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Assessing Institutional Responses to Climate Change Impacts in the North-Eastern Floodplains of Bangladesh

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Abstract
Bangladesh encounters diverse climate change impacts at different scales, which can severely affect rural communities and livelihoods. In response, the government of Bangladesh has initiated a number of institutional interventions through development plans to better support sustainable adaptation. There have, however, been relatively few assessments of how these interventions have impacted sustainable local adaptation. Focusing on the highly climate-affected north-eastern floodplain region of Bangladesh, this paper presents the results of a literature synthesis supported by primary field data to identify how existing policy barriers can threaten institutional responses to climate change impacts, while institutional rigidity and the non-inclusiveness of bureaucratic polity work to undermine efficiency, effectiveness, and equitability—some important considerations for sustainable adaptation. Our results point toward the need for public policy to better enable broader public participation in the design, implementation, and evaluation of adaptation plans.

Keywords Climate change adaptation · Sustainable development · Sustainable adaptation · Institutional responses · Wetlands

Introduction

Institutions are regulatory regimes and decision-making instruments (Fukuyama 2013; North 1991) that can enable or constrain coordinated responses to climate-related challenges (Adger et al. 2005; Dovers and Hezri 2010; Dupuis and Knoepfel 2013). According to Dupuis and Knoepfel (2013), formal adaptation-related decisions are generally taken at broader scales (e.g., through international negotiation and developing national policies) based on historic climatic data, climate forecasts, and generalized climate impact studies. This approach has been shown to have limitations in many developing areas, where rates of poverty and inequality are high and communities largely depend on climate-sensitive natural resources for their subsistence (Eriksen and O'Brien 2007; Rahman et al. 2017). In these cases, the ability of the government to realize national adaptation goals largely depends on the extent to which national institutions can account for spatially and temporally distributed decision-making politics (Dovers and Hezri 2010; Termeer et al. 2010; Urwin and Jordan 2008). Eriksen and O'Brien (2007) noted that climate adaptation and sustainable development need to go "hand in hand". However, not all adaptation actions fit well with sustainable development agendas (Barnett and O'Neill 2010; Eriksen et al. 2011; Juhola et al. 2016). Eriksen et al. (2011) subsequently identified four principles for "sustainable adaptation": (i) understanding a local context in terms of climate change impacts, social equity, and environmental integrity; (ii) acknowledging different values and interests; (iii) integrating local knowledge; and (iv) considering potential feedback between local and global processes. They further specified the fundamental agendas of sustainable adaptation stating that the outcomes of adaptation actions should qualify the objectives of reducing poverty and managing inequality without compromising environmental integrity. However, linking poverty and adaptation to climate change is complex and highly context specific (Brown 2011). Eriksen and O'Brien (2007) argued that reducing poverty and inequality and managing vulnerability are all important components of sustainable development pathways, which indicates that

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the adaptation actions need to be assessed from sustainable development perspectives.

This paper assesses the recent institutional responses by the Bangladesh government to promote sustainable adaptation in the climate-vulnerable wetland systems of the northeastern floodplains through different adaptation-related planning processes (Barnett et al. 2015). Despite unique geographic features and complex socioeconomic conditions, this area is highly understudied compared with the other parts of the country, limiting our capacity to understand the extent to which the existing adaptation policies are contributing to the sustainable development of the area (Miah et al. 2011; Rahman et al. 2018a). We conceptualize institutional responses as the permanent or temporary institutional changes in the national government to facilitate adaptation-related decision-making and implementation. Hence, we assess the adaptation actions taken by institutions in light of sustainable development perspectives.

The paper is guided by the following questions: (i) what have been the main national-level institutional responses to facilitate sustainable adaptation in Bangladesh? and (ii) to what extent have these responses been contributing to sustainable adaptation? In what follows, we present our conceptual framework and describe the assessment criteria employed in the study. We then present the research methods, followed by the results that we discuss based on the conceptual framework and assessment criteria presented in the next section. In the final section, we suggest some potential directions for policy and research.

Conceptual Framework

Central in our conceptual framework is the Fischer et al. (2007) three-tier process of institutional decision-making and implementation, which comprises: (i) the policy-making level; (ii) the bureaucratic polity level; and (iii) the policy implementation level (Fig. 1). The conceptual framework includes several criteria for a systematic assessment of the institutional responses at each level, which are further elaborated in Table 1.

Policy-Making Level

This is the level (e.g., parliament, cabinet, and ministry) of political negotiation and building common consensus among designated actors (e.g., parliament members and ministers) about the policy decisions to be taken. Policies are the institutional statements of a government's position to address a perceived climatic problem, which also includes directives and plans that identify the priority actions deemed necessary. This may include, for instance, different adaptation projects designed under an adaptation plan (Dovers and Hezri 2010). In this paper, we look specifically at the motivations and underlying drivers of the national adaptation planning and policy framework, as well as to the planning process (which can be authoritative, democratic, or decentralized); and the anticipated effectiveness of the plans in terms of multisectoral and contextual considerations (Dovers and Hezri 2010; Dupuis and Knoepfel 2013; Adger 2016). See Table 1 for a further elaboration of these assessment criteria.

Bureaucratic Polity Level

Bureaucratic polity is the hierarchical organizational level of government that performs a mediating role between national policy making and local policy implementation. Gurr (1974) defined polity as "*the basic political arrangements by which national political communities govern their affairs*" (McLaughlin et al. 1998). The implementation of government decisions requires coordination among different institutional organizations (Adger et al. 2005; Hajer 2003; Hickey et al. 2013), as well as financial arrangements and provisions for public participation. Together these three elements form the bureaucratic polity of a government (Hajer 2003). Well-functioning democratic structures and "good governance" that enable public participation and advocacy by academics and civil society in international climate negotiations (e.g., the Conferences of the Parties to the UNFCCC) and the implementation of adaptation actions, have become a "golden standard" for assessing the effectiveness of bureaucratic polity (Adger 2006; Berrang-Ford et al. 2014) (Table 1). In addition, information exchange and knowledge generation are needed, particularly in multi-faceted policy environments such as climate change adaptation (Fig. 1).

Policy Implementation Level

This level is the politically, geographically and/or social-ecologically defined constituency where government policies are implemented "on the ground". These levels are sensitive to local contexts (e.g., socioeconomic, political, environmental, and geographical) (Adger et al. 2005; Dovers and Hezri 2010; Smit and Wandel 2006). Since the adaptation policy decisions are physically implemented at this level, the sustainability implications of adaptation plans in Bangladesh need to be assessed at this level, focusing on social, economic, and environmental dimensions (Eakin et al. 2014). In doing so, we use the criteria of the Comparative Framework for Evaluating Sustainable Development Programs developed by Mog (2004). For further details see Table 1.

