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

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: barriers, mechanisms, adaptation, governance, Bangladesh.

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; Gibson, Ostrom, & Ahn, 2000; Termeer, Dewulf, & 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, & 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, & 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

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processes into simplified, static, and metaphorical statements about why current outcomes are 'incorrect' without sufficient evidence or explanation (Biesbroek, Termeer, Klostermann, & Kabat, 2014; 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., 2014; 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. (2014) 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, & 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 & 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, & 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

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approach', some studies discussed, often succinctly, how the barriers come into place. Azhoni, Holman, & 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 & 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 though 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). Acknowledgement of multiple interacting causal processes is important as it allows us to examine a single mechanism while 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

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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 & Eisenack (2018) analyzed the recurrent processes though which barriers emerge in water governance (see also Magliocca, Khuc, Ellicott, & De Bremond, 2019; Oberlack, Tejada, Messerli, Rist, & Giger, 2016). In this study, we adopt 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 (Falleti & Lynch, 2009; Hedstrom & Swedberg, 1996; Mahoney, 2001). To capture these dynamics, Hedström & 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) (Fig. 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). Hedström & 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).

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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).

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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 in order to plan and implement adaptation actions. The government has distributed the responsibility for climate change response across multiple 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 (NPDM) for short- and medium-term adaptation (Shaw et al. 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

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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 1). 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 five years, from 2012 to 2017. We took a five years' span for the interview to avoid interviewee memory bias. We purposively did not select specific projects in order 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

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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. Additionally, 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 2). 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 1013 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 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.

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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 & 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 Supplementary Material 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 adaptation process, and 'dominance of elites' in local level for which vulnerable groups are subjugated. These articles also identified '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 & Haque (2016) and Islam

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& 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.

Table 3 will be inserted here

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 & 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 & 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, Sumit 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 downscaled 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 & Huq (2014) found that local stakeholders including NGOs can rarely obtain downscaled 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 in order 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). A 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 in order to garner foreign funds. In these manners, through boundary control mechanism 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 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 in order 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). A 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. Rahman & 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 & 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

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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. 2014). 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. A 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 which has some impacts on adaptation governance process, as demonstrated by the findings of Stott & Huq (2014) that found that local vulnerable communities

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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 & Huq (2018), Sovacool, Tan-Mullins, Ockwell, & Newell (2017), Stock et al., (2020), Sultana (2014), and Vij, Warner, Biesbroek, & 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 is 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 etc. Biesbroek et al., (2014), Biesbroek & 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.

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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 and 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 empower these people which often ultimately 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 example, belief formation mechanism is important to build rapport among organizations and this mechanism may lead to efficient implementation of adaptation. Furthermore, Jones, Hesterly, & 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

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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 & 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 & 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 won't emerge.. Biesbroek et al. (2014) and Moser et al. (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 in order 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. (2014, 2017, 2019), 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 towards 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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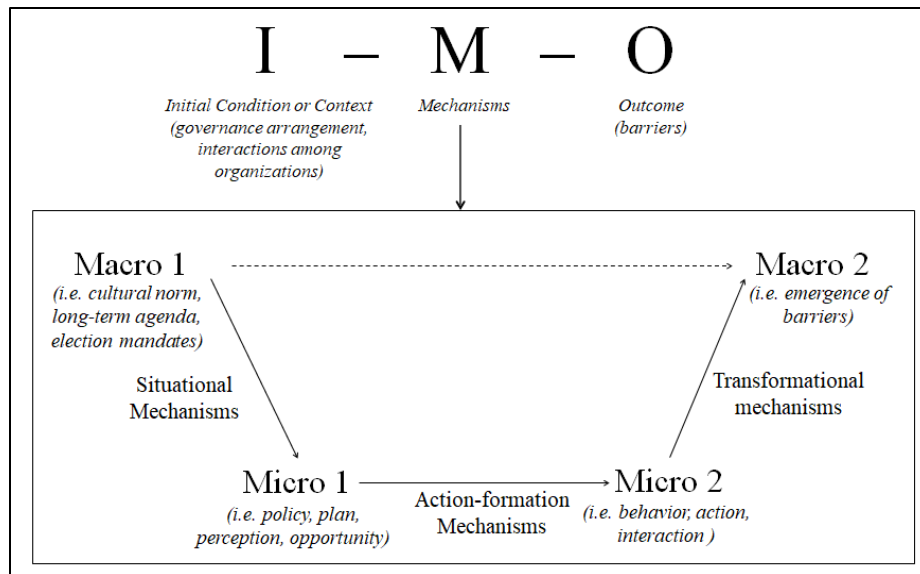
Figure 1: Conceptual framework for mechanism-based analysis proposed in scientific literature. The so-called bathtub model is nested within the mechanism (*M*) part of the *I-M-O* model. (modified from: Coleman 1994, Hedström & Swedberg 1996)

Table 1: Examples of action-formation mechanisms. These mechanisms have been identified through a thorough review of causal mechanism related literature in sociology, political science, geography, public administration subject areas.

