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Adaptation Tipping Points and Co-evolution of Community Engagement in Water-Centric Delta Development Pathway of Bangladesh

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Abstract

This research aims to inform how uncertain factors including community response have triggered adaptation tipping points in historical pathway of delta management in the southwest of Bangladesh. We applied the concept of Adaptation Tipping Points to analyze the co-evolution of community engagement and water management approaches in historical pathways specific to southwest Bangladesh since 1960. Results show that in addition to natural hazards and changing environmental conditions, adaptation tipping point result from new opportunities, donor influence, weak policy implementation and uncertain community response.

Keywords: *Adaptation, Tipping Point, Opportunity, Community, Response, Uncertainty*

Key Message

1. *ATPs have arisen not only from natural hazard and changing environmental conditions, but also from global discourse, new opportunity, donor influence, delayed or non-implementation of planned action and uncertain response of community.*

2. *In addition to factors that trigger an ATP, the factors targeted for countering ATP or tapping new opportunities play an important role in development oriented governance.*

3. *The uncertain community responses have manifested in the form of shifts in livelihood preference and social (un)acceptance for a water management intervention. The influence of uncertain community response in reaching ATPs are either constrained in top-down bureaucratic governance system or captured by social elite or indirect through donor influence.*

Introduction

With BDP 2100, Bangladesh is moving towards water centric adaptive delta management in recent years. The participatory approach to deal with uncertainty in community response is still under development. Historically, the delta development in Bangladesh has been dominated in water management sector. The management approach, strategies, policies, plans and projects have undergone transformational shifts in 1960s, 1990s, 2000s and 2010s. Each transition followed by shift or adjustment in institutional arrangement and assessment framework of problem identification, measure goal etc. The community engagement advanced along with the transition in water management. In 1960s, the water management have transformed from indigenous ecologically adapted temporary system to top-down techno centric structural system having no community engagement (Dewan, Mukherji et al. 2015). By 1990s, the water control approach shifted towards integrated flood mitigation and system rehabilitation including community engagement for empowerment. The participatory and integrated water resource management approach has been introduced for community engagement in Bangladesh around 2000s (Dewan, Buisson et al. 2014). Hence, historical analysis of factors that triggered an approach obsolete can inform insights to recent paradigm of adaptive delta management for dealing with those uncertain factors.

The term 'approach' in this research can be seen as a way of dealing with a situation or problem. Water management approaches are triggered by a range of physical and ecological, technical, economic, societal or political factors. Expressing uncertainties in terms of period that the existing strategy is effective through identification of adaptation tipping points (ATP)s have found to be useful for the policymaker (Kwadijk, Haasnoot et al. 2010). The ATP method originally developed in Netherlands to anticipate the future development of dynamic adaptive policy pathways (Kwadijk, Haasnoot et al. 2010). The method starts by identifying the general conditions under which a policy will fail referred to as the 'adaptation tipping point condition' and after these adaptation tipping points, additional or other policy actions are needed (Kwadijk, Haasnoot et al. 2010). The approach applied in analysis for exploring future uncertainties in water management strategies (Haasnoot, Schellekens et al. 2015), climate change adaptation (Kwadijk, Haasnoot et al. 2010) in Netherlands, flood risk management in Thames Estuary in UK (Lavery & Donovan, 2005) and western floodplain of Ganges in Bangladesh (Ahmed, Choudhury et al. 2017). All the above research was forward looking prospective studies to anticipate the future. An *ex-post* analysis to establish historical ATPs for the urban flood risk management in Bangladesh have applied the ATP method

(Ahmed, Gersonius et al. 2015). In this retrospective research, we applied the method for an *ex-post* analysis of historical ATPs in participatory water resource management in southwest region of Bangladesh.

The aim of this paper is to inform on how uncertain factors including community response have triggered ATP conditions in historical pathway of participatory water management in the southwest of Bangladesh since 1960s. For this, narratives of the general condition comprised of triggering factors have been developed. Then among other factors, the influence of uncertain community response manifested in livelihood preference and social acceptance of delta intervention has been illustrated.

Recent studies on Bangladesh and southwest coastal region have characterized the major shift in water resource management (Gain, Mondal et al. 2017), water governance (Chan, Roy et al. 2016), Integrated Water Resource Management (Rouillard, Benson et al. 2014), polder management (Nowreen, Jalal et al. 2014), Community Participation (Dewan, Mukherji et al. 2015), livelihood in southwest region (Bernier, Sultana et al. 2016). Literature suggest that conflicting livelihood preference i.e. rice and shrimp have triggered reverse embankment functionality (Ali 2006). The violent public cuts of embankment have shaped the emergence of Tidal River Management (TRM); that stemmed from inability of including 'local knowledge' in participatory water management (Nowreen, Jalal et al. 2014), Earlier studies have developed ground to re-emphasis on the role of (conflicting) livelihood preference and social (un)acceptance of water management intervention. Therefore in this research we focused on the influence of uncertain community response manifested in livelihood preference and social acceptance of water management intervention.