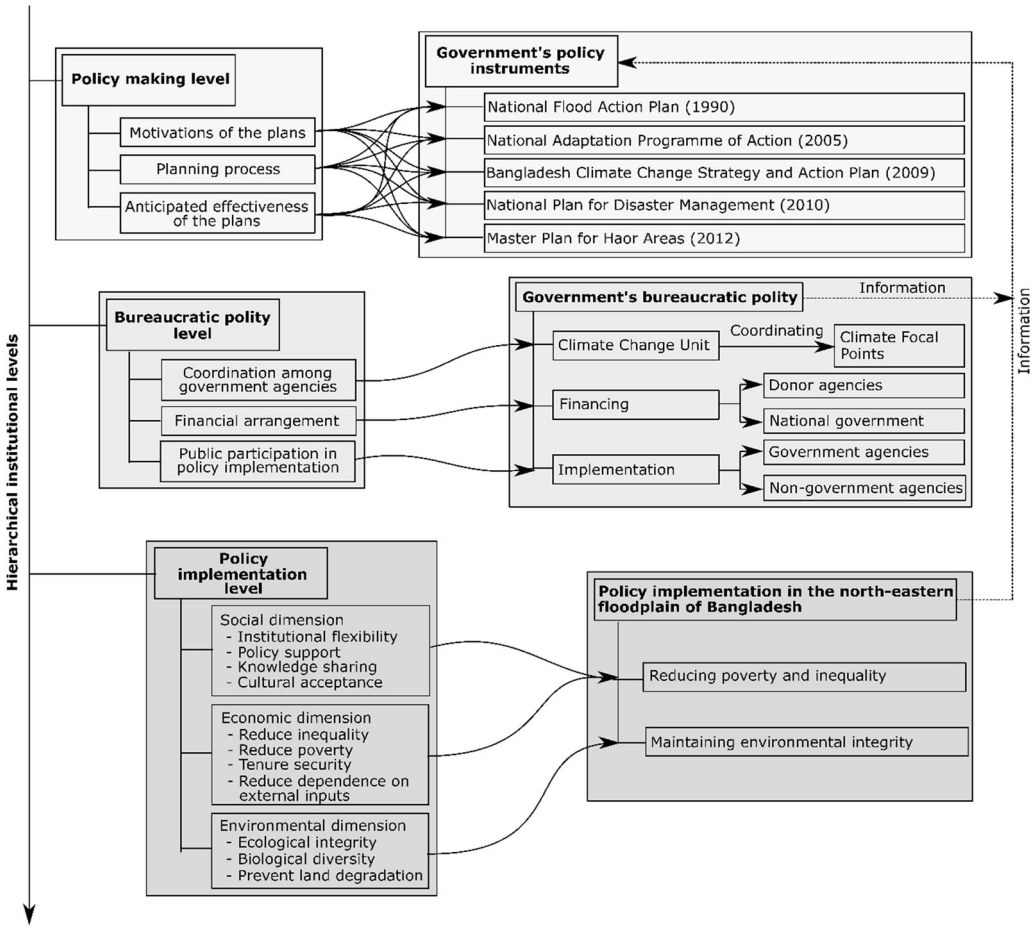

Fig. 1 Conceptual framework for the analysis of institutional responses to climate change in the north-eastern floodplain in Bangladesh

Social dimension

The social dimension examines the social acceptance of adaptation policies. Adaptation interventions are socially sustainable if they ensure justice in distributing climatic risks among different socio-economic classes, and equally acknowledge marginalized voices in the institutional processes of policy making and implementation. Therefore, one of the major challenges associated with climate change adaptation is to establish social equity. This requires an understanding of local power structures. Moreover, in order to help policy makers to develop more contextualized and culturally sensitive adaptation strategies, linkages with informal institutions are needed that represent culturally specific customs, norms, rules and values (Eriksen et al. 2011; North 1991) as these have the potential to engage context-embedded local knowledge (Eriksen et al. 2011; Rahman and Hickey 2019; Rahman et al. 2019). Adaptation policies seeking to address social challenges therefore need to exhibit a degree of institutional flexibility in order to facilitate formal–informal institutional linkages and enhance social resilience. Adger et al. (2005) defined institutional linkages as direct communications through a network for exchanging information and knowledge in support of tangible resource management. These considerations are summarized in the four assessment criteria mentioned in Table 1.

Economic dimension

Risks associated with climatic impacts are not uniformly distributed among the members of a society. Some are more affected because of poor economic capacity than others, and some can benefit from opportunities because they have access to assets and resources. Adaptation policies are economically sustainable when access to resources is ensured for creating opportunities to adapt. Consequently, poverty and economic inequality are the main economic factors that limit the ability of affected people to adapt to climate stress in developing areas (Rahman et al. 2018d). Several studies have revealed that poorer sections of society lose more due to climate stress than their richer counterparts, not only because they have less access to collective decision-making processes, but also less access to material

Table 1 Assessment criteria at various institutional levels

Assessment criteria	Definition	References
Policy-making level		
Motivations of the plans	The underlying drivers of adaptation planning (e.g., international governance and agreements; implicit and explicit recognition of climate change; reactive and/or anticipatory decision-making; socio-economic development; spatial and temporal horizon of plans).	Adger 2016; Füssel 2007; Dovers and Hezri 2010; Berrang-Ford et al. 2014
Planning process	Planning can be either top-down, authoritative and scenario based or bottom-up, participatory and multi-level. Top-down policies are often based on anticipation of future climatic impacts and aim at long-term adaptation actions, while bottom-up approach assesses current impacts to help enhance future adaptive capacity.	Fankhauser et al. 1999; Huq and Reid 2004; Few et al. 2007; Urwin and Jordan 2008
Anticipated effectiveness of the plans	The capacity of a policy to achieve its stated goals and to respond to local-level and multi-sectorial adaptation demand	Adger et al. 2003; Füssel 2007; Barnett and O'Neill 2010; Berrang-Ford et al. 2014; Juhola et al. 2016
Bureaucratic polity level		
Coordination among government agencies	This is the horizontal integration of sectors and agencies within a jurisdiction. Some common examples of such coordination involve ministerial councils, cabinet process, cross-agency taskforce, etc.	Adger 2006; Dovers and Hezri 2010; Huq and Rabbani 2011
Financial arrangement	Bureaucratic polity requires access to resources for the successful implementation of policy decisions. Financial arrangement is perhaps one of the most important resources particularly in the developing country contexts.	Lockwood et al. 2010; Abers, 2013; Berrang-Ford et al. 2014
Character of public participation in policy implementation	The provisions taken for stakeholder representation and ensuring fairness, accountability and transparency in institutional actions for policy implementation	Adger 2006; Huq and Khan, 2006; Berrang-Ford et al. 2014; Adger 2016
Policy implementation level		
Social dimension	We use four policy implementation assessment criteria[a] to assess the social sustainability of institutional processes in the local context: (i) institutional flexibility; (ii) policy support; (iii) knowledge sharing, processes of social change and organizational social networks; and (iv) cultural acceptance.	Adger et al., 2003; Thomas and Twyman 2005; Adger 2006; Paavola and Adger, 2006
Economic dimension	We assessed economic sustainability with four policy implementation assessment criteria[a]: (i) reduce inequality; (ii) reduce poverty and increase livelihood opportunities; (iii) tenure security and credit access; and (iv) reduce dependence on external inputs.	O'Brien and Leichenko 2000; Adger et al. 2003; Adger 2006
Environmental dimension	We analyzed this dimension using three policy implementation assessment criteria[a]: (i) ecological integrity; (ii) biological diversity; and (iii) prevent land degradation.	Barnett and O'Neill, 2013; Juhola et al. 2016

[a]See Mog (2004) for description

resources (e.g. land, water, equipment, and credit) and nonmaterial ones (e.g., knowledge and networks) (Adger 2000; Thomas and Twyman 2005; Paavola 2008; McDowell and Hess 2012; Rahman et al. 2018c). Therefore, the economic sustainability of adaptation policies needs to be assessed based on how the policies are dealing with unequal access to resources, reducing poverty and generating alternative livelihood opportunities, improving tenure security and access to credit, and reducing dependence on external inputs through cost-effective technology adoption (Adger 2006; Mog 2004; O'Brien and Leichenko 2000) (Table 1).

