

Beyond the barriers: An overview of mechanisms driving barriers to adaptation in Bangladesh

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Abstract

Climate change adaptation governance involves multiple actors, operating from local to national level, and during their interactions, several challenges may surface and act as barriers to adaptation. While existing studies attempted to create an exhaustive list of barriers by focusing on “what” is occurring, we continue to have a meager understanding of “how” or “why” barriers emerge in the governance process. Selecting Bangladesh as a case study area, we identify the mechanisms that cause the emergence of barriers in the climate change adaptation governance process. We particularly focus on the barriers that emerge through interactions among actors. We base our research on data from key-informant interviews and a systematic literature review. Our analysis reveals that there are at least five mechanisms that are involved in the emergence of barriers: enclosure and exclusion, boundary control, organizational inertia, belief formation, and frame polarization. Our identification of common mechanisms provides insights on actors' roles and activities in adaptation governance and elucidates the processes through which actors' interactions lead to barriers. This mechanism-based analysis of barriers will help to address and navigate through the barriers more effectively to ensure successful adaptation. As climate change is becoming mainstreamed in development plans and policies in our study area, identifying the mechanisms of adaptation barriers can elucidate how development and climate adaptation strategies are affected by identified barriers.

KEYWORDS

adaptation, Bangladesh, barriers, governance, mechanisms

1 | INTRODUCTION

The multidimensional nature and cross-scale impacts of climate change require a concerted effort from different actors for climate change adaptation (Cash et al., 2006; Cash & Moser, 2000; C. C. Gibson, Ostrom, & Ahn, 2000; Termeer, Dewulf, & Van Lieshout, 2010). These actors operate at different levels of governance (i.e., national, regional, and local). Through communications and negotiations, they interact with each other and form a network of governance to design and implement adaptation actions (Amundsen, Berglund, &

Westskogh, 2010; Bauer, Feichtinger, & Steurer, 2012; Bulkeley & Moser, 2007; Chhetri, Stuhlmacher, & Ishtiaque, 2019; Keskitalo, 2010). Their interactions can be continuous or episodic, depending on the context and actors' need (Fidelman, Leitch, & Nelson, 2013; Verkerk, Teisman, & Van Buuren, 2015), and are often characterized by their ambitions, preferences, responsibilities, and resources (Ford, Berrang-Ford, Lesnikowski, Barrera, & Jody Heymann, 2013; Termeer, Dewulf, & Breeman, 2013; Vink, Dewulf, & Termeer, 2013). Discrepancies in these attributes among actors may cause numerous challenges to surface during interactions and impair the governance

process (Amundsen et al., 2010; Juhola, Glaas, Linnér, & Neset, 2016). These challenges are popularly known as *barriers to adaptation*. Synonymously termed as “hindrances” or “constraints” or “impasses” in the literature, barriers to adaptation can generally be defined as obstacles or challenges that can impede the governance process of planning, implementing, and monitoring adaptation actions (Eisenack et al., 2014; L. Jones & Boyd, 2011; Moser & Ekstrom, 2010). This understanding of barriers implies that barriers are observable in the failures of the design and implementation of governance process. In this sense, if a barrier is not resulting in an impediment to adaptation, then it would not be considered as a barrier. Barriers, however, can be subjective and constructed by actors. Biesbroek, Termeer, Klostermann, and Kabat (2014a) termed this analytical lens as a “problem solving lens” in which barriers are found in the execution of governance process and addressed through optimizing the process by using the right resources, knowledge, or skills.

Research on barriers to adaptation primarily focused on generating a list of context-specific barriers identified for different phases of adaptation, often accompanied with generic suggestions on how to overcome them. For example, Biesbroek, Klostermann, Termeer, and Kabat (2013) did an evidence synthesis and found that institutional and social factors are key categories of barriers to adaptation (see also Eisenack et al., 2014; Moser & Ekstrom, 2010). This traditional approach of categorizing a factor or process as a barrier reduces complex and highly dynamic decision-making processes into simplified, static, and metaphorical statements about why current outcomes are “incorrect” without sufficient evidence or explanation (Biesbroek, Termeer, Klostermann, & Kabat, 2014b; Biesbroek et al., 2015). For instance, “lack of coordination” among actors has been identified as a barrier to adaptation by many scholars (i.e., Biesbroek, Klostermann, Termeer, & Law, 2011; Ekstrom & Moser, 2014; Lawrence et al., 2015) without sufficient explanation on how it comes into play. Further, barriers may be the result of asymmetrical power relations between actors and institutions or socially constructed limitations deriving from discursive framings of the political economy that influence perceptions and expectations. Addressing the barriers in decision-making processes requires explanations of the mechanisms that cause these unintended outcomes or barriers to emerge (Biesbroek et al., 2015; Biesbroek, Dupuis, & Wellstead, 2017). Unless we identify and address these mechanisms, attempts to overcome them may become futile. As such, some scholars have abandoned this conventional approach of barrier analysis that only identify barriers without explaining how they emerge and instead examine the underlying mechanisms that are involved in the emergence of barriers in the adaptation governance process to examine the causal processes involved (Biesbroek et al., 2014b; Biesbroek et al., 2015; Wellstead et al., 2018).

Mechanisms are unobserved but empirically traceable processes through which a causal factor generates an effect and thus can only be identified together with its associated effect (i.e., barriers) (Hedstrom & Ylikoski, 2010). For instance, Biesbroek et al. (2014b) found that previous conflicts, tensions, and distrust between municipalities and sub-municipalities (i.e., *conflict infection mechanism*) led to

lack of collaboration, identified as a barrier, in the Water Plaza project in the Netherlands. Similarly, Sieber, Biesbroek, and Block (2018) found that public and private actors preferred grey infrastructure-based solutions over ecosystem-based adaptation in flood management in Chi Basin, Thailand, while the government thought otherwise. In the course of the project their differences in framing the solution expanded (i.e., *frame polarization mechanism*) and eventually stagnated communications, creating an impasse (*aka barrier*) to adaptation. These mechanism-based analyses help us to understand how these barriers surface in the adaptation governance process. Nevertheless, there has yet been an effort to synthesize findings across different adaptation contexts to determine common mechanisms associated with barriers. Such research would support the development of adaptation strategies that can anticipate and address such mechanisms.