The remainder of this paper is structured as follows: the methods and material section introduces the ATP method; in the result section we describe the study area and present narratives; discussions and conclusion section illustrated the key learning and recommendation.

Methods and Material

To derive the internally coherent narratives, this research has examined available literature on evolution of water resource management, institutions, community engagement and livelihoods. The content analysis of relevant policy, plan, strategy and project documents has

been conducted. Literature, reports and insights from researchers meeting with policymaker, stakeholders and communities of different livelihood groups at the research areas formed the narratives.

ATP Method

ATPs defined as points where the magnitude of change is such that the current management strategy can no longer meet its objectives. Beyond the tipping points an alternative, adaptive, strategy is needed (Kwadijk, Haasnoot et al. 2010). ATPs might be reached due to physical and ecological, technical, economic, societal or political Causes (Kwadijk, Haasnoot et al. 2010). Example of physical boundary may shift of habitat due to sea level rise or salinity. The economic ATPs may arise due to lack of money either induced by large investment or by economic development. Society may change its values and norms, resulting in different objectives, which may cause an ATP or may shift the timing of an ATP (Offermans, Haasnoot et al. 2011). Political processes can make it unlikely to carry out a decision on time. Socio-economic development may either in combination with climate change and seas level or on itself result in earlier ATPs (Kwadijk, Haasnoot et al. 2010). The reasons for tipping point are that current policy became too expensive, technically impossible or socially unacceptable (Dewulf and Termeer 2015). The tipping point may also arise from condition that triggered new opportunities instead of adaptation to changing conditions. It is conceived that strategies and policies generally change gradually as it takes time to implement policy change. Sometimes the distinction between responses conceived as ‘significant revision’ and as an ‘incremental adjustment can be fuzzy and subjective.

For identification of past ATPs as like Ahmed, Gersonius et al. (2015) we considered the occurrence of transformational changes in management, policies and/or associated plans instead of merely the occurrence of incremental changes can be the key characteristics.

In this research, ATPs are taken as the point of reference where the approach in existing policies and/or plans are no longer sufficient and adjustments or alternative policies/plans have to be implemented. To identify ATPs in water management approach and interactions of factors the following two questions have been explored-

1. What was the approach and strategy of water management and community engagement?

2. What was the interaction among key factors triggering the above approach insufficient?

First, we focused to identify major approach and strategy of water management and community engagement. Secondly, we focused on the interactions of key global, political, economic, social and natural factors that triggered the above approach insufficient. The findings are consolidated to construct intrinsically coherent narratives. The narratives first explained the overall approach of strategy, policy, plan and projects in Bangladesh specific to southwest coastal zone; then focused on community engagement approach around that point; finally described the factors around that period for reaching ATPs (and countering ATPs, if any).

Results

The southwest coastal region of Bangladesh in the western Ganges delta constitute around 800 km^2 area and hosting around 10.2 million of population (Ahmed et al, 2017). This relatively flat, fertile plain lands are characterized by tidal dominated river system, streams and depressions (Nowreen, Jalal et al. 2014). Sundarbans, the world's largest continuous mangrove have immense protective and productive function. The river flow to the mangroves and the balance of freshwater and seawater has been modified with the upstream dam construction, construction of dyke and polders at the lower tidal plains and sea level rise. Around 43, often belongs to the first generation of total 145 polders are in this region (Ahmed et al, 2017). Figure 1 shows the southwest region with polders. The region faces an increasing number of challenges including cyclones, tidal surges, floods, drought, saline water intrusion, waterlogging, and land subsidence, which pose substantial threats to the livelihoods of the coastal community (Hossain, Dearing et al. 2016). Participatory water management approaches and strategies have been evolved historically to address this challenge.

Water management and community engagement approach

The identification and analysis of historical water management and community engagement approach in southwest coastal Bangladesh evident that a number of complex interacting factors triggered the approach insufficient and at the same time shape the counting approach or new opportunities. Table: 1 shows the participatory water management approach and key factors that trigger an ATP and counter that ATP. The relationships of interacting factors are described and analyzed at the narratives under each water management approach.