Environmental dimension

Sector-specific adaptation policies and actions may contribute to pollution of the environment and degeneration of ecological integrity in the shorter and/or longer term. Increased greenhouse gas emissions, for example, can result from certain adaptation actions, which may not influence the local environment substantially but could possibly contribute to the broader impacts of climate change (Barnett and O'Neill 2010). For instance, Kovats and Hajat (2008) noted that building houses that require an energy-intensive artificial cooling system as an adaptive measure to avoid fatal heat stress in urban areas would intensify carbon emissions. As such, adaptation actions may erode sustainable development by affecting environmental and ecological integrity, referred to as "maladaptation" (Barnett and O'Neill 2010; Juhola et al. 2016). Adaptation policies, therefore, need to be carefully scrutinized to avoid such maladaptation (Rahman and Hickey 2019). We assess the environmental sustainability of adaptation policies based on whether appropriate measures have been taken to minimize the environmental impacts of adaptation actions on ecological integrity, biological diversity, and land degradation (Table 1).

Methods

Study Area: The North-Eastern Floodplain of Bangladesh

Bangladesh is one of the most climate vulnerable countries in the world due to its geographic location, ecological characteristics, economic conditions, and social features (Ayers 2011). Geographically, the north-eastern floodplain of Bangladesh is surrounded by the Assam and Meghalaya Provinces of India on the eastern and northern sides respectively, Tripura to the south and the Brahmaputra River basin on the west (Fig. 2). Topographically, this region consists of small foothills along the eastern border and the Meghalayan Hills along the southern border (Bangladesh *Haor* and Wetlands Development Board (BHWBD 2012)). Beyond this area, wetlands (locally known as *Haors*[1]) cover the floodplain, with an area of 858,460 hectares (BHWBD 2012). Due to these outstanding geographic and climatic features, the floodplain experiences significant rainfall levels and seasonal flooding at varying intensities (Mirza 2003; Chowdhury and Ward 2004).

Flash flooding also occurs in the region, primarily due to sudden, elevated river flows as a result of heavy rainfall in the Indian territory (particularly in Meghalaya and Tripura) resulting in loss of livelihoods, severe damage to property and infrastructure (Nowreen et al. 2014; Shahid 2010). Nowreen et al. (2014), Masood and Takeuchi (2016), and Nury et al. (2017) have provided detailed accounts of the changing climatic patterns and flash flood regimes in this area, revealing that the area will likely face more frequent flash flood events in future. Resident communities in the north-eastern floodplain depend primarily on agriculture and fisheries for their livelihood, which are both highly sensitive to flash flood events (Banerjee 2010; Rahman et al. 2018c). Subsequently, the impacts of flooding on local social and economic conditions are extensive, multi-sectoral, and uneven (Banerjee 2007; Rahman et al. 2018b).

Research Design and Data Collection

We designed our research combining document analysis and primary data collection through focus group discussions and key respondent interviews to capture both national level institutional responses and their implementation in the north-eastern floodplains of Bangladesh. In order to understand institutional change at the policy making and bureaucratic polity levels, we analyzed and synthesized five adaptation-related national development plans using synthesis.

Since national governments and international policy forums consider climate change as one of the major challenges to sustainable development, we particularly focused on the broad policy issues related to climate change impacts and sustainable development. We followed a systematic approach to identify relevant secondary sources, using the following search terms in the Web of Knowledge and Scopus databases: "climate change", "adaptation", "Bangladesh", "institutions" AND "plan*". Since Bangladesh does not have any national or regional climate adaptation policy, we excluded the term "policy" from our search to

[1] Haors, as defined in Bangladesh Haor and Wetlands Development Board (BHWBD 2012, p. 65), "are the bowl-shaped depressions of considerable aerial extent lying between natural levees of rivers or high lands of the north-east region of Bangladesh. In most cases haors have been formed as a result of peripheral faulting leading to the depressions".