Studies on barriers to adaptation in the South Asian context mostly follow the “barrier approach” and focus on listing the barriers to adaptation encountered in different cases. For instance, Jones and Boyd (2011) explored the social barriers to adaptation in Nepal and listed differing risk perceptions and lack of access to resources as significant barriers. Also, Ahmed, Gersonius, Veerbeek, Alam Khan, and Wester (2015) found that sectoral shortsightedness and lengthy bureaucratic processes hinder urban flood risk management in Bangladesh. While these studies enhanced understanding of different types of barriers in adaptation, in most cases they failed to address the processes of how and why these barriers surfaced. However, using the same “barrier approach,” some studies discussed, often succinctly, how the barriers come into place. Azhoni, Holman, and Jude (2017), for example, examined the barriers to adaptation in Northern India and found that complacency, competing priorities, and power struggles are among the processes that lead to barriers. Similarly, Stott and Huq (2014) went beyond identifying “lack of collaboration” as a barrier and discussed how competition for funds causes this barrier to emerge in adaptation governance in Bangladesh. This small subset of literature has been generative in demonstrating how and why barriers emerge in the adaptation process. Here we argue for the need to build on this research to elicit the causal mechanisms associated with the barriers identified.

In this study, we adopted the “mechanism-based approach” to analyze the action-formation mechanisms (see Section 2) that are involved in the emergence of barriers in the adaptation governance process in Bangladesh by posing the following question: *What are the common mechanisms that can explain the emergence of barriers in the adaptation governance process in Bangladesh?* We are particularly interested in the coordination and collaboration among organizations that are involved in adaptation actions and thus household or community level interactions are beyond our scope. We address our research question by collecting empirical data through key-informant interviews and synthesizing secondary evidence through a systematic literature review of the existing barrier-related research. We attempt to fill the aforementioned research gap by identifying the common mechanisms that produce barriers to adaptation. We recognize, however, that because we are relying on self-reported data from interviewees and in peer-reviewed literature,



perceived barriers may not necessarily be objectively observed as such. In this study, we used the terms “actor” and “organization” interchangeably.

2 | MECHANISM-BASED ANALYSIS: CONCEPTUAL FRAMEWORK

The term “mechanism” can be applied to explicate cognitive processes as well as processes that bring societal transformation (Mayntz, 2004). Although the definition of mechanism is heavily contested in social science, the majority of definitions conceptualize mechanisms as processes that explain how *X* produces *Y* (see Mahoney, 2001). Similar to the widely acknowledged conceptualization, in this study, we define mechanisms as “unobserved but empirically traceable processes that act as causes in generating the outcome of interest and explain how and/or why one thing leads to another” (Anderson et al., 2006; Biesbroek et al., 2017; Mahoney, 2001). An outcome of interest may be generated through a single process or multiple processes can act together. In other words, the statement “*X* produces *Y*” does not essentially mean that *X* is the only or the most important causal process; instead, *X* can be a part of a combination of processes that generate *Y* (see Meyfroidt, 2015). Acknowledgment of multiple interacting causal processes is important as it allows us to examine a single mechanism whereas recognizing it may be one of many mechanisms that lead to a certain outcome (Ferraro & Hanauer, 2014). In this study, we attempt to identify mechanisms that may not be specific to any particular adaptation action, instead may appear in multiple cases in various contexts. Our approach, providing a more general view of mechanisms, is not uncommon. Identification of mechanisms leading to recurrent patterns in livelihood outcomes and vulnerability, for example, is often pursued through archetype analysis. For instance, Oberlack and Eisenack (2018) analyzed the recurrent processes through which barriers emerge in water governance (see also Magliocca, Van Khuc, Ellicott, & De Bremond, 2019; Oberlack, Tejada, Messerli, Rist, & Giger, 2016). In this study, we adopt the mechanism approach as it allows us to focus on frequent as well as less recurrent mechanisms.

A mechanism can occur frequently or exist in latency just to be triggered when contexts are favorable (Mahoney, 2001). As such, the context or initial condition is important in mechanism-based analysis as it allows us to recognize under which conditions some mechanisms are initiated and produce the outcome of interest (Falletti & Lynch, 2009; Hedstrom & Swedberg, 1996; Mahoney, 2001). To capture these dynamics, Hedstrom and Swedberg (1996) introduced the *I-M-O* model in which “*I*” stands for “initial condition,” “*M*” for “mechanism,” and “*O*” for “outcome.” If one considers a specific adaptation project, the “*I*” would be the specific governance setting of that project in which the involved actors interact. As we are interested about the broader perspective of barriers to adaptation governance in Bangladesh, in our study, “*I*” is the adaptation governance setting in Bangladesh in which different organizations are involved and interact with each other following institutional norms and rules to design and

implement adaptation actions, “*O*” is the barriers to adaptation governance, and “*M*” is the processes through which the interactions among organizations lead to the barriers.

To diagnose the mechanisms, we adopted the macro–micro–micro model or popularly known as the “bathtub” model (Coleman, 1994) (Figure 1). Framing mechanisms as nested, multilevel phenomena, this model stipulates that mechanisms must be understood by investigating the influence of macro level phenomena (e.g., social norms) over micro level phenomena (e.g., individual behavior) that generate another micro level phenomena (e.g., individual action) and ultimately affect the macro level phenomena (e.g., structure of social network). Hedstrom and Swedberg (1996) classified these macro–micro, micro–micro, and micro–macro linkages into three types: situational, action-formation, and transformational mechanisms. Situational mechanisms explain the influence of macro forces on more micro level phenomena. For instance, cultural practice, governance structure, government's long-term agenda or election mandate may determine the policy, perception, and opportunities of organizations. Action-formation mechanisms operate solely at micro level and link cognition to behavior. Policies and perceptions of organizations, for example, may dictate how they will interact or act with other actors. Transformational mechanisms specify how micro level factors affect macro level. For instance, influenced by policies or perceptions the organizations may interact in ways that lead to unintended outcomes like barriers. Examining all these three types of mechanisms in a single study is exhausting and may prevent in-depth analysis (Anderson et al., 2006).

In this study, we are interested in examining the action-formation mechanisms only, because they elucidate how or why the organizations (inter)act the way they (inter)act that ultimately lead to the emergence of barriers. To illustrate, if “lack of coordination” is identified as barriers, we are interested in the action-formation mechanisms (e.g., meager communication, avoidance of meetings) that trigger transformational mechanisms, which then lead to barriers. Notably, we intend to explain the emergence of barriers by associating this emergence with mechanisms that have already been identified in the literature. We summarized examples of action-formation mechanisms identified in the literature of sociology, political science, public administration, and geography in Table 1. These mechanisms are associated with the dimensions of action-formation processes (e.g., belief or attitude of actors, actor communication, and power relationship).