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 (Gibson, 2005). Boundary control mechanism can be observed in an authoritarian system or in a milieu where trust is lacking (Falleti & 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. 2014).

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

Table 3: Barriers to adaptation governance and their underlying causes.

Reference	Identified barriers	explanations
Interview with 27 organizations	- Limited participation of local/marginalized people - Poor coordination at the local level - Top-down approach of knowledge flow - Organizational conflict - Corruption	- Personal network based communication - Elite-perception - Institutional design - Dominance of local elites - Centralized governance approach
(Stott & Huq, 2014)	- Limited access to information/resources - Lack of collaboration - Poor coordination at the local level	- Personal network based communication - Power struggle among organizations - Competition for funds
(Bhuiyan, 2015)	- Limited participation of local/marginalized people - Corruption	- Dominance of local elites - Political conflict
(Choudhury & Haque, 2016)	- Limited participation of local/marginalized people - Corruption - Limited access to resources	- Dominance of local elites
(Haque, Bremer, Aziz, & van der Sluijs, 2017)	- Limited participation of local/marginalized people - Lack of collaboration	- Elite perception - Narrow framing of adaptation
(Araos, Ford, Berrang-Ford, Biesbroek, & Moser, 2017)	- Lack of collaboration - Framing differences	- Narrow framing of adaptation - Personal network based communication

(Islam & Walkerden, 2017)	- Limited participation of stakeholders - Poor coordination at the local level - Corruption	- Elite perception - Frame polarization - Institutional design
(Rahman & Giessen, 2017)	- Lack of collaboration	- Personal network based communication
(Rahman & Tosun, 2018)	- Struggle for authority among organizations - Corruption	- Elite perception - Power struggle among organizations
(Rahman & Hickey, 2019)	- Lack of collaboration - Limited participation of local/marginalized people	- Narrow framing of adaptation - Myopic vision - Dominance of local elites

Appendix

Appendix 1

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)

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

Appendix 2

Table: 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		1580
	Duplicates		567
	Total articles for screening		1013

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

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: barriers, mechanisms, adaptation, governance, Bangladesh.

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; Gibson, Ostrom, & Ahn, 2000; Termeer, Dewulf, & 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, & 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, & 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, 2014; 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

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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., 2014; 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. (2014) 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, & 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 & 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, & 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, & 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 & 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

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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 though 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). Acknowledgement of multiple interacting causal processes is important as it allows us to examine a single mechanism while 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 & Eisenack (2018) analyzed the recurrent processes though which barriers emerge in water governance (see also Magliocca, Khuc, Ellicott, & De Bremond, 2019; Oberlack, Tejada, Messerli, Rist, & Giger, 2016). In this study, we adopt 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 (Falleti & Lynch, 2009; Hedstrom & Swedberg, 1996; Mahoney, 2001). To capture these dynamics, Hedström & 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.

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To diagnose the mechanisms, we adopted the macro-micro-micro model or popularly known as the 'bathtub' model (Coleman, 1994) (Fig. 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). Hedström & 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).

__Figure 1 will be inserted here__

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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 in order to plan and implement adaptation actions. The government has distributed the responsibility for climate change response across multiple 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),

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Bangladesh Climate Change Strategy and Action Plan (BCCSAP), and National Plan for Disaster Management (NPDM) for short- and medium-term adaptation (Shaw et al. 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 1). 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 five years, from

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2012 to 2017. We took a five years' span for the interview to avoid interviewee memory bias. We purposively did not select specific projects in order 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. Additionally, 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 2). 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 1013 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 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.

Table 2 will be inserted here

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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 & 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 Supplementary Material 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 adaptation process, and 'dominance of elites' in local level for which vulnerable groups are subjugated. These articles also identified '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 & Haque (2016) and Islam & 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

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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.

Table 3 will be inserted here

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 & 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

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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 & 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, Sumit 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 downscaled 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 & Huq (2014) found that local stakeholders including NGOs can rarely obtain downscaled 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,

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these organizations try to be directly involved in every aspect of the project in order 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). A 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 in order to garner foreign funds. In these manners, through boundary control mechanism 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 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 in order 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). A 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.

