, J., Laing, A., Newig, J., Parrish, B., Prell, C., Raymond, C. and Stringer, L. C., M. S. (2010). What is social learning? *Ecology and Society*, *15*(4), r1. http://www.ecologyandsociety.org/vol15/iss4/resp1/

Robinson, L. W., & Berkes, F. (2011). Multi-level participation for building adaptive capacity: formal agency-community interactions in northern Kenya. *Global Environmental Change*, *21*(4), 1185–1194. https://doi.org/10.1016/j.gloenvcha.2011.07.012

Rodela, R. (2013). The social learning discourse: trends, themes and interdisciplinary influences in current research. *Environmental Science and Policy*, *25*, 157–166. https://doi.org/10.1016/j.envsci.2012.09.002

Rodela, R. (2011). Social Learning and natural resource management: the emergence of three research perspectives. *Ecology & Society*, *16*(4),30. http://dx.doi.org/10.5751/ES-04554-160430

Rodina, L., Baker, L. A., Galvin, M., Goldin, J., Harris, L. M., Manungufala, T., Musemwa, M., Sutherland, C., & Ziervogel, G. (2017). Water, equity and resilience in Southern Africa: future directions for research and practice. *Current Opinion in Environmental Sustainability*, *26–27*, 143–151. https://doi.org/10.1016/j.cosust.2017.09.001

Roosli, R., & O'Brien, G. (2011). Social learning in managing disasters in Malaysia. *Disaster Prevention and Management: An International Journal*, *20*(4), 386–397.

https://doi.org/10.1108/09653561111161716

Rumbach, A. (2016). Decentralization and small cities: towards more effective urban disaster governance? *Habitat International*, *52*(2015), 35–42. https://doi.org/10.1016/j.habitatint.2015.08.026

Scannell, L., Cox, R. S., & Fletcher, S. (2017). Place-based loss and resilience among disaster-affected youth. *Journal of Community Psychology*, *45*(7), 859–876. https://doi.org/10.1002/jcop.21897

Scannell, L., & Gifford, R. (2017). The experienced psychological benefits of place attachment. *Journal of Environmental Psychology*, *51*, 256–269. https://doi.org/10.1016/j.jenvp.2017.04.001

Setten, G., & Lein, H. (2019). "We draw on what we know anyway": the meaning and role of local knowledge in natural hazard management. *International Journal of Disaster Risk Reduction*, *38*(May), 101184. https://doi.org/10.1016/j.ijdrr.2019.101184

Shah, S. H., Angeles, L. C., & Harris, L. M. (2017). Worlding the intangibility of resilience: the case of rice farmers and water-related risk in the Philippines. *World Development*, *98*, 400–412. https://doi.org/10.1016/j.worlddev.2017.05.004

Sharpe, J. (2016). Understanding and unlocking transformative learning as a method for enabling behaviour change for adaptation and resilience to disaster threats. *International Journal of Disaster Risk Reduction*, *17*, 213–219. https://doi.org/10.1016/j.ijdrr.2016.04.014

Singh, R. K., Singh, A., Zander, K. K., Mathew, S., & Kumar, A. (2021). Measuring successful processes of knowledge co-production for managing climate change and associated environmental stressors: adaptation policies and practices to support Indian farmers. *Journal of Environmental Management*, *282*, 111679. https://doi.org/10.1016/j.jenvman.2020.111679

Stone-Jovicich, S., Goldstein, B. E., Brown, K., Plummer, R., & Olsson, P. (2018). Expanding the contribution of the social sciences to social-ecological resilience research. *Ecology and Society*, *23*(1), 41. https://doi.org/10.5751/ES-10008-230141

Taiban, S., Lin, H. N., & Ko, C. C. (2020). Disaster, relocation, and resilience: recovery and adaptation of Karamemedesane in Lily Tribal Community after Typhoon Morakot, Taiwan. *Environmental Hazards*, *19*(2), 209–222. https://doi.org/10.1080/17477891.2019.1708234