3 | STUDY CONTEXT

Bangladesh is experiencing climate change impacts in the form of recurrent flooding, increased frequency of tropical cyclones, higher tidal surges, wider tidal fluctuations, and penetration of salt water inland (Bhuiyan & Dutta, 2012; Dasgupta et al., 2014). The potential negative consequences of climate change have persuaded the government of Bangladesh to adopt an inclusive approach to plan and implement adaptation actions. The government has distributed the responsibility for climate change response across multiple

FIGURE 1 Conceptual framework for mechanism-based analysis proposed in scientific literature. The so-called bathtub model is nested within the mechanism (M) part of the I-M-O model. (modified from: Coleman, 1994, Hedstrom & Swedberg, 1996)

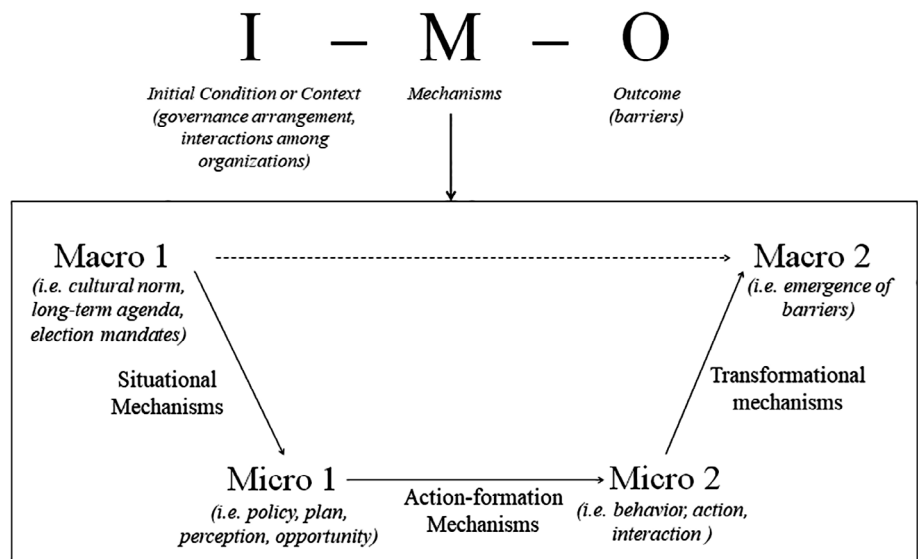


TABLE 1 Examples of action-formation mechanisms

Mechanism	Definition
Belief-formation	It states that the numbers of individuals who perform a certain act signal to others the likely value or necessity of the act, and this signal will influence other individuals' choice of action (Hedstrom & Swedberg, 1996).
Organizational inertia	It is the tendency of a mature organization to continue on its current trajectory (Gilbert, 2005). This inertia can be described as being made up of two elements – resource rigidity and routine rigidity. Resource rigidity stems from an unwillingness to invest, while routine rigidity stems from an inability to change the patterns and logic that underlie those investments. Resource rigidity relates to the motivation to respond, routine rigidity to the structure of that response.
Boundary control	It takes place when some actors want to keep its resources, abilities, or conflicts localized and strictly limit access to these (E. L. Gibson, 2005). Boundary control mechanism can be observed in an authoritarian system or in a milieu where trust is lacking (Falletti & Lynch, 2009).
Enclosure and exclusion	Enclosure and exclusion mechanisms are representations of power dynamics among the actors. Enclosure means capturing resources and authority and exclusion indicates marginalizing stakeholders (Sovacool, Linnér, & Goodsite, 2015). Enclosure happens when authority and/or resources are transferred to a few influential private actors. Exclusion takes place in tandem with enclosure and it dismisses the participation of particular groups of stakeholders in the adaptation process.
Frame Polarization	It is an interactive process through which the distance between the perspectives of two or more opposing groups increases over time due to repeated reaffirmation of the same point by the actors involved (Dewulf & Bouwen, 2012).
Veto player	It is the influence of one actor in this case resembles the veto player theory. Veto players can block decision-making processes based on powerful resources that they own and for reasons not always made transparently clear (Klijn, Edelenbos, & Steijn, 2010).
Lost in translation	This well-known mechanism of lost in translation is particularly relevant in hierarchical systems where communication flows through formalized channels. In these governance systems, each actor interprets the information according to his/her ability and communicates this with other stakeholders. Even simple messages interpreted by sympathetic agents can become mangled beyond recognition as they pass from one person to the next (Martin, 2010).
Conflict-infection	The mechanism refers to the secondary effects that follow from primary processes but which might seem to be unconnected in either space or time, except that some of the same actors happen to be involved. The mechanism captures the process of how the effects of conflicts in one policy arena are transposed to other arenas by the actors that move between these arenas (Biesbroek et al., 2014a, 2014b).

Note: These mechanisms have been identified through a thorough review of causal mechanism related literature in sociology, political science, geography, public administration subject areas.

organizations with mandates of different scopes, and has fostered the participation of non-governmental organizations (NGOs). Also, the government formulated National Adaptation Program of Action (NAPA), Bangladesh Climate Change Strategy and Action Plan (BCCSAP), and National Plan for Disaster Management (NPDMD) for short- and medium-term adaptation (Shaw, Mallick, & Islam, 2013). In

their effort to implement the NAPA, the government focuses on six sectors of engagement: agriculture, forestry, water, livelihood, industry and infrastructure, and policy and institutions (NAPA, 2009, Vij et al., 2017). These organizations operate at different levels of governance. While managing adaptation actions, these involved organizations horizontally (same level) and vertically (different level) interact

with each other (Ishtiaque et al., 2019; M. S. Rahman & Tosun, 2018). Their interactions sometimes lead to the emergence of barriers in the adaptation governance process (Ahmed et al., 2015; Bhuiyan, 2015; Zevenbergen, Khan, van Alphen, Terwisscha van Scheltinga, & Veerbeek, 2018). For instance, "lack of participation" of certain groups has been identified as barriers by many (Bhuiyan, 2015; Sovacool, D'Agostino, Rawlani, & Meenawat, 2012; Stott & Huq, 2014). However, most of the barrier studies limit their scope in identifying barriers only; how or why barriers emerge remains largely unexplored. As such, in this paper, we identify the common mechanisms of barriers to adaptation within decision-making processes around climatic changes in Bangladesh.

4 | METHODS

We used two strategies to collect data. First, we conducted key-informant interviews to obtain information on barrier mechanisms. Second, to inform and corroborate our analysis of the interviews, we performed a systematic literature review (SLR) to identify barrier mechanisms associated with adaptation in the region. The combination of the interviews and the SLR is intended to ensure we are identifying frequently observed mechanisms in adaptation governance in Bangladesh, beyond the limitations of our own primary data collection. We acknowledge that what is construed as a barrier to adaptation action, and how that barrier is explained, is subjective. In interviews, the respondent can report barriers that other respondents involved in the same action-formation process do not perceive, characterize differently, or strategically ignore. Researchers can interpret circumstances as barriers and associate causal factors with such barriers, where other actors may not agree. For this reason, we found it important to supplement our primary data with other empirical work on adaptation in Bangladesh to enhance the validity of the conclusions we draw concerning the association of specific mechanisms for the emergence of barriers.