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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. Rahman & 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 & 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. 2014). 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

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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. A 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 which has some impacts on adaptation governance process, as demonstrated by the findings of Stott & 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 & Huq (2018), Sovacool, Tan-Mullins, Ockwell, & Newell (2017), Stock et al., (2020), Sultana (2014), and Vij, Warner, Biesbroek, & 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 is 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

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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 etc. Biesbroek et al., (2014), Biesbroek & 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 and 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 empower these people which often ultimately 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 example, belief formation mechanism is important to build rapport among organizations and this mechanism may lead to efficient implementation of adaptation. Furthermore, Jones, Hesterly, & 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

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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 & 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 & 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 won't emerge.. Biesbroek et al. (2014) and Moser et al. (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 in order 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. (2014, 2017, 2019), 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

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help identify specific processes (perhaps unseen or assumed unrelated) that impede action towards 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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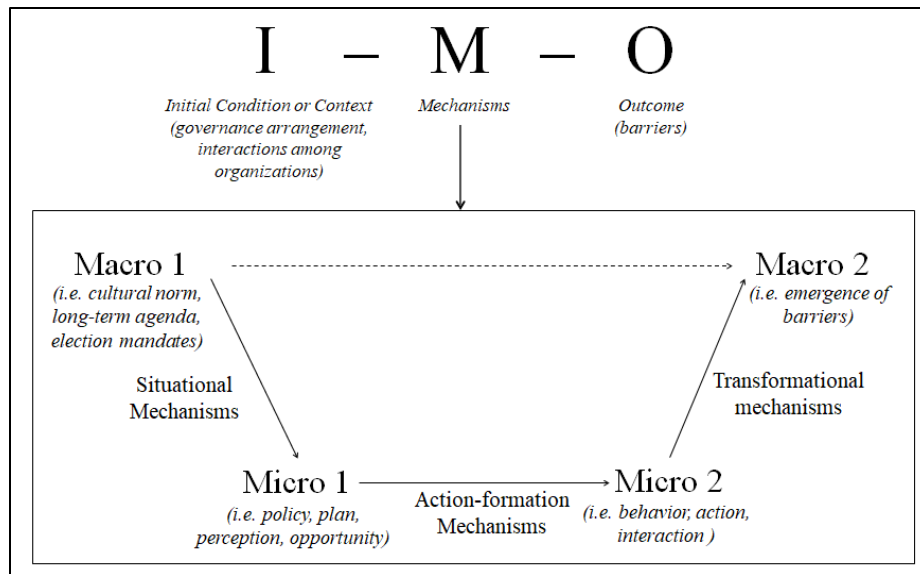
Figure 1: Conceptual framework for mechanism-based analysis proposed in scientific literature. The so-called bathtub model is nested within the mechanism (*M*) part of the *I-M-O* model. (modified from: Coleman 1994, Hedström & Swedberg 1996)

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Table 1: Examples of action-formation mechanisms. These mechanisms have been identified through a thorough review of causal mechanism related literature in sociology, political science, geography, public administration subject areas.

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 (Gibson, 2005). Boundary control mechanism can be observed in an authoritarian system or in a milieu where trust is lacking (Falleti & 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. 2014).

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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

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Table 3: Barriers to adaptation governance and their underlying causes.

Reference	Identified barriers	explanations
Interview with 27 organizations	- Limited participation of local/marginalized people - Poor coordination at the local level - Top-down approach of knowledge flow - Organizational conflict - Corruption	- Personal network based communication - Elite-perception - Institutional design - Dominance of local elites - Centralized governance approach
(Stott & Huq, 2014)	- Limited access to information/resources - Lack of collaboration - Poor coordination at the local level	- Personal network based communication - Power struggle among organizations - Competition for funds
(Bhuiyan, 2015)	- Limited participation of local/marginalized people - Corruption	- Dominance of local elites - Political conflict
(Choudhury & Haque, 2016)	- Limited participation of local/marginalized people - Corruption - Limited access to resources	- Dominance of local elites
(Haque, Bremer, Aziz, & van der Sluijs, 2017)	- Limited participation of local/marginalized people - Lack of collaboration	- Elite perception - Narrow framing of adaptation
(Araos, Ford, Berrang-Ford, Biesbroek, & Moser, 2017)	- Lack of collaboration - Framing differences	- Narrow framing of adaptation - Personal network based communication
(Islam & Walkerden, 2017)	- Limited participation of stakeholders - Poor coordination at the local level - Corruption	- Elite perception - Frame polarization - Institutional design
(Rahman & Giessen, 2017)	- Lack of collaboration	- Personal network based communication
(Rahman & Tosun, 2018)	- Struggle for authority among organizations - Corruption	- Elite perception - Power struggle among organizations
(Rahman & Hickey, 2019)	- Lack of collaboration - Limited participation of local/marginalized people	- Narrow framing of adaptation - Myopic vision - Dominance of local elites

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Appendix 1

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 2

Table: 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		1580
	Duplicates		567
	Total articles for screening		1013

Reviewer#A Comments:

No.	Reviewer A Comments	Response
1	The paper combines interview data and a systematic literature review to provide mechanism-based explanation of how barriers to adaptation governance arise in Bangladesh. I send my apologies to the authors for the unusually long review time, mostly due to covid-related turbulences. The paper is well written and is a timely contribution. It fits well with the aims and scope of EPG. I identified a number of potentials/necessities to improve the article. With these revisions, I am sure that the article will make a good contribution to the state of knowledge in this research field.	Thank you for your comments and suggestions.
2	Abstract: "six mechanisms": I counted five.	We apologize for the typo. We corrected it in the revised version.
3	Introduction: very well written, presenting a clear rationale for the study, rooted in a research gap. One suggestion for improving the introduction: I tend to agree with "Addressing the barriers in decision-making processes requires explanations of the mechanisms that cause these unintended outcomes or barriers to emerge" (lines 61-63). However, the precise methodology of explanations based on causal mechanisms seems to be *one* suitable methodology to create answers on "how and why do barriers emerge". Another methodology that is closely related and seems suitable, but is not exactly the same as mechanismic explanation is presented by Moser et al. (2019). Your statement in line 61-63 would appear stronger to me if you could clarify its relation with the methodology presented by Moser et al. (2019).	Thank you very much for your comment. We are glad that you like our introduction. We agree that our methodology is somewhat similar to Moser et al. (2019); however, they are different in nature. Moser et al. (2019) used grounded theory approach in their research on adaptation finance challenges of local government. They collected data from online survey and workshops. Later, they coded those data and identified patterns emerged from the data. To this stage, our method is quite similar. We collected data through systematic literature review and key-informant interviews. We also transcribed and coded our data and identified causes of barriers. However, Moser et al. (2019) finally came up with seven focal points around which the adaptation finance challenges were clustered. In grounded theory approach, no theories or frameworks conceived beforehand. Instead, the analysts attempt to formulate theories from the data. Moser et al. (2019) followed this approach. But in our case, we used the I-M-O framework and grounded our argument using the so-called 'bathtub

		model'. Also, we identified the mechanisms from different disciplines, such as sociology, political science, geography. We associate the pattern we identified in our data with these mechanisms. In this way, our methodology is significantly different from Moser et al. (2019).
4	Section 2: very well written, explains the mechanismic lens to barriers well. The examples in Table 1 are helpful. Could the authors consider finding an answer to the following concern: The authors have provided good examples for mechanisms, and I could in principle think about dozens of "candidate mechanisms" more. The long lists of barriers are a problem, according to the paper's introduction and previous studies. Can the authors add a criterion that helps the readers assess what makes a mechanismic explanation a good mechanismic explantation? That might help us avoid replacing the long lists of barriers with (ambiguous) lists of mechanisms.	We apologize for the misunderstandings. In this study, we analyzed only the action-formation mechanisms because they elucidate how or why the organizations (inter)act the way they (inter)act that ultimately lead to the emergence of barriers. In Table 1, we provided some examples of action-formation mechanisms that have been discussed in the literature of various disciplines. We listed these mechanisms based on their association with the dimensions of action-formation processes. In the revised manuscript, we made it clear. We think these examples will help the readers to better understand the action-formation mechanisms. Our results found that some of the mechanisms are evident in the adaptation governance in Bangladesh.
5	Section 2: there are related interest and advances about causal mechanisms in land systems science (LSS), even though the debates in climate adaptation scholarship and LSS are not explicitly connected yet. It could make sense to spearhead this by relating the introduction of causal mechanisms in section 2 of this paper to Meyfroidt (2016), Oberlack et al. (2016) and Magliocca et al. (2019), because these three papers could offer additional relevant reference points for section 2 of the present paper.	We thank you for this suggestion. The articles you mentioned were very useful. We used these articles to revise our article. We would like to point out that in the land system science, studies mostly adopted 'archetype approach' to examine the recurrent process *aka* mechanisms that generate a certain outcome. The archetype approach is similar to mechanism approach in examining the process or mechanisms through which an outcome is generated. However, while archetype approach looks for recurrent processes or patterns for identification, mechanism approach takes both recurrent and less recurrent processes into consideration. For this reason, we adhere to mechanism approach in our study. In the revised manuscript, we

		included this argument.
6	Section 3: I do not have specific expertise on the Bangladesh context. While I can therefore not fully assess the accuracy of the given context information, it seems plausible.	Thank you for your comment.
7	Section 4: The methodology combines primary data with a systematic literature review (SLR). It seems to be appropriate to answer the research questions. Adding a sentence on how you combined the two methodologies would be helpful (i.e. how your integrated/triangulated/validated the different insights, treated potentially complementary or inconsistent results).	Thank you for your suggestion. In the revised version, we added a section about the coding process. In that section, we elaborated on how we integrated the literature review and interview transcripts. Also, we added how we validated our results. Please see section 4.3.
8	Section 4: My main concern is that it is hardly possible to understand the coding process and quality of the SLR: "We analyzed these articles and coded them to identify the barriers and the causal processes of occurrence. We then associate these processes with the mechanisms that were gathered from the literature" (lines 244-246). The provided example is good, but not enough to understand coding well enough. (1) Did the authors conduct double-coding and intercoder reliability checks (which would be important for high-quality qualitative SLRs such as the present one), and could you report on this, please? (2) Could you provide the codebook as an appendix, please? It will help future research to elicit mechanisms from primary data by building on your study.	We regret for not providing the details of coding process in our paper. In the revised version, we added a new section about the coding process. In that section, we discussed how we coded and validated our results. Please see section 4.3.
9	Section 5.1: Why are the "underlying causes" in Table 1 different to the mechanisms in section 5.2?	Our method includes three steps: First, identification of barriers. Second, eliciting the potential causal explanations. Third, associating these explanations (listed in Table 3) with the categories of causal mechanisms identified in the broader literature (Table 1).