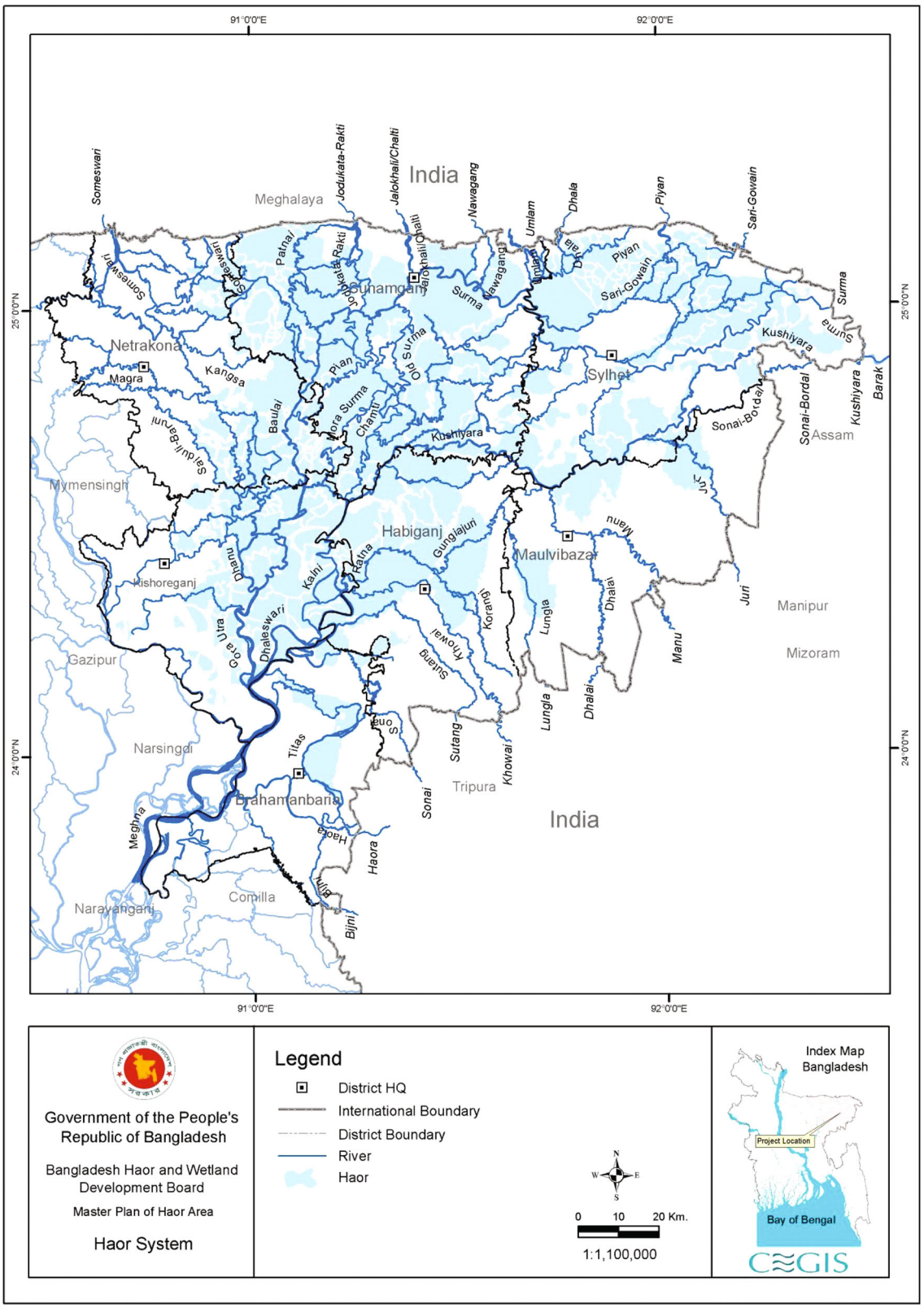

Fig. 2 Haor areas of the northeastern floodplain of Bangladesh [Source: Ministry of Water Resources (MoWR), 2012]

avoid the incorporation of unnecessary studies. We subsequently identified 98 studies of relevance to the scope of our research. We then screened these studies based on three selection criteria: (i) study covering aspects of policy analysis; (ii) the study deals with local and national development plans with a climate change adaptation component; and (iii) the relevance of the study to our study area. The screening process resulted in 45 studies being selected for detailed analysis. We also examined different government documents identified as having high relevance to the study (e.g., the Flood Action Plan reports) to support our analysis.

Importantly, undertaking a synthesis of secondary studies has two major limitations: data quality and the sole dependence on secondary materials. Data quality problems can arise from the use of inappropriate methods, insufficient data and/or analytical weaknesses in the secondary materials being used. Recognizing the relative deficit of secondary sources in the selected study area (Rahman et al. 2018a), we also collected primary data through focus group discussions and key informant interviews in the two most important wetland systems in the north-eastern floodplains: the Hakaluki and Tanguar *haors*.

Primary data collection involved 14 focus group discussions in the peripheral villages of the wetlands selected from each bordering *union*—the lowest administrative unit of the Bangladesh government (10 focus groups in Hakaluki from 11 unions and 4 focus groups in Tanguar *haor* from 4 unions, with 8–10 participants each). Following focus group best practices (Krueger and Casey 2009), we maintained group homogeneity by selecting participants from similar socio-economic and professional backgrounds (e.g., income range 5000–15000 Taka/month, direct dependence on wetland resources for primary livelihood activities and not involved in community leadership roles). We also conducted key informant interviews ($n = 20$) with local community members (7), government officials (7), nongovernment officials (3), and local experts (3). Community key informants were selected from identified leaders of different groups (e.g., fishermen and farmers), while the government officials were selected from local, regional, and national level administration units. Table 2 presents the questions discussed during field data collection, based on the dimensions and policy implementation criteria presented in the conceptual framework.

Analytical Method

We followed an inductive approach to data analysis for our synthesis, allowing us to condense data from large and diverse texts in order to indicate relational structures which could then enable generalization to, and abstraction of, theories (Zimmer 2006). Based on our analytical framework (Fig. 1) and assessment and policy implementation criteria (Table 1), we defined categories to extract relevant data through coding (Thomas 2006), where the coding protocol followed the assessment criteria described in the Section "Conceptual framework". We then screened the codified data by relating, comparing and contrasting findings on the basis of relative importance. Moreover, to enable data triangulation, we codified the primary field data using the same protocol, and compared them with the synthesis outcomes (Bergman 2012).

Results

Institutional Responses in the North-Eastern Floodplain of Bangladesh

Policy making level

Motivations of the adaptation plans In Bangladesh, most development plans are components of different national development policies, and few of them aim specifically at undertaking climate adaptation actions (see MPHA 2012), placing a greater emphasis on ensuring the socio-economic stability of communities. Nevertheless, these plans are the major vehicle through which the national government implements climate policy, and therefore served as an appropriate proxy for further analysis. After reviewing all active plans related to sustainable development and flooding, we identified the following five as being the most important to our study area:

The National Flood Action Plan, 1990s (FAP) is the first national level, extensive and long term plan to protect Bangladesh from flood events (Paul 1995). The FAP sought flood protection through structural solutions such as engineered embankment and hydraulic structures (Rasid and Mallik 1995; Sultana and Thompson 2010). Establishment of flood protection infrastructures was not new in Bangladesh, which began in the 1960s, and the FAP is the extension of such interventions. Protection of agricultural productivity from flood stresses appeared to be a major policy objective as was the provision of agricultural irrigation during the dry season through water conservation (Boyce 1990; Mirza and Ericksen 1996). Strategically, this plan tried to regulate flooding within desired levels by maneuvering flood water flow within canals, channels, water reservoirs and ditches, a process known as flood compartmentalization (Paul 1995); although such intervention was not executed in the north-eastern floodplain. The structural developments under this plan, along with pre-existing embankments, have led to a significant alteration of cropping patterns throughout the country (Rasid and Mallik 1995).

Table 2 Questions discussed in focus group discussions and key informant interviews

Political criteria	Political subcriteria	Questions
Social dimension	Institutional flexibility	(i) Do you form community-based organization? (ii) Do you communicate with government agencies to facilitate the functioning of your organizations? (iii) If yes, how often and are you satisfied with the services provided by the government agencies?
	Policy support	(i) Do you have access to common fishing property right? (ii) Who do communicate with the government on behalf of you with the government agencies for getting the property right?
	Knowledge sharing, process of social change, and organizational network	(i) Do the government officials communicate with the community members to learn about locally adapted activities? (ii) How do the upper levels of government get informed about local practices?
	Cultural acceptance	(i) Do the government interventions have particular attention to women, economically marginalized groups or ethnic minorities?
Economic dimension	Reduce inequality	(i) What are the most common livelihood activities in the study area? (ii) Is the community highly differentiated in terms of socio-economic status?
	Reduce poverty and increase livelihood opportunity	(i) What are the most common alternative livelihood activities? (ii) Do government officials organize training activities that are supportive for livelihood activities?
	Tenure security and credit access	(i) What are the processes of sharecropping? (ii) How the fisheries resource access is managed? (iii) What are the most common credit sources for local community members?
	Reduce dependency on external inputs	(i) What are the most common crops cultivated in the area? (ii) What is the preference level of community members to government official suggested crops?
Environmental dimension	Maintain ecological integrity	(i) How frequently do farmers use fertilizer and pesticides? (ii) What are the most common fishing practices?
	Maintain biological and genetic diversity	(i) Do you think wetland environment is degrading? How? (ii) Do you think fish diversity has been declining in recent years? If so, what are the potential causes for the decline?
	Prevent land degradation	(i) What is most important reason for flood in the area?