4.1 | Key-informant interviews

We identified the organizations associated with climate adaptation governance through an online search and snowball sampling. Aligning with the NAPA, we selected organizations in five key sectors of engagement: agriculture, forestry, water, livelihood, and infrastructure. We began our selection process by identifying the government organizations from the websites of sectoral ministries. After reviewing the functions and activities of the organizations, we selected only those organizations whose mandates included climate adaptation. From the websites of each of these organizations, we identified their collaborating partners and thus expanded our sample. In total, we selected 27 organizations that included government, non-government, and international entities (see Appendix A). These organizations operate at national, district, and sub-district levels of governance.

The interviews were conducted in between June and August 2017. We focused on current adaptation initiatives as well as past initiatives that had been undertaken in the last 5 years, from 2012 to 2017. We took a 5 years' span for the interview to avoid interviewee memory bias. We purposively did not select specific projects to identify the broader patterns of barrier mechanisms. Using a semi-structured interview protocol, we interviewed the key informants of those organizations who had substantial knowledge of that organization's activities and held enough authority to comment as a representative of that organization. Our interview protocol contained questions designed to elicit respondents' experience about the progress of adaptation actions in which they were involved, coordination and collaboration with other organizations during adaptation actions, factors and processes that make the adaptation planning or implementation challenging, and how these challenges impair the governance processes. Our interviewees provided us with detailed account of their actions, interactions, and impediments that they faced. To triangulate barrier related information, we attempted to interview as many as possible involved actors. For example, if a forest organization official talks about a barrier that involves water and livelihood organizations, we interviewed those two organizations about that barrier so that we can examine the barrier from different perspectives. In addition, we collected project details and annual reports of interviewed organizations to get a detailed understanding of their actions. We extracted barrier-related information (e.g., challenges, causal factors, or processes that influenced the governance process negatively) from the interviews and project documents and transcribed and coded them (see Section 4.3).

4.2 | Systematic literature review

We conducted a systematic literature review (SLR) with an intention to distill the studies that might take the traditional "barrier approach" but also went past identifying the barriers and discussed the processes involved in the emergence of barriers or at least provided explanations. We adopted the ROSES (RepOrting standards for Systematic Evidence Synthesis in environmental research) protocol in the SLR process. We began our search process using different combinations of keywords (i.e., *climate change*, *adaptation*, *barriers*, *challenges*, *governance*) in the Web of Science platform (see Appendix B). We included only peer-reviewed journal articles in English that were published in the period of 1990–2019 and limited our regional focus to Bangladesh. The initial search on Web of Science search engine retrieved 1,013 articles. We developed exclusion and inclusion criteria (Table 2) to ensure the selection of articles that provide contexts and detailed examples of how barriers come into play, in addition to discussions on barriers. We found that most of the barrier-related studies on Bangladesh were mostly confined their discussion to identifying barriers without providing sufficient evidence or examples of the mechanisms or processes of emergence of those barriers and thus we found that only 67 articles were relevant for a full-text review. In the step 2, we found that only 26 articles (~40%) discussed barriers with examples of how they hinder the adaptation governance

TABLE 2 Inclusion and exclusion criteria

Process	Inclusion criteria	Exclusion criteria	Accepted	Rejected
Step 1: Title & Abstract Screening	Title or Abstract of the article must include topic related to adaptation/ disaster management/ vulnerability/ resilience in flood management sector. Abstract further includes discussion of adaptation governance or barriers or challenges or constraints.	Title or abstract of the article may include topic related to climate adaptation, disaster management, vulnerability or resilience but the abstract does not contain any discussion of adaptation governance or barriers or challenges or constraints.	67	946
Step 2: Article Screening (Full text review)	Article that considers interactions among actors as context and identifies barriers or challenges of adaptation governance or management and explains the barriers with examples or attempts to provide causes.	Article may list out the barriers but fails to provide examples or causes and does not make an attempt to explain in details. Article does not consider interactions among actors as context of analysis.	26	41
Step 3: Article Screening (Critical appraisal & synthesis)	Article attempts to address the causal mechanisms of the emergence of barriers through a detailed discussion or examples of how barriers are emerging. The article discusses the context of the barriers and provides sufficient details and examples of the barriers.	Article might explain the barriers with examples but does not make an attempt to analyze the underlying causes or article that is not methodologically robust.	09	17

process. However, not all of these articles explored the explanation of the emergence of barriers. Only nine articles (~13% of adaptation governance or barrier-related articles) attempted to analyze how these barriers emerged through the interactions among actors (see Table 3 for the list of the nine articles). These studies provided contexts in which the barriers emerged and examples of why barriers come into play and how they affect adaptation processes.

4.3 | Coding process

We coded the findings we obtained from the interviews and SLR. In the coding process, we first analyzed interview transcriptions and selected articles to list out the barriers in adaptation governance processes. We looked for words like “barriers,” “challenges,” “hindrance,” “impair,” “prohibit,” “impasse,” “disallow” in the interview transcripts and selected articles and identified the barriers. Next, for each barrier, we coded the reasons of the barriers based on the information given in the article. We also relied on the detailed examples provided by interviewees to elicit the explanations. In the coding process, two researchers coded separately. In case of disagreement, the third researcher stepped in and took the final decision; however, we had an agreement in more than 90% of cases. To validate the coding process, the third researcher took a subset of articles and coded separately. Later, from the contextual discussion (e.g., details of involved actors, unfolding of the events) of these articles and interviews, we associate these explanations with the mechanisms that were gathered from the literature (see Table 1). This association was done by a thorough discussion among the involved researchers. Our criterion of association was objective similarities

between the contextual discussion as well as explanations and the definition of the mechanism. For example, Islam and Walkerden (2017) identified “limited participation of local people” as a barrier in adaptation governance. From their examples and discussion, we identified the cause as “elite capture of governance processes” and from the contextual discussion we found that “enclosure and exclusion mechanism” can explain the emergence of this barrier best. Similarly, our interviews revealed “lack of emergency funds” as a barrier. From the examples given by the interviewees, we realized that “myopic vision” or “shortsightedness” of the organization is the dominant cause. Considering the contextual examples provided by the interviewees, we associate it with “organizational inertia” mechanism (see Data S1 for the codebook).