| 10 | Section 5.2: "we identified five mechanisms" (line 285): as noted in the comment on section 2 above, it would strengthen the results here, if the reader were to understand the criteria that make these five (rather than four/six/ten…) mechanisms the appropriate explanation for the barriers. In the same vein, why do not all of the example mechanisms from Table 1 appear here? | Thank you for the comment. In the revised paper's method section, we stated that the criterion of associating causal explanations with mechanisms is the objective similarities between them. We analyzed the contexts and processes involved in the emergence of barriers in adaptation governance in Bangladesh and identified the causal explanations. We then associate these explanations with the mechanisms based on mechanisms' definitions. We found five mechanisms can explain the emergence of barriers that we identified in this study.

Table 1 has been provided to give an overview of action-formation mechanisms. These mechanisms have been discussed on various disciplines. The five mechanisms that we discussed later have been included in this table. We think in addition to these five mechanisms, we should include other common mechanisms in this table. That will assist the researchers to understand the type of action-formation mechanisms. It will also help future researchers. |
| --- | --- | --- |
| 11 | Section 5.2: (1) very interesting results. (2) I felt that the text about the causal mechanisms may benefit from rephrasing the sentences to make the observed effects (i→m→o) even more explicit. At the moment, this line of thought about the causal effects seems to get a bit lost in constructing too many sentences through "our interviews reveal that…" and "author et al. show that" instead of "A and B lead to C, if D (source: interview number or reference)". In the same vein, it would make sense to check whether all interview quotes are necessary to illustrate the key effects (for me as a reader, they were too many quotes, thereby rather distracting attention from understanding the mechanisms). | Thank you for your comment. In the revised version, we incorporated your suggestions. We deleted quotes that we deemed extraneous. We also presented our result in I->M->O format so that it is easily understandable to readers. |
| 12 | Section 6 (discussion): the notion of Bangladesh as "research lab" (line 460) seems inappropriate to me given the severity of | Thank you for indicating this. In the revised paper, we rephrased this |

	impacts. Can find a more respectful expression, e.g. Bangladesh is forced to experiment with climate adaptation issues (or something similar)?	line.
13	Section 6: The discussion misses some relevant references of recent studies. Potential useful references on explanations of adaptation barriers (addressing "how and why barriers emerge" in related sectors, mechanism-based), which are not yet referenced: Alam et al. (2018), Oberlack/Eisenack (2018), Moser et al. 2019. Relating key insights from these studies to the results of this paper in the discussion section could strengthen this paper by showing its novelty and added value.	In the revised version, we included the insights of relevant articles. We think these are useful articles for our paper. For example, Oberlack et al (2016) found that enclosure of livelihood assets and elite capture are making community participation ineffective. This is very similar to our findings. Please see the discussion section details.
14	Section 6: Why did some of the presumed mechanisms from Table 1 or those identified in the three studies mentioned above NOT appear to have explanatory power in this study context?	This is a great question. Table 1 has been provided to give an overview of action-formation mechanisms. These mechanisms have been discussed on various disciplines. That will assist the researchers to understand the type of action-formation mechanisms. It will also help future researchers. Among all the mechanisms listed in Table 1, five of them were found to explain the barriers in adaptation governance in Bangladesh. Through interviews and literature review we did not obtain barriers that could be explained by other mechanisms. However, we cannot rule out the possibility that a more specific or in certain contexts, other mechanisms can be found useful too. To sum up, as we did not find barriers that can be explained by other mechanisms than these five, we did not include those in our study.
15	Minor details: - line 294 "empowering" instead of "powering"?	Thank you for your suggestion. Please see the revised version.

	- some grammar issues/typos could be resolved in a final language editing.	
16	Suggested References: Alam, G. M., Alam, K., Mushtaq, S., Khatun, M. N., & Leal Filho, W. (2018). Strategies and barriers to adaptation of hazard-prone rural households in Bangladesh. In *Limits to Climate Change Adaptation* (pp. 11-24). Springer, Cham. Meyfroidt, P. (2016). Approaches and terminology for causal analysis in land systems science. *Journal of Land Use Science*, *11*(5), 501-522. Magliocca, N. R., Van Khuc, Q., Ellicott, E. A., & de Bremond, A. (2019). Archetypical pathways of direct and indirect land-use change caused by Cambodia's economic land concessions. *Ecology and Society*, *24*(2). Moser, S., Ekstrom, J., Kim, J., & Heitsch, S. (2019). Adaptation finance archetypes: local governments' persistent challenges of funding adaptation to climate change and ways to overcome them. *Ecology and Society*, *24*(2). Oberlack, C., Tejada, L., Messerli, P., Rist, S., & Giger, M. (2016). Sustainable livelihoods in the global land rush? Archetypes of livelihood vulnerability and sustainability potentials. *Global environmental change*, *41*, 153-171. Oberlack, C., & Eisenack, K. (2018). Archetypical barriers to adapting water governance in river basins to climate change. *Journal of Institutional Economics*, *14*(3), 527-555.	Thank you for these suggestions. We used these articles in our revised paper.