Thomalla, F., & Larsen, R. K. (2010). Resilience in the context of tsunami early warning systems

and community disaster preparedness in the indian ocean region. *Environmental Hazards*, *9*(3), 249–265. https://doi.org/10.3763/ehaz.2010.0051

Tidball, K. G., Krasny, M. E., Svendsen, E., Campbell, L., & Helphand, K. (2010). Stewardship, learning, and memory in disaster resilience. *Environmental Education Research*, *16*(5–6), 591–609. https://doi.org/10.1080/13504622.2010.505437

Tran, T. A., & Rodela, R. (2019). Integrating farmers' adaptive knowledge into flood management and adaptation policies in the Vietnamese Mekong Delta: a social learning perspective. *Global Environmental Change*, *55*, 84–96. https://doi.org/10.1016/j.gloenvcha.2019.02.004

Tschakert, P., & Dietrich, K. A. (2010). Anticipatory learning for climate change adaptation and resilience. *Ecology and Society*, *15*(2), 11. http://www.ecologyandsociety.org/vol15/iss2/art11/

Uddin, M. S., Haque, C. E., Walker, D., & Choudhury, M.-U.-I. (2020). Community resilience to cyclone and storm surge disasters: evidence from coastal communities of Bangladesh. *Journal of Environmental Management*, *264*, 110457. https://doi.org/10.1016/j.jenvman.2020.110457

UNISDR. (2015). Sendai Framework for Disaster Risk Reduction 2015 - 2030. *Third World Conference on Disaster Risk Reduction, Sendai, Japan, 14-18 March 2015*. https://doi.org/A/CONF.224/CRP.1

Van Epp, M., & Garside, B. (2019). Towards an evidence base on the value of social learning-oriented approaches in the context of climate change and food security. *Environmental Policy and Governance*, *29*(2), 118–131. https://doi.org/10.1002/eet.1835

van Voorst, R. (2016). Formal and informal flood governance in Jakarta, Indonesia. *Habitat International*, *52*, 5–10. https://doi.org/10.1016/j.habitatint.2015.08.023

Vaneeckhaute, L. E., Vanwing, T., Jacquet, W., Abelshausen, B., & Meurs, P. (2017). Community resilience 2.0: toward a comprehensive conception of community-level resilience. *Community Development*, *48*(5), 735–751. https://doi.org/10.1080/15575330.2017.1369443

VanLandingham, M. (2018). Resilience among vulnerable populations: the neglected role of culture. In Zakour, M. J., Mock, N., & Kadetz, P. (Eds.). *Creating Katrina, rebuilding resilience: Lessons from New Orleans on vulnerability and resiliency* (pp. 257–266).

https://doi.org/10.1016/B978-0-12-809557-7.00011-9

Vinke-de Kruijf, J., & Pahl-Wostl, C. (2016). A multi-level perspective on learning about climate change adaptation through international cooperation. *Environmental Science & Policy*, *66*, 242–249. https://doi.org/10.1016/j.envsci.2016.07.004

Walch, C. (2019). Adaptive governance in the developing world: disaster risk reduction in the State of Odisha, India. *Climate and Development*, *11*(3), 238–252. https://doi.org/10.1080/17565529.2018.1442794

Webb, G. R. (2018). The cultural turn in disaster research: understanding resilience and vulnerability through the lens of culture. In H. Rodríguez, W. Donner, & J. E. Trainor (Eds.), *Handbook of disaster research* (2nd ed., pp. 109–121). Springer International Publishing. https://doi.org/10.1007/978-3-319-63254-4_2

Weichselgartner, J., & Kelman, I. (2015). Geographies of resilience: challenges and opportunities of a descriptive concept. *Progress in Human Geography*, *39*(3), 249–267. https://doi.org/10.1177/0309132513518834

Xavier, L. Y., Jacobi, P. R., & Turra, A. (2018). On the advantages of working together: social learning and knowledge integration in the management of marine areas. *Marine Policy*, *88*, 139–150. https://doi.org/10.1016/j.marpol.2017.11.026