5 | RESULTS

5.1 | Barriers in adaptation governance process

The articles we reviewed identified a series of barriers to adaptation. Most of these articles found “limited participation of local/marginalized people” in adaptation processes as a barrier. Because of this barrier, local priorities were often disregarded (Islam & Walkerden, 2017), chance of maladaptation increased (Choudhury & Haque, 2016), and successes of adaptation were impaired (Haque, Bremer, Bin Aziz, & van der Sluijs, 2016). The explanations included “elite-perception” of the involved organizations that undermine the potential contribution and role of local people or marginalized groups in the adaptation process, and “dominance of elites” in local level for which vulnerable groups are subjugated. These articles also identified

**TABLE 3** Barriers to adaptation governance and their underlying causes

Reference	Identified barriers	explanations
Interview with 27 organizations	<ul style="list-style-type: none"> Limited participation of local/marginalized people Poor coordination at the local level Top-down approach of knowledge flow Organizational conflict Corruption 	<ul style="list-style-type: none"> Personal network based communication Elite-perception Institutional design Dominance of local elites Centralized governance approach
(Stott & Huq, 2014)	<ul style="list-style-type: none"> Limited access to information/resources Lack of collaboration Poor coordination at the local level 	<ul style="list-style-type: none"> Personal network based communication Power struggle among organizations Competition for funds
(Bhuiyan, 2015)	<ul style="list-style-type: none"> Limited participation of local/marginalized people Corruption 	<ul style="list-style-type: none"> Dominance of local elites Political conflict
(Choudhury & Haque, 2016)	<ul style="list-style-type: none"> Limited participation of local/marginalized people Corruption Limited access to resources 	<ul style="list-style-type: none"> Dominance of local elites
(Haque, Bremer, Aziz, & van der Sluijs, 2017)	<ul style="list-style-type: none"> Limited participation of local/marginalized people Lack of collaboration 	<ul style="list-style-type: none"> Elite perception Narrow framing of adaptation
(Araos, Ford, Berrang-Ford, Biesbroek, & Moser, 2017)	<ul style="list-style-type: none"> Lack of collaboration Framing differences 	<ul style="list-style-type: none"> Narrow framing of adaptation Personal network based communication
(Islam & Walkerden, 2017)	<ul style="list-style-type: none"> Limited participation of stakeholders Poor coordination at the local level Corruption 	<ul style="list-style-type: none"> Elite perception Frame polarization Institutional design
(M. S. Rahman & Giessen, 2017)	<ul style="list-style-type: none"> Lack of collaboration 	<ul style="list-style-type: none"> Personal network based communication
(M. S. Rahman & Tosun, 2018)	<ul style="list-style-type: none"> Struggle for authority among organizations Corruption 	<ul style="list-style-type: none"> Elite perception Power struggle among organizations
(H. M. T. Rahman & Hickey, 2019)	<ul style="list-style-type: none"> Lack of collaboration Limited participation of local/marginalized people 	<ul style="list-style-type: none"> Narrow framing of adaptation Myopic vision Dominance of local elites

“corruption” as a significant barrier to adaptation. Interestingly, as in the case of the barrier “limited participation,” “dominance of elites” in local level was also found as an explanation for corruption. Choudhury and Haque (2016) and Islam and Walkerden (2017) found that local elites, often backed by ruling political party, are involved in exploiting money and influencing organizations in favor of their objectives. Bhuiyan (2015) identified that corruption takes place because of political influence at all levels of governance. He showed that despite having no experience in climate change related works, several non-government organizations obtained climate funds because of their affiliations with ruling political parties.

In addition to the barriers identified in the literature, our interview analysis found the “top-down approach of knowledge flow” as a barrier. This is a prominent feature of centralized forms of adaptation governance. Often, knowledge production is limited at the national level and inclusion of local level knowledge is not appreciated. Furthermore, we identified “organizational conflict” as a barrier. Our results show that the institutional design and approach may cause this conflict. These explanations allowed us to analyze the mechanisms involved in the emergence of barriers. Table 3 summarizes the barriers and explanations that we found from our interviews and the SLR.

5.2 | Mechanisms involved in the emergence of barriers

Based on the barriers we identified in the above section, we identified five mechanisms that can be associated with the barriers to explain their emergence in the adaptation governance process in Bangladesh: enclosure and exclusion, boundary control, organizational inertia, belief formation and frame polarization. Notably, these mechanisms do not essentially act alone; instead they can be entangled together, thereby causing a barrier to emerge and impede adaptation actions.

5.2.1 | Enclosure and exclusion

A common theme in our analysis was that of specific individuals or groups prevented from participating by decision-making or policy-making processes that are dominated by elites. The *enclosure and exclusion* mechanism enables us to explain barriers, such as limited participation of local/marginalized people and lack of collaboration. The enclosure mechanism represents how power and resources are grasped only by a few actors in a governance process, while the exclusion mechanism indicates how

exercise of power by certain actors dismisses the participation of others in the governance process (Sovacool et al., 2015). In adaptation efforts in Bangladesh, enclosure and exclusion most often take place together. For instance, we found that in an adaptation project related to constructing multipurpose disaster shelter (*I: interactions among multilevel actors*) local social elites (e.g., rich, politically powerful) were successful in lobbying at the national level (*M: enclosure and exclusion*) to locate the disaster shelters close to their residences (*O: corruption*) (interview#12,13). We also found that in a project on embankment (*I: interactions among local actors*), these elites utilized the public sluice gates constructed for irrigation purposes for their personal gains (*M: enclosure and exclusion*) and thus marginalize others (*O: marginalizing people*) (interview#2–4, 15–17). In our interview, the Bangladesh Water Development Board (BWDB) district official said, “Due to manpower shortage, we have to put responsibility to union chairmen to manage the sluice gates for irrigation purposes. It's true that some of them misuse their vested authority and utilize sluice gates for personal benefits ignoring the collective impacts.” (interview#16). Similar to our findings, Choudhury and Haque (2016) found that connection with local administration and management officials is considered as a source of power for social elites in local areas. Their exercise of power to influence the adaptation governance process often creates factionalism and a patron-client relationship in local areas. Along with the social elites, organization officials also contain elite-perception as demonstrated by a statement of a sub-district administration official during our interview: “The sub-district administration is like a king here and the king knows better what is good for their subjects (i.e. constituents) than the subject themselves” (interview#20). Similarly, Islam and Walkerden (2017) found that local organization officials are often involved with social elites in misuse of power and in corruption.

We further found that the participation of local people in adaptation governance is also marred by this mechanism. In many adaptation projects (*I: interactions among local actors*), local organization officials often select only the social elites (*M: enclosure and exclusion*) with whom they are in regular communication to ensure that participation of local people took place, while the marginalized or vulnerable groups are left aside (*O: marginalizing people*) (interview#10, 13, 21–23, 25–26). The enclosure and exclusion mechanism is not only dominant in local areas, it can also be observed in the decision-making process at the national level. Araos et al. (2017) and Haque et al. (2017) found that certain organizations encapsulate decision-making power which leads to less collaborative efforts. Because of historical trends of preference for technical solutions over more integrated ones, the engineering or technical organizations do not feel compelled to cooperate with other organizations (Stock, Vij, & Ishtiaque, 2020). For instance, in an adaptation project in northeastern Bangladesh, the water board decided to construct river embankments for flooding (*I: interactions among national level actors*) without consulting with organizations involved in socio-economic aspects of the area (*M: enclosure and exclusion*). As such, the “problem framing” remains narrow leading to displacement and livelihood loss of local people (*O: lack of collaboration*) (Haque et al., 2017). In our interviews, we found that the national level coordinating meetings organized by the Planning Commission are often ignored by some organizations because the lead organization, often an engineering or technical

organization, takes the control of decision-making. A respondent from the Planning Commission commented: “These project coordination meetings sometimes become mere formalities. Even many important organizations, such as Ministry of Finance, do not attend many meetings.” (interview#5). In these ways, the enclosure and exclusion mechanism leads to barriers related to inequity and discrimination of marginalized actors.