Reviewer#B Comments:

No.	Reviewer B Comments	Response
1	The mechanism based approach can lead to identification of processes that hinder adaptation, however, the study context remains vague and undefined. Therefore, it is difficult to grasp the exact content and temporal scale of the analyzed adaptation governance, thus the subject of this study. It might be recommendable to define a specific period of time to shape the scope of the work.	Thank you for your comment. We regret any misunderstanding. In this paper, we use a broader perspective to examine the barriers. For this reason, our study context was not specific to a certain number of adaptation projects. Instead, we were interested to examine the causal mechanisms that lead to emergence of barriers in the overall adaptation governance process. Our temporal scale was 2012 – 2017. In the revised version, we incorporated this information.
2	There are inconsistencies in the objective "*What are the mechanisms that can explain the emergence of barriers in the adaptation governance process in Bangladesh?", We are particularly interested in the interactions among organizations that are involved in adaptation actions" (p3),* the undefined timeframe and multiple contexts in which barriers in the adaptation governance take place, the methodology of interviews and a literature review, the lacking information on content analysis techniques in the methodology, action formation mechanisms, the lacking information on transformational mechanisms and the various different examples make it difficult to understand the paper. Especially the focus on interaction is not peoperly explained, as interaction between the organizations is not properly analysed, just randomly mentioned, where needed, to explain a mechanism in the result section. Adittionally, literature proves that mechanisms rarely occur alone, but rather, sets of mechanisms are triggered in different rounds of decision making (see example of Waterplaza in the Netherlands), this remains largely unexplained in the results section. Also, the	In this paper, we conceived 'interactions' in a broader sense. By 'interactions' we meant the communications and negotiations among organizations in the overall adaptation actions, from planning to implementation. In the beginning of the introduction section we specified that this study will deal with the interactions among organizations. In the revised paper, we made it more explicit and provided a time frame for study. We intentionally take multiple contexts for this study because our purpose was to identify mechanisms in the overall adaptation governance in Bangladesh. Narrowing down to specific projects will not serve our purpose. We agree that mechanisms may not occur alone rather they can be triggered together. As we did not focus on specific project/s, we could not specifically say which mechanisms occurred together. A complementary form of analysis, Archetype analysis, analyzes common patterns of barriers and associated mechanisms. We would require a larger sample of work to discern such patterns. However, we discussed in the discussion section that mechanisms can occur together. More specifically, we argued: "The mechanisms we identified can occur individually or simultaneously; some of them can

	fact that not every barrier leads to de facto delays or impasses and might be strategically framed and socially constructed remains unmentioned in the analysis – one severe flaw of this work.	even be entangled with each other to generate barriers archetypes".
3	The paper lacks clarity on the nature of barriers as perceptions of actors, and as such, their socially constructed nature. A list of barriers must therefore be understood as a highly subjective enumeration of perceived potential reasons why adaptation processes can fail (They do not necessarily hinder an adaptation process in reality). Such barriers often involve strategic framing by involved actors, and hence, formulating policies based on these barriers is difficult. Also, the empirist ontology of barriers, their linear notion and static character needs to be highlighted. Here, the paper presents a somewhat fragmented understanding of such barriers – this needs to be revised!	We are approaching this article via empirico-inductive approach. We took a pragmatic stance, where we inducted others experiences via key-informant interviews and SLR. Following a constructivist approach, there is a possibility that the subjective opinions might not reflect the complete reality of the barriers and underlying mechanisms. However, we believe that the data collection strategies and empirico-inductive approach could bring a closer look at the perception of reality and principle of generalization.
4	A clear description of how barriers are defined in this research is needed, as it remains unclear, what a barrier in the specific context of this paper represents. Reading the paper, it rather seems to be a vague overarching idea of anything, that has been framed/identified in literature that could potentially hinder effective adaptation governance.	Thank you for your comment. We adopted the popular definition of barrier that was also adopted by other barrier scholars (e.g. Eisenack et al. 2014, Moser and Ekstrom 2010). We provided specific definition of barrier in our study. In the revised paper, we further included that barriers have been viewed through problem solving lens (see Biesbroek et al. 2014: Analytical lens on barriers). As our main purpose is focusing on the barrier mechanism, we do not have ample opportunities to discuss the debate of barrier definition in this paper. For this reason, we used the widely acknowledged definition of barriers.
5	Further, the causal notion of mechanisms should be elaborated – however, the current methodology does not ensure that mechanisms indeed underly such causality – a weakness of	Thank you. In the revised paper we attempted to make out methods more understandable to the readers. We derived the explanations from our detailed conversation with interviewees as well as from articles that we reviewed. We later associate these explanations with

this paper.