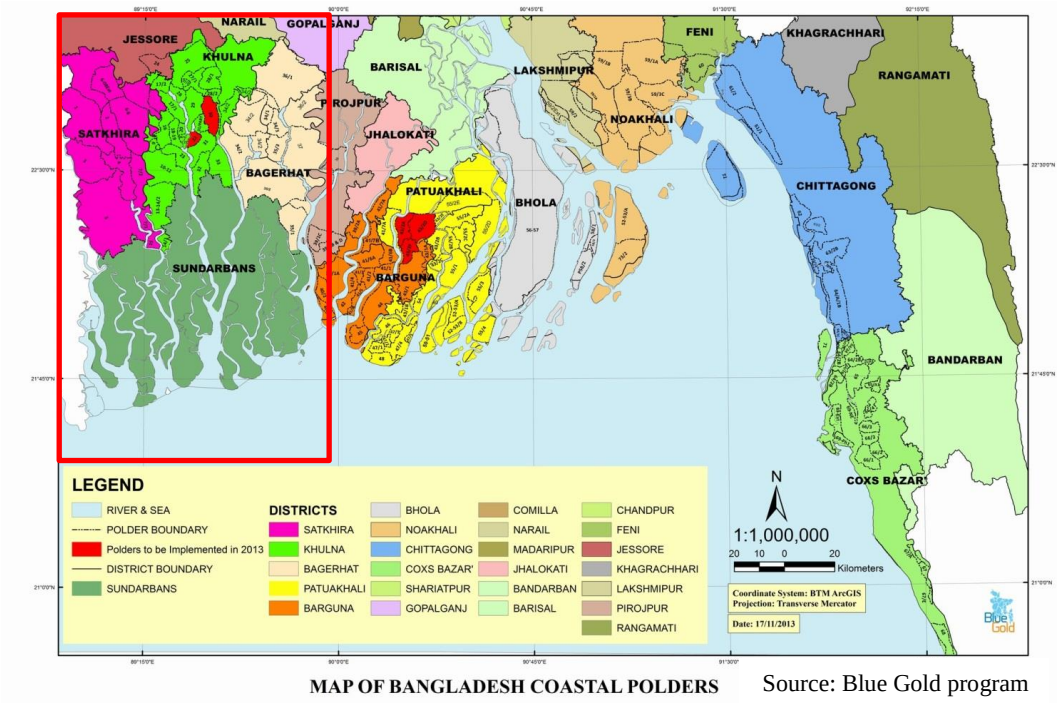

Figure 1: Southwest region with polders (marked in red box)

Indigenous adapted system, operated by local community (before 1960s)

In the indigenous system, the temporary earthen embankments allowed river water to enter into the flood plains in the monsoon, when the salinity is low. For rest of the year, the arable lands were protected from saline water with earthen embankment, low dyke, wooden sluice gates etc. This embankment called '*ostomashi badh'* or '*dosher badh'* allowed fertile silts to settle on the land thus kept river flowing. This approach brought good harvest in dry season and a variety of fish in the monsoon. This traditional river system management of local community had adapted with the natural process of tidal flooding, river erosion and sedimentation. These hundred years of experience and practice had evolved towards equilibrium ecology. This natural system benefited nourishment from sediment and regular flushing through tidal movement but also cost damage from disastrous flooding. The changing political context after partition of India in 1947, abolition of *Zamindari* system in 1956 stemmed uncertainty and gap in political leadership. The disastrous floods of 1954, 1955 and 1956 led the UN for 'Krug Mission Report'. The report recommended government for flood protection intervention and institutional reformation. At this point, the government opted for a centralized state water bureaucracy in 1959. The key factors for reaching ATPs include natural disaster, political situation and local management system while the factors for countering ATPs were new opportunities, funding and advice of donor, and global discourse for structural solution, grow more food.