The National Adaptation Program of Action, 2005 (NAPA) was the first national level adaptation plan committed to at the Conference of Parties (COP) 7 in Marrakesh, 2001 (Islam et al. 2013b). It was designed to initiate urgent adaptation needs (Zaman 2011). The plan involves 15 adaptation strategies covering diverse actions across the country (Islam et al. 2013b; NAPA 2005), with numerous location-specific initiatives (Ayers 2011). The NAPA (2005) planning process made significant advancements to Bangladesh's national planning by adjusting national sustainable development goals and including rigorous stakeholder consultation (NAPA 2005). The plan was an important step forward to "mainstreaming adaptation" in national development planning (Ayers and Huq 2009). The NAPA planning team identified 15 priority activities that were enlisted as adaptation projects to be implemented in different areas of the country (Islam et al. 2013b). These projects include eight intervention type projects (physical adaptation actions) and seven facilitation type projects (institutional infrastructure development actions). For details see NAPA (2005).

The Bangladesh Climate Change Strategy and Action Plan, 2009 (BCCSAP) was developed in response to the resolutions of COP 13 in Bali, 2007, commonly known as the Bali Action Plan (Alam et al. 2013). In developing the BCCSAP (2009), it appeared that the NAPA (2005) was not a long-term plan for combating climatic challenges largely because it lacked mitigation measures (Ayers and Huq 2009). As a response, the development of the BCCSAP (2009), 2009 was considered a revised version of the NAPA (2005), representing a national "roadmap" to confronting and reducing the impacts of climate change (Alam et al. 2013), described as a comprehensive and integrated example of adaptation planning (Ayers et al. 2014b). This plan was based on six major themes: (1) social security, (2) structural solutions, (3) formal institutional strengthening, (4) knowledge management systems, (5) comprehensive disaster management, and (6) development through carbon emission mitigation management (Islam et al. 2013a). Over a 10-year implementation period, the plan identified 44 programs under the themes to be funded by both national government and international donor agencies, and implemented by both government and nongovernmental organizations (BCCSAP 2009).

The National Plan for Disaster Management, 2010–2015 (NPDM) is a national and international response to the intensified natural disasters affecting Bangladesh. Hierarchical institutionalization and action for disaster preparedness is at the core of the plan, which categorized activities of disaster management into national, district, sub-district and local levels with strong emphasis on monitoring and evaluation (Khan and Rahman 2007). In addition to postdisaster interventions such as immediate relief and re-installation of infrastructure, the plan emphasizes disaster preparedness by building the capacity of affected people to respond to climate change impacts through widespread awareness building and increasing their resilience by boosting their livelihoods. As with other geographic areas, the north-eastern floodplain has been given particular attention because of its vulnerability to flooding, and the need to enhance the capacity of affected people to safeguard life and livelihood through adaptation measures (NPDM 2010).

The Master Plan for Haor Areas, 2012 (MPHA) is the only locally based integrated development plan for the north-eastern floodplain. It identifies 18 different development sectors (e.g., water resource management, agriculture, fisheries, livestock, health, transportation, etc.), and was designed to be implemented over 20 years through 166 development projects, divided into three priority classes: "very high", "high" and "medium". Since the majority of the population in this region live in rural areas and the economic activities are highly dependent on natural resources, issues related to climate change stresses, particularly flood protection through water resource management, have been given special priority (MPHA 2012).

Planning processes Climate change adaptation planning in Bangladesh has been evolving since the early 1990s, from being highly centralized and authoritative national processes (Hanchett 1997; Rasid and Haider 2003; Alam et al. 2013) to more participatory and decentralized processes. For example, most of the projects under the FAP were developed and commenced with support from donor agencies but without prior consultation with the affected communities (Alam et al. 2013; Rasid and Haider 2003). Reviewing the FAP 6 (1995), which particularly focuses on the north-eastern floodplain, revealed limited public participation throughout the process. Following the NAPA (2005), guidelines, Bangladesh developed its national adaption plan by engaging different stakeholders. Although there were no formally incorporated community representatives in the NAPA team, planners consulted with the affected people to assess their climate change perceptions and need-based prioritizations (Huq and Rabbani 2011; Islam et al. 2013b). The BCCSAP (2009), has been criticized for a lack of public participation (Alam et al. 2013), due to the lack of community involvement in project prioritizations, although it did incorporate participatory learning from the NAPA process (Rai et al. 2014). In the cases of the MPHA (2012), and the NPDM (2010), planners worked harder to enhance community participation,

although none of the plans placed community representatives in a formal decision-making role (Haq and Khan 2006; Alam et al. 2013). A summary of each of these development plans is presented in Table 3.

Effectiveness of the plans The FAP was designed to serve only one or a few national objectives within a shorter term (e.g., protecting agriculture or infrastructure) (Brammer 2010; Thompson and Sultana 1996). Excessive rainfall during peak river flows is an important reason for extreme floods in Bangladesh, while river channel destruction through encroachment and the filling-in of river banks by local elites adds pressure to natural water flows (Cook and Lane 2010). In the case of wetland ecosystems, flood regulation through embankments limits water flow and reduces the availability of diverse ecosystem services (Custers 1993). Due to the general failure of the FAP to provide direction for flood adaptation, the government shifted its attention away from flood protection through infrastructural establishment (Cook and Wisner 2010; Sultana and Thompson 2010).

Projects funded under NAPA (2005) were only able to generate short-term employment and protection opportunities for affected communities and focused too heavily on protecting physical barriers to reduce climate change impacts, at the expense of reducing exposure (Ayers 2011). It indicates that the policy process did not incorporate learning from the FAP into the contemporary adaptation plans (Naser 2014). Consistent with this observation, Alam et al. (2013) noted that projects funded under the NAPA (2005) generated short-term financial benefits for the community members, as there were no future directives after the completion of a project. As a result, the NAPA projects were not likely to have a dramatic effect on fostering the adaptive capacity of local communities.

Two major operational challenges have been identified in the implementation of the BCCSAP (2009). First, the plan is highly generalized, and therefore inadequate to meaningfully address the diverse natural disasters and geographic areas in Bangladesh. Secondly, the plan suffers from significant contradiction with other national plans and policies (e.g., the National *Jalmahal* (Wetlands) Management Policy, 2009), leading to inter-organizational conflict. These issues are common in Bangladesh and many other parts of the world (Khan and Rahman 2007; Durigon et al. 2012) and present an ongoing challenge for polity.