mechanisms based on the contextual discussion. As we intend to find the causal mechanisms in the overall adaptation governance in Bangladesh, we did not elaborate the contexts. Because, we found that although contexts may vary but the mechanisms are triggered in similar ways.

| 6 | The paper does not present a thorough analysis of the CMO model in Bangladesh, as Figure 1 presents. A detailed description of the initial condition, inlcuding main actors and a distincly demarced timeframe in which barriers will be mechanismically explained is lacking. Rather, mechanisms that explain impasses or hindrances in literature are transferred to the Bangladeshi context, trying to explain barriers (see b) – here, it is difficult to find a causal logic in the mechanisms, the time scale on which they operate. An analysis of rounds of discussion, as done by Sieber et al. could have helped – any form of ordering the interview information, the barrier and the different strands of governance activities (forestry, water management) would be benefitial for this paper. | Thank you for your comment. Sieber et al conducted a great study on mechanisms. Although our research question is broadly similar to theirs, but we think our purposes are significantly different. Unlike Sieber et al., we did not want to confine our study to specific cases. Instead, we attempted to identify the mechanisms that emerge in the overall adaptation governance process. We think this is more similar to the approach that archetype analysis takes, although conceptually our study is different from archetype analysis.

Our approach was at once deductive and inductive. The mechanisms identified in the broader literature, and synthesized in Table 1, provided initial propositions of possible mechanisms that might surface in Bangladesh, as deductive categories. Nevertheless, we also let the Bangladeshi data speak for itself. While we did not identify any new categories of mechanisms from our analysis, we did identify barriers not discussed in the literature (e.g. "top-down approach of knowledge flow" and organizational flow as a barrier)

Our approach involves various contexts; however, we mentioned in our article that we focused on six sectors of engagement and on the interactions among involved actors. Because of the varied contexts, we do not think details of initial conditions or governance processes will fulfill our purpose. In the revised paper, we indicated the initial conditions involved which level of actors (e.g. national level, multilevel). We also specified that the timeline was 2012-2017. We do not think that mechanisms are temporal events; rather they are conditions of social relationship. The temporal relationship is implicit |

		in the way that actors explain why or why not an action occurred or did not occur.
		We think our interview analysis and literature review were capable to retrieve explanations of barriers as we considered the contexts (i.e. initial conditions), main actors, and governance processes in our analysis.
		In the revised paper, we put interview number and the list of barriers (see table 3).
7	"Adaptation governance" is a rather broad overarching category of a variety of independent or dependent actions and processes taking place. The analysis could benefit from a distinct identification of time frame, scales sectors and the different actors involved.	Thank you for your comment. In this study, we focused on six sectors of engagement that have been prioritized in the National Adaptation Plan of Action. We considered the major actors (i.e. organizations) that are involved in these sectors (please see Appendix 1 for the name of the organizations). These actors operate at different levels of governance (i.e. national, regional, local). In the revised paper, we added the time frame (2012-2017).
8	It might be recommendable to revise the abstract, both title and abstract in their current form are slightly different from the content of the paper. Rather, it deals with the barriers that come forth from implementing adaptational policies in Bangladesh – analyzed through a barrier analysis based on expert interviews and literature review in global context, and transferring this global knowledge to explain governance in Bangladesh. Barriers are themselves not critically analyzed, but rather follow the linear logic inherent to the barrier approach. Based on the identified barriers, a deductive machanismic explanation is sought, with unclear methodology.	We revised the title and abstract. In this study, by focusing on the action-formation domain we are focusing on the explanations associated with the objective observations that an action (i.e. adaptation) did not occur when it was expected to have occurred in relation to policy and mandates. The explanation maybe subjective, but we think if such explanations surface repeatedly in our data as well as in literature, we may be able to identify the common mechanisms.