5.2.2 | Boundary control

The *boundary control* mechanism explains how barriers, such as “limited access to information” and “lack of collaboration” emerge. This mechanism takes place when organizations limit access to specific resources that they control. Our interview analysis revealed that knowledge development is nationally centralized and the organizations that are involved in down-scaled knowledge production attempt to keep hold of it (*I: interactions among multilevel actors*). We found that the information or data are conceived as an asset or product by some organizations and they use these resources as sources of power (*M: boundary control*). These organizations utilize complicated bureaucratic processes as ways to limit access and wield power over other organizations (*O: limited access to information*) (interview#1–4,6–9,21–23). Similar to our findings, Stott and Huq (2014) found that local stakeholders including NGOs can rarely obtain down-scaled information that has been produced by national level government-funded or owned organizations. In our interviews, we further found that through the boundary control mechanism some organizations prohibit collaboration in adaptation actions. Instead of seeking assistance from specialized organizations, these organizations try to be directly involved in every aspect of the project to hold control over the project. For instance, in a climate resilient infrastructure related project, the Local Government Engineering Department (LGED) was responsible for constructing climate resilient infrastructures and the Forest Department (FD) was supposed to afforest the remaining project lands (*I: interactions among national level actors*). However, instead of taking assistance from FD, the LGED afforested the lands by themselves and with a higher cost (*M: boundary control*) (interview#7–10). An FD official commented in this regard: “We do all forestry related works, but LGED doesn't want to involve us so that they can do afforestation on the embankments with a higher cost and do some corruption.” (*O: lack of collaboration, corruption*) (interview#9). Apart from corruption, LGED intends to be a one-stop solution organization to garner foreign funds. In these manners, through boundary control mechanisms some organizations limit access to information and curtail collaborative efforts and thus impair adaptation processes.

5.2.3 | Organizational inertia

Organizational inertia indicates how organizations demonstrate an unwillingness to invest in new ventures or to change patterns of work and it explains the emergence of some barriers, such as “poor coordination at local level” and “framing differences.” Through interview analysis, we found that to avoid overlapping jurisdictions and potential conflicts several



organizations discourage cooperation at the local level. This happened because of their work patterns and rules of engagement which were formed before climate change became a concern. Therefore, in an emergency situation, some organizations face jurisdictional dilemmas, prolonged bureaucratic processes, and financial crisis. For instance, in a sudden event of embankment breach, Bangladesh Water Development Board (BWDB) takes at least 2–3 weeks to start taking remedial measures due to absence of contingency plans (*I: interactions among multilevel actors*) (interview#14–17). Historically, BWDB is involved in constructing and maintaining embankments without having a plan for emergency events as those were rare. However, under a changing climate, embankment breach or overflow becomes more frequent but because of historical work pattern BWDB is disinclined to invest resources for emergency management (*M: organizational inertia*). A BWDB high official commented: “We do not have emergency fund. When an embankment collapses, it entirely depends on the field engineer to gather resources to manage the situation. The head office cannot immediately help.” (*O: poor coordination*) (interview#14). We further found that organizational inertia mechanism explains differences in framing. In the NAPA and BCCSAP, the government plans to create a contiguous green belt across the coastal area and FD is one of the main organizations to establish this green belt (*I: interactions among national level actors*). Historically, FD was involved in afforesting newly emerged coastal lands (locally known as *char*) and we found that FD was not completely able to embrace the new directives on coastal adaptation (*M: organizational inertia*) (interview#6–10). An FD high official appears to be befuddled when asked about the green belt: “The Prime Minister wants green belt along the coast; it’s a political priority now. But we are still focusing on afforesting the coastal islands. Of course, coastal green belt is in our agenda, but work is progressing slower than it was supposed to be because of various reasons.” (*O: framing differences*) (interview#7). We think that coastal green belt is a relatively new venture for FD and their traditional work pattern prevents them to begin working on it proactively.

5.2.4 | Belief formation

The *belief formation* mechanism assists us in explaining barriers like “lack of collaboration” and “corruption.” This mechanism enables actors to positively value the judgment of others and thus induces trust building and concerted efforts (Hedstrom & Swedberg, 1996). As this mechanism is at the core of building rapport, it has both benefits and disadvantages. While it can facilitate adaptation process, we found that it can also cause barriers to emerge. M. S. Rahman and Giessen (2017) reported that the success of adaptation efforts in Bangladesh largely depends on the personal network of the high officials or the project directors of organizations. The collaboration skills of these officials determine the management of adaptation efforts that involve multiple actors. Also, the nature and frequency of their interactions often rely on the trust among the involved organizations and the senior officials are responsible to building trust. Stott and Huq (2014) found that the relationship of trust is particularly important for non-government organizations (NGOs) as they use this relation to acquire funding, information, and other support for their organizations. While the belief formation

mechanism helps to build trust among organizations, it can also lead to inefficiency in organizational abilities. From our interviews, we found that the transfer or resignation of an organization’s high official can cut off or weaken the ties with other organizations that s/he established. For instance, in a coastal towns environmental infrastructure project, the engineering department (LGED) and the water development board (BWDB) were collaborating well (*I: interactions among regional level actors*). Their collaboration weakened substantially when the district level head of BWDB was transferred. The new head lacked cooperative mindset and did not act fast enough to prevent delays in collaborative efforts (*M: belief formation*). An official from LGED said: “We had great collaborations with BWDB when Mr. X was the project director. After he was transferred, our collaboration stopped because the new director was not welcoming to collaborative efforts.” (*O: lack of collaboration*) (interview#12). This mechanism can lead to corruption as well. Bhuiyan (2015) reported that while disbursing the Climate Change Trust Fund money (*I: interactions among national level actors*), the Awami League government selected a number of NGOs that have no prior experience in climate change related works due to political rapport (*M: belief formation*). They were funded only because of their relation with the ruling party (*O: corruption*). In these ways, belief formation mechanism, which individually has no negative normative connotations, can lead to the emergence of barriers in adaptation governance.