Bureaucratic polity level

Coordination among governmental agencies The government of Bangladesh has made some progress in achieving inter-organizational coordination, driven partly by international support and partly by adaptive learning at local levels (Alam et al. 2013). For example, the Bangladesh Water Development Board under the Ministry of Water Resources operated as the main actor in the implementation of the FAP. However, this organization failed to maintain coordination with other government organizations (Sultana and Thompson 2010). For example, while the Water Development Board worked to curtail flood impacts on agriculture, it paid less attention to other ecosystem services (e.g., fisheries) and livelihood economic activities (e.g., fishers, boatmen, and labor), and therefore, created negative externalities for other sectoral interests (Mirza and Ericksen 1996; Sultana and Thompson 1997).

More recent development plans (devised after 2000) focus primarily on hierarchical institutionalization. In order to assess the multi-sectoral impacts of climate change, and to foster inter-organizational cooperation, the government of Bangladesh established climate change focal points in each relevant ministry. Coordinated by a Climate Change Unit, these focal points were managed by the Ministry of Environment and Forests. As a result, the channeling of information and negotiation over task prioritization became facilitated through central government. This innovation resulted in more multi-sectoral development plans like the NAPA (2005), BCCSAP (2009), and MPHA (2012) (Huq and Rabbani 2011; Islam et al. 2013a; Islam et al. 2013b). The establishment of the Bangladesh *Haor* Development Board (2000) under the Ministry of Water Resources represented an important advancement in regional development institutionalization. All development activities under the MPHA (2012) are expected to be implemented through multi-organizational cooperation (MPHA 2012) (see Fig. 3). However, how the multi-organizational cooperation will be achieved is not clarified in the plan.

Financial arrangement for executing plans FAP was mostly funded by external agencies, although the government has its own financing mechanism for the MPHA (2012) and NPDM (2010) under the national development plan. On the other hand, two parallel funding institutions operate in Bangladesh to manage climate change impacts supported with funding from donor agencies and the government separately (Huq and Rabbani 2011; Rahman et al. 2016; Rahman and Tosun 2018). Here, the donor agencies' funding institutions work with plans that are focused on climate change issues, while the government funding institutions work with both climate change and national development issues (O'Donnell et al. 2013).

The government of Bangladesh established the Bangladesh Climate Change Resilience Fund in 2010, with a total donor funding of $110.2 million USD from UK, Sweden, Denmark and the European Union (Ahmed and Islam 2013; O'Donnell et al. 2013). While the Fund is administered by

Table 3 Summary of the selected climate change-related development plans in Bangladesh

Plans	Motivations of the plans	Planning process	Effectiveness of the plans	References
Flood Action Plan (1990s)	• Structural solution to flood problems • Protection of agricultural productivity • Water conservation for dry season through compartmentalization	• Highly centralized with authoritative control • Influenced by donor agency decisions	• Heavily criticized for the inappropriateness • Incompatible with the geomorphological nature of river systems • Poorly manifested community demand	Boyce 1990; Brammer 2010; Rasid and Haider 2003; Sultana and Thompson 2010; Brammer 2010; Ayers 2011
National Adaptation Plan for Action (2005)	• Locally based adaptation initiatives • Criteria based prioritization of adaptation interventions	• Involvement of multiple stakeholders for consultation	• Successful in providing short-term income generation opportunities • Insufficient for long-term adaptation options	Ayers and Huq 2009; Huq and Rabbani 2011; Ayers 2011
Bangladesh Climate Change Strategy and Action Plan (2009)	• Development of national adaptation roadmap • Activities based on national adaptation demand	• Absence of stakeholder participation in planning process • Consulted with the NAPA 2005 experience	• Highly generalized in structure • Contradicts other national policies and plans	Alam et al. 2013; Ayers et al. 2014a; Alam et al. 2013
National Plan for Disaster Management (2010)	• Institutional reorganization • Capacity building for disaster preparedness and post disaster management	• Participatory planning process • Consultation with community members	NA (insufficient information)	Khan and Rahman 2007; Alam et al. 2013
Master Plan for *Haor* Areas (2012)	• Locally based development intervention • Water resource management for livelihood security • Developing alternative livelihood activities	• Participatory planning process • Consultation with community members	NA (insufficient information)	MPHA 2012

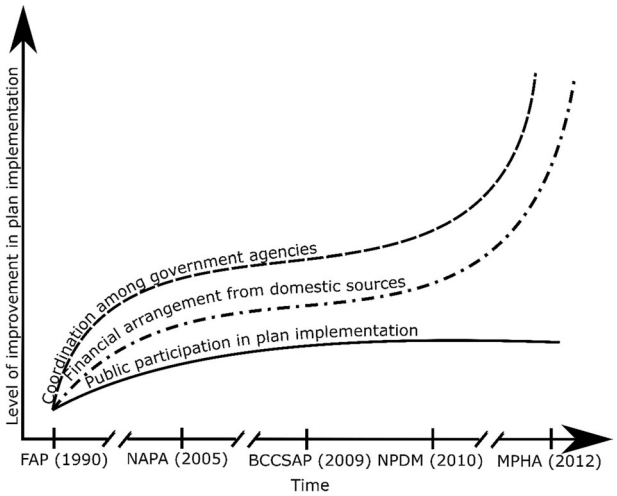

Fig. 3 Evolution of bureaucratic polity in the development plans. (Coordination on development agencies was poor in the FAP. However, later plans concentrated on this issue, which indicates an upward movement. The FAP was dependent on foreign aid for financial arrangement, while the NAPA (2005) and BCCSAP (2009) both depend on government and foreign support. On the other hand, the NPDM (2010) and MPHA (2012) are fully government funded. Public participation in the planning process has increased in more contemporary plans, but it remains insufficient in plan implementation. Consequently, we show that this trend follows a straight line after the FAP

the government, the World Bank provided fiduciary and coordination support to manage the fund (Huq and Rabbani 2011).

National government funding for climate impact management is administered through the Bangladesh Climate Change Trust Fund, established in 2009. This fund represents an adaptive institution created in response to the immediate climate change risks facing Bangladesh (Alam et al. 2013). The government allotted 300 million USD to this fund, which is governed by a Board of Trust and a technical committee, with monitoring mechanisms for financial transparency (Huq and Rabbani 2011). The incorporation of climate change adaptation concerns in the national development plan and financing is a clear indication of its mainstreaming, which is particularly sought for sustainable adaptation practices (Ayers et al. 2014a).

Public participation in plan execution Most of the plans we reviewed acknowledged public participation as an important part of the planning process (Huq and Khan 2006). However, public participation in plan execution has not been similarly emphasized. For example, Sultana and Thompson (2010) reported that public participation through local institutionalization was tried in some of the small-scale flood management projects, but with modest success. In addition, contemporary plans open space for the participation of nongovernment organizations in project implementation, creating individual project-based opportunities. However, broad-based public participation remains scarce because most plans have failed to design institutional structures suitable for encouraging local institutionalization (Alam et al. 2013; Rahman et al. 2012). For example, the first NAPA project failed to address the demands of vulnerable local communities and implemented the projects without consulting local communities (Ayers 2011, Bhuiyan 2015), which could further increase the vulnerability of these communities (see also Alam et al. 2013). This suggests that the implementing institutions may not be adequately decentralized in the national plans.