9	The methodology section of the reviewed paper is weak.	Thank you for your comment. In the revised paper, we added a separate sub-section in methods. In that sub section we explained the coding process elaborately. Also, we revised the key informant and systematic literature review sub-sections. We removed the content analysis part; instead we did break down the steps in the new sub section.
	The key informant interview section is lengthy and flawed. How the barriers were destilled from information on progress of adaptation actions, factors and processes that make the adaptation planning or implementation challenging remains unexplained. Also, it does not become clear how "the interactions among organizations that are involved in adaptation actions" (aim and interest of the study, page 3) can be analyzed. The authors fail to explain the employment of content analysis techniques, which should be at the core of destilling mechanisms that lead to the emergence of impasses (e.g. through process tracing methods, e.g. Biesbroek et al, 2014, Sieber et al., 2018, theory can be found e.g. Collier et al, 2013). This needs to be added.	Furthermore, we clarified the aim and interest of the study in the revised paper. We focused on collaboration and coordination among organizations and we indicated that the term 'interactions' involves communication, negotiation, collaboration, coordination etc. However, we did not find it necessary to define the term 'interactions'.
10	The selection criteria for the evidence synthesis remains unclear. Did the search string select papers for Bangladesh, or global literature on mechanisms?	We provided a table in Appendix 2 which includes the search strings. We limit our literature search only in Bangladesh and we mentioned it in the methodology section.
11	There still seems to be confusion in the methods section on the nature of barriers and mechanisms and how these are linked (barriers, processes, mechanisms). Barriers do not necessary underly a causal logic, nor are they necessarily related to processes The methodological step of identifying mechanisms in the literature (based on a global literature review) and the transfer of these mechanisms to a totally different context, with totally different initial conditions, seems to lack reasoning as the methologoical section is flawed at this point–courageous at best.	We agree that majority of barrier-related study do not provide sufficient explanation to derive causal logics. However, some studies go beyond identification of barriers and discuss the underlying reasons for which the barriers come into play. Through systematic literature review, we found that only 13% of the barrier related studies conducted in Bangladesh have this type of information. We mentioned in the methodology section.

We think the mechanisms that were identified in the literature are more universal in nature. In Table 1, we provided the definitions of mechanisms. Synthesized from literature covering a diversity of contexts and circumstances, suggesting that there are some generalizable categories of mechanisms that hypothetically could be |

found in distinct contexts. We would not, however, expect that all such mechanisms would be present in any specific context, and we also recognize that the synthesis presented in Table 1 is not necessarily comprehensive; additional case studies and attention to mechanisms may provide new information that would alter the characterization of these mechanisms in the future. As has been demonstrated with the associated archetype analysis literature (Oberlack et al. 2016, Oberlack and Eisanack 2018, Shackleton et al. 2015), despite a wide diversity of cases and contexts, common generalizable patterns of factors and processes associated with patterns of social and ecological outcomes can be identified from case study literature. For example, "enclosure and exclusion mechanism" represents capturing resources and authority and marginalizing stakeholders. The presence of this mechanism can be observed in a variety of context (please see following references as examples). For this reason, we think that the definition/meaning of the mechanism determines whether it could be applied to a context.

Oberlack, C., Tejada, L., Messerli, P., Rist, S., & Giger, M. (2016). Sustainable livelihoods in the global land rush? Archetypes of livelihood vulnerability and sustainability potentials. *Global environmental change*, *41*, 153-171.

Oberlack, C., & Eisenack, K. (2018). Archetypical barriers to adapting water governance in river basins to climate change. *Journal of Institutional Economics*, *14*(3), 527-555.

Shackleton, S., Ziervogel, G., Sallu, S., Gill, T., & Tschakert, P. (2015). Why is socially-just climate change adaptation in sub-Saharan Africa so challenging? A review of barriers identified from empirical cases. *Wiley Interdisciplinary Reviews: Climate Change*, *6*(3), 321-344.

12	The figure needs to be properly cited, and subheadings specified, as otherwise could be misleading as framework that this paper takes. Subheadings should be specified for all Figures and Tables	Thank you for your comment. We addressed this point in our revised paper.
13	Dear authors, Thank you very much for this interesting work. There seems to be a lot of potential, however, please find my feedback enclosed. There are some intrinsic aspects related to the mechanismic approach that need to be adjusted, also, the methodology needs severe revision. Conclusions, on the other hand, are very strong	Thank you for your comment. We regret any misunderstandings. In this paper, we intend to identify the common mechanisms that can explain the emergence of barriers in the overall adaptation governance in Bangladesh. In the revised paper, we clarified our objective. We focused on the interactions of organizations (their collaboration and coordination). We also elaborated on barriers and we are using 'problem-solving' lens as per Biesbroek et al. (2014) to analyze the barrier mechanism. In this study, we first identify the barriers, their causes, and then associated these causes with mechanisms based on the similarities of contextual discussion as well as causal explanation and definition of mechanism. We revised our methodology section to make these steps more understandable to readers. We provided a timeline in the revised paper. Furthermore, in the result section, we attempted to introduce initial conditions, involved mechanisms, and outcome (barrier). We would like to underline that our main purpose is to identify causal mechanisms in adaptation governance. For this reason, we focused on six key sectors and collaboration and coordination among 27 organizations. In this way, we focus only on action-formation mechanism related to interactions among actors (i.e. organizations). We also gathered secondary evidence through systematic literature review so that we can identify the mechanisms more effectively. Because of our purpose, we could not focus on specific adaptation cases or projects. A focus on specific project may help us to detail the context, involved actors, all relevant processes, but at the end we will not be able to tell that the identified mechanisms are prevalent in the

overall adaptation governance or take place only for that specific
case.

We put the tracked-change version of the manuscript first to demonstrate what changes have been made. Later, we put a cleaned version of the manuscript.