Table 1: participatory water management approach and key factors

	Water management approach	**Key Factors** (Reaching ATP and countering ATPs/ new opportunities)
Before	Indigenous tidal basin management by local people and local administration	• Changing political context after partition of India • Abolition of *'Zamindari'* (local administration) system • Disastrous floods led crops and settlement damage • Need for flood control and agricultural development
1960s	Structural engineering based flood control by central bureaucracy without stakeholder consultation or participation	• Green revolution, grow more food • Donor policy advice and finance • Problem perceived as issue of 'construction infrastructure' • The technical solution of a developed delta, impose stability • Global oil and financial crisis • Shift in donor preference from financing 'mega-infrastructure'
1970s	Small scale structural and non- structural flood control involving local community	• Famine and independent • Need for rural employment and food production • Focus on food production neglecting other ecological services • Donor learning from projects with NGOs on social empowerment
1980s	Small scale structural and non- structural flood control including pro-poor participation with empowerment objective	• donor advice, knowledge and finance • International market, environment condition shifting livelihood • Upstream Ganges water diversion by India resulted low flow • Water congestion led public protest and cut • Environmental issues, loss of livelihood and living condition • Need for rehabilitation of structure • Floods damage, lack of multi-sectoral focus and public support
1990s	Integrated flood mitigation, system rehabilitation and formalizing community participation in maintenance of structure	• Global discourse of CBNRM , climate change, sustainability • Donor advice and finance, limited stakeholder consultation • Public protest against structural rehabilitation and public cut • Environmental issues from floods, cyclones, drainage congestion, shrimp farming, poor structure maintenance • Lack of funding, late or non- implementation • Need for a multi-sector, multi-agency long term planning
2000s	Integrated Water Resource Management, community participation for O&M and ' water Plus' approach	• Donor acknowledgement of local knowledge • Conflicting water structure management of rice and shrimp • loss of livelihood and living condition, anti-shrimp movement • Lack of funding, late or non- implementation • Limited shift in multiagency bureaucratic top-down system • Future uncertainty due to cc and socio-economic development • Adhoc short term intervention triggering 'lock in' • Need for integrated, adaptive long term delta planning and implementation approach
2010s	Long-term adaptive water-centric delta approach with participation at multipurpose cooperatives.	• Learning, research and preference • Climate change and socioeconomic development • Integration of funding with plan • Long term uncertainty

Centralized, Engineering mega- construction, no participation (1960s)

The centralized top-down techno centric water management system started with 'flood control' approach. Following the global discourse of supporting mega structure for water control and green revolution, large-scale investment in Flood Control Drainage (FCD) projects was initiated after adoption of a 20-year Water Master Plan in 1964. With the finance and policy advice of international aid agencies and financial institutes, entirely engineering based solution as an issue of 'infrastructure construction' was sought. The polders, an enclosure, system was introduced with permanent high earthen embankment to protect land from daily tidal inundation of saline water, monsoon rain and storm floods. Sluices allowed removing accumulated rainfall from the polders by gravity flow during low tide. Neither community management nor stakeholder involvement has detached the local knowledge of the ecology of this dynamic delta system (Dewan, Mukherji et al. 2015). Increasing rice production, specifically *Aman* in monsoon season, was the single objective to satisfy increasing national demand (Nowreen, Jalal et al. 2014). In terms of this objective, the polder system worked well for 10 to 15 years by significant increase in agricultural production mostly contributed from expansion of arable land. At the end of this period, the global oil and financial crisis led 'the financing of mega- projects infrastructure' less attractive for donors in 1970s.

The key factors reaching ATPs were global oil and financial crisis and changing environmental condition, political regime while the countering factors for ATPs were shaped by need for drainage improvement, irrigation for crop production and donor preference in small scale solution.

Small scale structural and non-structural solution, people's participation (1970s)

This approach characterized by quick implementation of small-scale flood control, drainage improvement, and irrigation scheme. Immediate after the famine in 1970 and independent in 1971, the donors, as like earlier, played key role in reshaping Bangladesh's water policy. IBRD report on land and water resource recommended low cost and labor-intensive small scale water projects, proposing the use of low lift pumps and tube-wells for surface and groundwater withdrawals (Gain, Mondal et al. 2017). The learning from *Comilla* cooperative model emerged in 'green revolution' and evaluation of EIP phase I stressed towards more attention to social equity and importance of including local stakeholders such as farmers and community members in water management (Dewan, Mukherji et al. 2015). Being linked with

empowerment NGOs involved in water projects, the focus on participation of poor, landless and women for empowerment has influenced by 'putting the last first' approach. Meanwhile, after completion of Farakka barrage in 1974, the diversion of Ganges water at upstream by India resulted low flow in the rivers of this region. The ill effect of the 'polder system' inspired from comparatively stable and developed delta to highly active delta was evident soon. As polder system prevented silt being deposited at land from river, the high rates of sedimentation resulting rivers and canals dried out and led to drainage congestion over a decade. The natural process of subsistence and compaction of land inside the polder and sediments in riverbeds have reversed the elevation to be ineffective the gravity flow of water. Above all, the change in regional hydro morphology resulted in disruption of river-floodplain connectivity; tidal amplification etc. This led to the loss of ecosystem services i.e fish breeding ground. Furthermore, the eastward shifting of Ganges and constant river erosion, leading to high cost to maintain the polders (Dewan, Mukherji et al. 2015). Learning concluded a need for planned development of water resources, comprehensive assessment of projects including social inclusion.