5.2.5 | Frame polarization

Frame polarization occurs when the value, perception, and belief of actors vary significantly through repeated reaffirmation of the same point (Dewulf & Bouwen, 2012) and this mechanism assists us in explaining how some barriers, such as framing differences or lack of collaboration, emerge. In an instance of frame polarization, actors do not attempt to consider or accept another’s point of view but rather try to push their own perspectives onto others (Biesbroek et al., 2014b). We found that climate change adaptation (CCA) is often conceived as disaster risk reduction (DRR) in Bangladesh. This muddling of CCA and DRR prevails among a range of actors, from senior organization officials to local marginalized people. We found that even if CCA is framed as a continuous and forward-looking strategy in the policy documents (i.e., NAPA, BCCSAP), many organizations frame it in terms of short-term response *aka* DRR. For instance, BWDB focuses mostly on constructing and repairing embankments particularly before and after rainy season but allocates meager resources for regular maintenance (*I: interactions among multilevel actors*). In our interview, a BWDB high official commented: “Our operation and management budget is limited while we put more resources in repair and reconstruction. In the 1980s, we had 18,000 people and our total budget was \$90 million. Now, we have ~\$450 million budget, but only 6,000 employees and our work area increased. With this huge shortage of manpower, it’s impossible for us to regularly maintain the embankments.” (interview#14). We think that BWDB has not yet completely accommodated CCA framing in practice and pushes DRR framing by focusing only on repair and reconstruction (*M: frame polarization; O: framing differences*) (interview#14–17). We

further found that many NGOs perceive CCA as DRR and despite getting funds for climate change related works, they only mobilize when a disaster happens (interview#21–23). When we asked about adaptation-related works, the NGO officials seem perplexed and started talking about disaster response. An NGO official said: “*We have committees at different levels of administration and our primary focus is to respond quickly during emergency time. Without disaster events, we don't have many things to do.*” (interview#21). In this way, these NGOs developed a relief culture that has some impacts on adaptation governance process, as demonstrated by the findings of Stott and Huq (2014) that found that local vulnerable communities were conditioned to expect emergency relief as part of any adaptation investment. Without the promise of such immediate tangible benefits, they were less willing to engage in adaptation strategies. We further found that frame polarization mechanism causes organizational conflicts that lead to lack of collaboration. Through our interview analysis, we found that BWDB is responsible for constructing embankments and LGED builds roadways over it, but they frame the problem differently (*I: interactions among regional level actors*). While BWDB is concerned about protecting inlands from flooding and thus oppose road construction over embankments, LGED focuses on regular use of roadways and disregards BWDB's view (*M: frame polarization*). Although both organizations work in climate change adaptation and have overlapping jurisdictions, their diverging framings of the same problem lead to organizational conflicts (*O: organizational conflict, lack of collaboration*) (interview#11–17).

6 | DISCUSSION

Bangladesh deals with a variety of climate adaptation issues, yet explanations of the causal mechanisms of barriers to adaptation are limited. For instance, various scholars such as Bhuiyan (2015), Paprocki and Huq (2018), Sovacool, Tan-Mullins, Ockwell, and Newell (2017), Stock et al. (2020), Sultana (2014), and Vij, Warner, Biesbroek, and Groot (2019) discuss the role power dynamics and interplay in Bangladeshi adaptation governance but there is a little to no explanation of how these power-related issues become barriers. Our study advances the knowledge on barriers and their mechanisms in Bangladesh by providing a typology of common barrier mechanisms to climate adaptation. During the systematic literature review, we found that a very small portion of articles include brief discussions and examples on how barriers emerge in the adaptation governance process. Our approach to analysis is useful in the case of Bangladesh because of the availability of a large amount of literature in Bangladesh related to climate adaptation, from which we could identify a small sample to systematically explore mechanisms. However, this approach is less suitable in geographical contexts without ample literature on climate change adaptation. As Maxwell (2004) has argued, detailed and varied data are essential to reveal the involved processes. We argue that triangulation is an important step in this approach because the explanations of barriers can be subjective. Considering perspectives of all involved actors about a barrier will mitigate the subjective bias and may lead to more objective analysis of mechanisms. In case of absence of secondary data, the collection of primary data needs to be

rigorous, encompassing various aspects of challenges or barriers including but not limited to the type of barriers, processes of adaptation, interactions among actors, approaches to deal with challenges and so forth. Biesbroek et al. (2014b), Biesbroek and Candel (2019), and Sieber et al. (2018) used a process-tracing method to identify mechanisms involved in barriers to adaptation. Although time-consuming and resource intensive, this method can enable researchers to distill barrier related mechanisms from an in-depth case study.

Our mechanism-based analysis reveals how certain mechanisms influence interactions among actors and generate certain barriers. We particularly focused on the action-formation mechanisms as that allows us to investigate why actors interact the way they interact. Action-formation mechanisms are influenced by situational mechanisms and lead to transformational mechanisms. For a complete understanding of mechanisms involved in the emergence of barriers, we recommend the examination of all three types of mechanisms. For instance, in our interviews, officials from BWDB individually acknowledged the significance of the emergency fund and plan, yet collectively they do not take any action. The mechanism of organizational inertia (i.e., resource/routine rigidity) explains this lack of action. An upper level analysis of situational mechanisms would further reveal that why organizational inertia takes place, and how tradition and history lead to this inertia, while a lower level analysis on transformational mechanisms would demonstrate how inertia affects adaptation governance.

The mechanisms we identified can occur individually or simultaneously; some of them can even be entangled with each other to generate barriers archetypes (Oberlack & Eisenack, 2018). A larger, global sample might be required to substantiate the existence of such archetypes and their associated mechanisms. We found that enclosure and exclusion, frame polarization, and organizational inertia mechanisms at times co-occur. BWDB, as an example, has not totally adopted CCA framing by focusing only on repair and reconstruction of embankments (*M: frame polarization*), and allocates less resources for maintenance (*M: organizational inertia*). Consequently, the local level officials work with local influential people to form maintenance committee and thus selectively empower these people which often lead to exclusion of marginalized people in important decision-making process (*M: enclosure and exclusion*). We also think that some mechanisms may be responsible for the emergence of barriers but they can be strategically framed because of their benefits. For instance, belief formation mechanism is important to build rapport among organizations and this mechanism may lead to efficient implementation of adaptation. Furthermore, Jones, Hesterly, and Borgatti (1997) argued that social mechanisms can be transferred or diffused through the network the actors are embedded in. In this study, we found that some government organizations treat the knowledge or data they produced as a source of power and restrict other organizations to access that information (*M: boundary control*). This approach of handling information also encouraged other organizations not to share information.