Policy implementation level: north-eastern floodplain of Bangladesh

Relatively little research has been conducted in the north-eastern floodplain of Bangladesh, and the area is underrepresented in national development plans (Rahman et al. 2018a). Hence, it is difficult to assess the influence of the plans on local sustainability in our study area. Based on the policy implementation assessment criteria (see Policy Implementation Level Section, Table 1 and Table 2), we assess local sustainability dimensions under the influences of the adaptation plans. A generalized interpretation of the plans against the selected policy implementation criteria (Tables 1 and 2) described in the Policy Implementation Level Section has been presented in Table 4.

Social dimension *Institutional flexibility*: The adaptation and development plans for the north-eastern floodplain face constraints mainly due to poor inter-institutional linkages. Institutional rigidity and a technocratic approach—two common properties of formal institutions in Bangladesh—likely result in a lack of acknowledgement of local, informal, or traditional resource management institutions. The north-eastern floodplain is home to diversified resource user groups, many of whom depend on common property resources for their subsistence activities (fishing, grazing grounds, wild edible food collection, etc.). Therefore, the longevity of these informal resource management institutions is essential, and considerable information on community needs in support of adaptation is likely available.

Policy support: The government has emphasized enhancement of local government capacity in support of local development (NPDM 2010). While local government has an important role to play in a democratic system, in reality, local government positions tend to be dominated by local elites in Bangladesh. In particular, the common property management policy of Bangladesh has facilitated their control of local natural resources, providing considerable potential for the misappropriation of resource-based adaptation interventions.

Table 4 Generalized assessment of plans against sustainability criteria

Policy implementation criteria	FAP	NAPA	BCCSAP	MPHA	NADP
Social dimension					
Institutional flexibility	−	−	−	−	+
Policy support	−	−	−	−	+
Knowledge sharing and organizing social network	−	−	+	−	+
Cultural acceptance	−	−	+	+	O
Economic dimension					
Reduce inequality	−	−	−	−	O
Reduce poverty and livelihood opportunity	−	+	+	+	O
Tenural security	NR	−	−	−	NR
Credit access	O	−	+	+	NR
Reduce dependency on expensive external inputs	O	−	+	−	NR
Environmental dimension					
Maintaining ecological integrity	O	−	−	−	NR
Maintaining biological and genetic diversity	NR	−	+	+	NR
Prevent land degradation	+	+	+	+	NR

Note: "+" has been given to indicate positive relation between a plan and a criterion, while "−" has been placed for a negative relation. "O" has been used to indicate where there is insufficient data to assess, while "NR" has been used when the criterion is not relevant to the plan

Knowledge sharing, process of social change and organizing social network: Government strategies in the development plans also indicate nonpragmatic approaches to community resilience building. For example, there are two projects suggested under the NAPA (2005) in the floodplain: the enhancement of potato cultivation as an adaptive agricultural practice, and alternative fishing practices, both of which are technology intensive. Interestingly, Anik and Khan (2012) and Pavel et al. (2014) reported that the floodplain communities had already adapted sixteen agricultural, fisheries and other livelihood techniques before the implementation of the projects, and that they should have been included in the plans. Notably, most of them are less technology intensive and more adaptive knowledge driven. Mismatches between practice and plan sub-project interventions suggest knowledge gaps and poorly networked formal and informal institutional systems. This issue was also highlighted by a subdistrict level fisheries officer from Tanguar *haor*,

> "We usually report to the higher-level authorities using a specific reporting format, which was developed long ago. We do not add any new information unless it is requested".

More explicitly, the NAPA (2005) emphasized the need for information channeling from top to bottom levels. This means that government agencies will develop adaptive technologies and disseminate them among the affected communities using their formal administrative system through development projects. However, opportunities for "bottom-up" information flow are absent under this plan. Likewise, the BCCSAP (2009) relies on externally developed adaptation technologies like structural solutions (e.g., river excavation and embankment building) to climate-induced flood stress and their implementation and dissemination, although it makes some provision for adaptation through scientific exploration like developing climate-resilient crop varieties. Further, in the MPHA (2012), the national government plans to use local government as the dissemination agencies for externally devised technologies, rather than using them as information-gathering agencies.

Cultural acceptance *Cultural acceptance*: While the north-eastern floodplain is ethnically diverse, none of the development plans made provision for the impact of culture on adaptation and social incorporation. These distinct ethnic communities have their own institutional structures and agricultural practices that are different from formal governance structures. Similarly, our primary data suggests that the plans lack enough sensitivity to gender issues. For example, a local community leader from Hakaluki *haor* stated that

> "Unlike the other parts of Bangladesh, you'll barely see women involved in income-generating activities in this region because this is not socially acceptable. People will rather starve than allow women family members to work outside".

In support of this observation, another key informant, who is a local government representative (*Union Parishad*) noted that

> "… women cannot be equally judged with men … their involvement in income-generating activities will reduce the efficiencies of men".

Both these statements indicate strong social and cultural opposition to pro-women sustainable adaptation actions. However, it is not clear from existing plans how these issues will be addressed.

Economic dimension *Reduce inequality*: The majority of people in the study area are characterized as being poor

based on their fixed asset ownership (MPHA 2012). In addition, the economic inclusion of women in the study area is very low, with most of their economic activities, like wild food collection, catching fish for household consumption and homestead gardening, having use value, but no formal market value. Reflecting this bias, none of the plans sought to institutionally manifest women as an economically functioning group, although the NAPA (2005) and MPHA (2012) did incorporate women in the planning process. This was also the situation for minority ethnic communities. Such formal planning oversights can further drive poverty, social–economic exclusion and inequity within local communities.

Reduce poverty and increase livelihood opportunity: The MPHA (2012) has adapted a number of strategies for reducing poverty through sectoral development (e.g., agriculture, fisheries, and livestock), however, it is highly dependent on the NAPA (2005) and BCCSAP (2009) for climate-sensitive livelihood activities. Importantly, neither of these national adaptation plans are focused on the north-eastern floodplain, with only two local adaptation projects under the NAPA (2005) and no specific project under the BCCSAP (2009) in the region. On the other hand, institutional and organizational structuring and specification are necessary for the development of capital assets (e.g., establishing training facilities for human capital development, scientific and innovative agricultural practice facilitation, and cross-community information channeling). Data collected through focus groups and interviews suggested that community members undertake collective action through small cooperatives, which facilitate their access to different government incentives, particularly for agricultural development. Notably, according to a regional level officer from the Department of Agriculture, most of these supports stem from national agricultural extension programs, which are not often sensitive to local climatic context.

Tenure security and credit access: According to the MPHA (2012), 48% of households completely depend either on sharecropping or work as agricultural laborers, arrangements that are managed through informal institutions. Fisheries tenure security is also unclear, with resource access often controlled by local elites. Because of clear property rights, many of these community members do not have access to formal credit sources. Consequently, community members remain dependent on informal lending organizations or individual money lenders for their financial capital, particularly for larger investments (e.g., fisheries) (Rahman et al. 2015).