Xu, D., Hazeltine, B., Xu, J., & Prasad, A. (2018). Public participation in NGO-oriented communities for disaster prevention and mitigation (N-CDPM) in the Longmen Shan fault area during the Wenchuan and Lushan earthquake periods. *Environmental Hazards*, *17*(4), 371–395. https://doi.org/10.1080/17477891.2018.1491382

Xu, J., Xu, D., Lu, Y., & Wang, Q. (2017). A bridged government–NGOs relationship in post-earthquake reconstruction: the Ya'an service center in Lushan earthquake. *Natural Hazards*, *24*, 1–26. https://doi.org/10.1007/s11069-017-3056-3

Zhang, Q., Hu, J., Song, X., Li, Z., Yang, K., & Sha, Y. (2020). How does social learning facilitate urban disaster resilience ? A systematic review. *Environmental Hazards*, *19*(1), 107–129. https://doi.org/10.1080/17477891.2019.1671786

APPENDICES

Appendix 1: Research Instruments

Appendix 1A: Instruments at the Community Level

➢ **Guided questionnaire for Semi-structured interview (SSI):**

1. How did you used to see natural hazards (i.e. cyclones) before you experienced it?
2. How do you frame natural hazards, disasters and your relationship with nature now?
3. How do, and to what extent do you think your exposures to environmental hazards shaped your framing?
4. How did you prepare for the first ever cyclone you faced?
5. How did your prepare for the later events?
6. How would you prepare if there is one in the future?
7. What have you learned? How did your learning contributed?
8. How did your indirect experience (e.g., learning from others) shape your perspective towards hazards/disasters?
9. What are the factors that constraints from translating learning into action? Elaborate.
10. Do you participate in the collective learning platforms? How and where? Elaborate.
11. How do you feel to be a non(participant) of collective learning platform?
12. Do you think that the collective learning platforms are useful and important?
13. Do you think institutions take your learning into account?

➢ **Guided questionnaire for Key Informants Interview (KII):**

1. Who participates in the learning platform and why?
2. Who gets excluded by whom?
3. Who are the key decision makers?
4. Whose voice is heard?
5. What are the underlying motives of people's participation?
6. Is there any incentive?
7. Who gets what? Why and how?

➢ **Guided questionnaire for Oral history interview:**

1. Please start with your first experience with a mega disaster.

2. How did you cope with that disaster?

3. What about later events?

4. What have you learned from those events?

5. How do learning from one event helped to cope with later events?

6. Were you able to act based on learning?

➢ **Guided questionnaire for Focus Group Discussion (FGD)**

1. What have you learned from past natural disasters?

2. Is learning translated into action for building resilience?

3. If yes, how?

4. If no, why not?

5. What are the constraints to translate learning into action?

6. Do disaster management institutions take your learning into account?

7. What have you learned from different GO-NGO disaster management institutions?

➢ **Participant observation (structured observation protocol):**

1. What is the nature of participation in the collective learning platform?

2. Is there any discussion about past learning, mistake and future planning?

3. Who participates in the learning platform (gender and age composition)?

4. What are the contents and focus of discussion?

5. Is community people's learning being taken into account and documented?

6. Who makes decision?

7. Whose voice is heard?

Appendix 1B: Household Survey

District: Barguna
Upazilla (Sub-district): Amtali/Taltali   Code:
Union:
Village:
<div align="center">

Block-I
Socio-demographic profile of individuals
</div>

1. Occupation
  a. Main source of earning

b. Other:
- I.
- II.
- III.
- IV.
- V.