How do mechanism-based explanations help us to overcome or at least navigate through barriers that emerge in the interactions among actors? Mechanism-based explanations provide insights on actors' roles and activities in governance and elucidates the common processes through which actors' interactions lead to unintended



outcomes. Our approach reflects the example others have pursued in seeking explanations for undesirable or unsustainable outcomes in governance. For example, the analysis of Oberlack et al. (2016) revealed that due to enclosure of assets and elite capture the governance principle “community participation” may not be effective as intended. This approach to analysis exposes the forms of social interactions and activities that are problematic, which can then be anticipated and regulated or addressed through appropriate incentive structures, capacity building and governance design. They can also address these mechanisms by enabling actors to continuously interact or mutually change the institutional rules and norms. Dewulf and Bouwen (2012), for example, found that creation of a coordinating space for mutual interactions and understanding each other’s framings could work against triggering the enclosure and exclusion mechanism. In this way, if a suite of possible mechanisms are identified and actions are taken to proactively disarm these mechanisms before barriers emerge, then perhaps governance as a whole can improve. However, it does not ensure that new mechanisms will not emerge. Biesbroek et al. (2014b) and Moser, Ekstrom, Kim, & Heitsch (2019) warned that short-sighted interventions in one mechanism can backfire and trigger new mechanisms. We too think that at times transformational changes may be required to effectively address a mechanism (e.g., cultural shift, introduction of new set of institutional rules). For instance, to remove organizational inertia, organizations need to be flexible, adaptive, and inclusive, requiring a fundamental change in the approach of organizational culture. Consequently, despite sincere attempts of addressing these mechanisms, some of them may exist to some extent. Our objective should be to create an interaction milieu in which the influence of these mechanisms will be acknowledged and diminished. For this reason, we need more evidence-based analysis on mechanisms involved in adaptation barriers. Future studies should carefully map the interrelations and co-occurrence of barrier mechanisms.

7 | CONCLUSION

As climate change impacts are observed at multiple scales, involvement of many actors in adaptation becomes a necessity. It is neither uncommon nor surprising that barriers may emerge through the interactions among these actors. Within the increasingly abundant literature on climate change adaptation, studies focusing on barriers to adaptation are insufficiently attuned to power relations and causal mechanisms. Although many studies reported such barriers, they lack explanation of the processes that are involved in the emergence of these barriers. While these studies are important contributions on how different policy actors perceive barriers and how barriers affect adaptation governance, they do not demonstrate how these barriers are coming into play. This study attempts to address this lacuna by identifying the mechanisms of barriers to adaptation governance in Bangladesh. Methodologically, we attempted a novel approach of fusing interview data and empirical evidence obtained from a systematic literature review that uses the conventional approach of barrier analysis. Similar to Biesbroek et al. (2014b, 2017), we argued that an analysis of causal mechanisms

elucidates the underlying processes that are associated with the emergence of barriers. We examined the mechanisms of barriers to adaptation governance in Bangladesh in this study and we found that at least five mechanisms are involved in the emergence of barriers: enclosure and exclusion, boundary control, belief formation, organizational inertia, and frame polarization.

Current adaptation literature suffers from its lack of attention to power dynamics and causal mechanisms. We argue that a mechanism focused approach to analyzing barriers to adaptation can help identify specific processes (perhaps unseen or assumed unrelated) that impede action toward adaptation. This approach is especially salient in Bangladesh, a highly-vulnerable nation to climate-related risks that hosts an overabundance of scholarly research on the social dimensions of climate change. If properly attuned to power relations, implementing a mechanism focused approach to studying adaptation barriers in the global South (i.e., Bangladesh) may indeed facilitate the deterrence of sea-level rise more than levees.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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APPENDIX A

Surveyed Organizations:

- Ministry of Agriculture
 - Department of Agricultural Extension (national level) (interview#1)
 - Patuakhali Department of Agricultural Extension (regional level) (interview#2)
 - Barguna Department of Agricultural Extension (regional level) (interview#3)
 - Kalapara Department of Agricultural Extension (local level) (interview#4)
- Ministry of Planning
 - Planning Commission (national level) (interview#5)
- Ministry of Environment, Forest, and Climate Change
 - Department of Environment (national level) (interview#6)
 - Forest Department (national level) (interview#7)
 - Patuakhali Forest Department (regional level) (interview#8)
 - Barguna Forest Department (regional level) (interview#9)
 - Patharghata Forest Department (local level) (interview#10)
- Ministry of Local Government
 - Local Government Engineering Department (national level) (interview#11)
 - Patukhali Engineering Department (regional level) (interview#12)
- Barguna Engineering Department (regional level) (interview#13)
- Ministry of Water Resources
 - Bangladesh Water Development Board (national level) (interview#14)
 - Patuakhali Water Development Board (regional level) (interview#15)
 - Barguna Water Development Board (regional level) (interview#16)
 - Kalapara Water Development Board (local level) (interview#17)
- Ministry of Public Administration
 - Patuakhali District Administration (regional level) (interview#18)
 - Barguna District Administration (regional level) (interview#19)
 - Kalapara Sub-district Administration (local level) (interview#20)
- Non-Government Organizations (NGOs)
 - BRAC (local level) (interview#21)
 - Sangram (local level) (interview#22)
 - Coastal Association for Social Transformation (local level) (interview#23)
- International Organizations
 - World Bank (national level) (interview#24)
 - Asian Development Bank (national level) (interview#25)
 - Food and Agricultural Organization (national level) (interview#26)
 - Bangladesh Red Crescent Society (national level) (interview#27)

APPENDIX B

TABLE B1 Search key words (as of July 2019)

Search Number	Platform	Search key words	Number of articles
1	Web of Science	TS = (climate change OR *adapt* OR climat* adapt*) AND TS = (challenge* OR barrier* OR obstacl* OR constrain*) AND TS = (Bangladesh)	284
2	Web of Science	TS = (natural dis* OR disaster* OR disaster manage* OR disaster risk reduction) AND TS = (challenge* OR barrier* OR obstacl* OR constrain*) AND TS = (Bangladesh)	130
3	Web of Science	TS = (disaster vulnerability OR vulnerab* OR resilien*) AND TS = (challenge* OR barrier* OR obstacl* OR constrain*) AND TS = (Bangladesh)	211
4	Web of Science	TS = (govern* OR bureaucra* OR institution*) AND TS = (climate change OR climate adaptation) AND TS = (challenge* OR barrier* OR obstacl* OR constrain*) AND TS = (Bangladesh)	66
5	Web of Science	TS = (climate change OR *adapt* OR climat* adapt*) AND TI = (challenge* OR barrier* OR obstacl* OR constrain*) AND TS = (Bangladesh)	34
6	Web of Science	TS = (govern* OR bureaucra* OR institution*) AND TS = (climate) AND TI = (challenge* OR barrier* OR obstacl* OR constrain*) AND TS = (Bangladesh)	10
7	Web of Science	TS = (flood* OR flash flood OR drought OR storm surge* OR river bank erosion OR tsunami OR salinity intrusion) AND TS = (challenge* OR barrier* OR obstacl* OR constrain*) AND TS = (Bangladesh)	167
8	Web of Science	TS = (govern* OR inst*) AND TS = (challenge* OR barrier* OR obstacl* OR constrain*) AND TS = (Bangladesh)	678
	Total		1,580
	Duplicates		567
	Total articles for screening		1,013