Reduce dependency on external inputs *Reduce dependency on external inputs*: As previously mentioned, the NAPA (2005) conducted development projects in the floodplain. One of these projects involved the promotion of potato cultivation as an alternative agricultural practice. Potato is cultivated across Bangladesh during winter with the lowest production contribution coming from the north-eastern floodplain (Uddin et al. 2010). Per acre potato production is the lowest in this area because of unsuitable land properties, particularly in the wetlands (BBS 2014; Uddin et al. 2010). One key informant, who is a local level agriculture extension officer in Hakaluki *haor*, suggested that

> "Potato cultivation in this area is subjected to late blight disease because of foggy winter conditions, and winter rain is also not uncommon here. Thus, it requires extra costs for pesticides, which discourage the farmers from cultivating potato".

Ironically, by encouraging people to increase their use and dependence on external inputs, this plan exacerbates potential resource-use conflicts. On the other hand, the BCCSAP (2009) noted the expense of external inputs, yet still retained the concept of potato cultivation, arranging short-term credit access for potato cultivation to help farmers bear the costs through micro-credit. Alternatively, some farmers have innovated with alternative crops, particularly in Hakaluki, including kidney beans, mustard and coriander. One such farmers posited that:

> "I have 100 bighas (33 acres) of land, and I have allotted most of them for cultivating mustard, coriander, bean and cucumber because I can harvest these crops much earlier than others like rice. Furthermore, these crops are more profitable so I can easily buy rice for consumption".

Consistent with this observation the BCCSAP (2009) promoted locally-adapted crops and went further than the NAPA (2005). The MPHA (2012) also largely enhanced locally adapted technologies like cage fisheries and floating gardens.

Environmental dimension

Maintaining ecological integrity: Plans, including the NAPA (2005), BCCSAP (2009), and MPHA (2012) emphasize the expanded production of high-yielding crop varieties to support food security and local agricultural development (Hossain et al. 2006). However, our respondents suggested that these varieties are fertilizer intensive, while the impacts associated with this practice on the agro-ecosystems of the north-eastern floodplain area are under-researched. On the other hand, the establishment of embankments under the FAP caused considerable ecosystem disturbance for fisheries resources. Further, repairing

and reconstructing embankments were given priority in all the contemporary development plans without the need for environmental assessment.

Maintaining biological and genetic diversity: Many of our community key informants cautioned that the abundance and diversity of both wetland flora (e.g., wild edible plants) and fauna (e.g., fish and migratory birds) are declining, which is directly and indirectly linked to climate-related impacts like habitat quality loss and destruction due to irregular flood and rainfall, drought and siltation. In this region, the livelihoods of poorer fishers tend to be dependent on small and diversified fisheries that have been shown to be highly susceptible to climate change. Although the MPHA (2012) contains some ambitious interventions intended to conserve biodiversity (e.g., the establishment of fish sanctuaries and supporting wetlands co-management), one of our respondents noted that lease-based fisheries resource management system encourages the investors to overexploit the resource for profit maximization, which will likely undermine the effectiveness and efficiency of the MPHA (2012) (see also (Rahman et al. 2012; Rahman et al. 2015)).

Prevent land degradation: A particularly important natural feature associated with the floodplain is siltation, a common river hydrological scenario in Bangladesh (Mirza and Ericksen 1996). Prolonged flood periods cause an overload of silt that reduces river depths; while contamination of rivers from excessive use of chemical fertilizer and pesticide for the cultivation of high-yielding variety rice may reduce land and water quality. The NAPA (2005), BCCSAP (2009) and MPHA (2012) have provisions to reduce siltation and erosion problems by dredging, repairing and constructing embankments in critical areas.

Discussion and Conclusion

This paper assessed the national institutional responses to climate change and their implications for local sustainable adaptation in the north-eastern floodplain of Bangladesh using a combination of document analysis and primary data collection through focus group discussions and key respondent interviews. The results inform and extend discussions on sustainable adaptation from a polycentric institutional perspective. Findings suggest that the existing national adaptation plans in Bangladesh have resulted in considerable institutional reforms at various administrative levels in support of sustainable adaptation. It is evident that the reforms have been brought about by the government's incorporation of public participation in the planning and implementation processes. Eriksen and O'Brien (2007) and Agarwal et al. (2012) have argued that more decentralized planning processes operating through empowerment and capacity building in local communities and local governments will be necessary for improved adaptation action. In addition, Dovers and Hezri (2010) and Urwin and Jordan (2008) note the need for vertical integration of different institutional levels (from local to national and vice versa). However, in the context of Bangladesh, Ayres (2010) observed that the participatory adaptation decision-making processes are heavily biased by the power differentials among the participants. Our results additionally highlight that socio-economic inequality, along with power differentials, pose serious obstacles to the implementation of sustainable adaptation plans at local levels. As a result, following Dovers and Hezri (2010) and Raymond and Robinson (2013), we argue that institutional responses will not lead to sustainable adaptation outcomes in north-eastern Bangladesh without taking adequate account of locally-embedded adaptation decision-making and their effective implementation.

Our study area is dominated by wetland ecosystems that provide diverse livelihood opportunities for resident communities who belong to different social groups with differentiated socio-economic status (e.g., different ethnic, gender, religious, and professional groups). Within these social groups we found that the dynamics of excluding women and ethnic minorities from economic opportunities was generally driven by local values and interests. However, our policy analysis showed that there was no incentive or empowerment provided to these marginalized groups to become part of the local adaptation planning and implementation process. This observation was also reported in Sultana (2010) and Shabib and Khan (2014) stating that contemporary development plans (e.g., the NAPA (2005), BCCSAP (2009), and MPHA (2012)) poorly addressed gender issues, including discrimination. While local knowledge-based adaptation action is considered to be a useful way of developing sustainable adaptation actions (Dovers and Hezri 2010), we found that the existing national adaptation plans were mostly motivated by transformational or "truly new" techniques (Kates et al. 2012). Our analysis suggests that most of these interventions were technology and financial input intensive, which may further enhance socio-economic differentiation and inequities. In addition, technology intensive practices such as embankment building or the extensive use of fertilizer and pesticides, are sector specific and can cause significant negative externalities to local environments, people and economies. For example, the local communities in our study area largely depend on both wild flora and fauna (including fish) from the wetland ecosystems for livelihoods and dietary diversity, with "maladaptive" actions potentially raising policy challenges related to household food and nutrition security (Allison et al. 2009; Hickey et al. 2016).

While our data does not allow a systematic analysis of cross-scalar feedback interactions (Eriksen et al. 2011), it does suggest that sector-specific adaptation planning served to undermine sustainable adaptation in our study area. More broadly, our analysis suggests that national government responses may benefit from paying closer attention to the principles of sustainable adaptation, particularly by (i) ensuring that planning processes actively incorporate and empower community members in problem identification, decision-making and implementation; (ii) facilitating two-way information and knowledge flows among different communities and different modes of governance (e.g., local governance); (iii) detecting locally developed technologies and strategies and looking to out-scale (something already present in the MPHA (2012) but absent in other plans); (iv) beginning the process from local contexts in order to better navigate functioning political, cultural and social barriers; and (v) taking a multi-sectoral approach to ensure pragmatic and coherent implementation.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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