2. Formal years of education

3. Age

4. Sex

5. Religion

6. Family members

Male	Female
Total	

7. Earning members

8. Sources of income

Name of the sources	Income in taka/yearly

9. Land ownership

a. Agricultural
- i. Self-owned
- ii. *Khasland*
- iii. Amount of rice from these lands
- iv. Amount of agricultural land in the *Kharchariar Haor*

b. Non-agricultural land
- i. Self-owned
- ii. *Khasland*

c.   Other land
10. Property (Both moveable and non-moveable)

<div align="center">

Block-II
Loss and Damage

</div>

11. Types of natural hazards faced.

12. Number of cyclones experienced in last 20 years

13. Worst disaster experience.

14. Types of losses
  a)   b)   c)   d)

15. Loss of family members
  a.   Yes.   b. No
      If yes, how many?

16. Types of damage
  a.   crop (in quantity)
  b.   health (nature of health hazards)
  c.   property (housing and others)
  d.   livestock (types and quantity)
  e.   fuel sources/fodder
  f.   other (please explain)

Appendix 1C: Instruments at Institutional levels (Guided Questionnaire for GO-NGO Officials):

1.   To what extent learning is part of disaster management practices in your organization?

2.   To what extent would you consider learning is part of management practice for improvement?

3.   What is the focus of learning (e.g. preparedness, response or recovery)?

4.   To what extent flexibility is considered?

5.   How does DM policy change shape institutional practices?

6.   How do disaster management institutions shape DM policies in Bangladesh?

7.   How do institutional capacities shape learning and action based on learning?

8.   Does this institution prepare any "lesson learned document" after a mega disaster?

9. To what extent and how "lesson learned document" influence future planning and action?

10. Do you take lessons from community people and lower level institutions?

11. How you interact with policy makers and influence policy?

12. Explain the situations of your success and failure with reasons.

13. Is there any scope for you to deliver the learning of community people and your organization to the policy makers? If yes, how do you do that?

14. How do learning by policy actors shape DM policy?

15. How would you describe Government's action or inaction regarding DM?

16. What are the roles of lower-level institutional learning?

17. How do drivers at national level, such as pressure from different bridging organizations shape DM policy?

18. What are the barriers to i) implement new learning for future planning; ii) formulate forward-looking policy?

Appendix 2: Ethics Approval

University of Manitoba | Research Ethics and Compliance

Human Ethics
208-194 Dafoe Road
Winnipeg, MB
Canada R3T 2N2
Phone +204-474-7122
Email: humanethics@umanitoba.ca

PROTOCOL APPROVAL

TO: Mahed-Ul-Islam Choudhury   (Advisor: C. Emdad Haque)
Principal Investigator

FROM: Julia Witt, Chair
Joint-Faculty Research Ethics Board (JFREB)

Re: Protocol J2018:049 (HS21814)
Understanding Multi-level Learning for Disaster Risk Reduction
And Enhancing Community Resilience in Bangladesh

Effective: August 21, 2018   **Expiry:** August 21, 2019

Joint-Faculty Research Ethics Board (JFREB) has reviewed and approved the above research. JFREB is constituted and operates in accordance with the current *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans.*

This approval is subject to the following conditions:

1. Approval is granted only for the research and purposes described in the application.

2. Any modification to the research must be submitted to JFREB for approval before implementation.

3. Any deviations to the research or adverse events must be submitted to JFREB as soon as possible.

4. This approval is valid for one year only and a Renewal Request must be submitted and approved by the above expiry date.

5. A Study Closure form must be submitted to JFREB when the research is complete or terminated.

6. The University of Manitoba may request to review research documentation from this project to demonstrate compliance with this approved protocol and the University of Manitoba *Ethics of Research Involving Humans.*

Funded Protocols:
- **Please mail/e-mail a copy of this Approval, identifying the related UM Project Number, to the Research Grants Officer in ORS.**

Research Ethics and Compliance is a part of the Office of the Vice-President (Research and International)
umanitoba.ca/research

TCPS 2: CORE

Certificate of Completion

This document certifies that

Mahed Choudhury

has completed the Tri-Council Policy Statement:
Ethical Conduct for Research Involving Humans
Course on Research Ethics (TCPS 2: CORE)

Date of Issue: **11 June, 2014**