The natural disaster, changing environmental condition, political condition, funding constraint triggered the occurrence of ATPs while the counter ATPs were shaped with NGO influence on empowerment, updated knowledge and donor influence.

Small scale management, pro-poor community participation (1980s)

The water management approaches continue to small scale structural and nonstructural solution. The pro-poor community participation approach has been adapted for earthworks and poverty alleviation of targeting poor and landless. Multidisciplinary staff hired in the purely engineering based implementing agencies to integrate both technical and socio-economic expertise in project interventions in EIP phase II. However, a later evaluation suggests that the program was still unable to achieve its aim of social inclusion that results the central focus for EIP phase III and delta development projects. The pro-poor targeting as 'Landless Cooperative Societies' and 'Target groups' were created to incorporate the opinions of landless and marginalized. For the first attempts, people's participation was included in designing government infrastructure and direct contracts to carry out earthworks. The participation by the poorest was built on the acknowledgement of inherent power inequalities embedded in society 'as an end itself' where empowerment was an end (Dewan, Buisson et al. 2014). The management of water infrastructure was maintained by government–employed

gatekeepers called '*Khalashis*' and community were not responsible for this. The absence of regular and routine maintenance dredging coupled with low upstream flow and amplification of tidal influence embedded a vast volume of sediment-laden monsoon flood flows. The flooding, water logging, salinity progressively became worse classified as 'man-made disasters' coupled with major cyclone in 1985. A decrease in income, worsening of sanitation conditions, loss of livelihood, and problems in gaining access to residents' homes, agricultural land, and infrastructure facilities forced many people moved onto the embankment. At the same time, increased demand and high prices for shrimps on the international market and the resulted saline condition has motivated people specifically the large and absentee landholders to switch to intensive shrimp farming. The embankment construction focused on agricultural and economic gain turned into the environmental concerns of neglected distributional effect of costs and benefits. The investment possibilities for rehabilitating the land were sought by government involving international finance agency in 1984. The '*Beel Dakatia Andolon'* in 1989 raised the indigenous solution with 'public cut' for waterlogging and protested for further structural solution. Two consecutive floods in 1987 and 1988 brought into the need for integrated flood risk management through structural and non-structural measure derived by international donor that lack multi-sectorial focus and public support.

The natural disaster, changing environmental condition, non-implementation, funding constraint, inability to account the social voice and lack of public support triggered the occurrence of ATP while the counter ATP shaped with the global discourse, new opportunity, updated knowledge and donor influence.

Integrated flood mitigation, system rehabilitation, formalized participation (1900s)

Following the first five year study phase, the integrated approach for flood mitigation ranges from flood forecasting and warning system to high cost embankment put forward in coordination with donor agencies. In this period of military dictatorship, a radical departure towards participatory approach was resulted from the poor outcome of project evaluation, extensive debate and pressure from donors (Chadwick and Datta 1999). As part of global discourse of CBNRM, the community based water management approach became a mean to address the environmental issues with high donor preference and competent requirement for the projects. Thus, the external concept of CBNRM and 'community' participation imposed in the water management in such a way that does not reflect the local socio-ecological power dynamics (Dewan, Mukherji et al. 2015). Despite the idea of people participation high in

donor agenda the approach taken was fully depoliticized and disconnected from the issue of landless, power dynamics, and embedded social equality. Community as 'homogeneous group', free of internal politics and power dynamics, are neither practical nor feasible. This notion as 'representative of all stakeholders' has been forwarded in creation of water management organization. In contrast to the earlier practice, the participation was promoted by donors as 'means to an end', the end being involving communities for maintenance and upkeep of water infrastructures. The water management groups in continued system rehabilitation approach were ineffective, captured by social elite and short lived mainly due to quick and vast quantities, without being anchored in local institutions and social realities. While in presence of community participation mechanisms WMO, the structural engineering solution of KJDRP project faced strong public protest in favor of indigenous river basin management. In contrast to the favor of indigenous solution of local community, the KJDRP project (1994 -2002) has undertaken the structural solutions including construction of large regulations to counter drainage congestion. With strong social protest local people cut their embankment at *Beel Vaina* turned the 1000 hectare *Beel* into a tidal basin. This allowed sediment deposition, raised the land; remained functioning till 2001 has increased the cross section of the *Hari* river downstream. This public cut was milestone to the strong political message from local stakeholders to the project management to consider the opinion of the people better. It was also proved that (temporary) tidal basins could seriously benefit the *Hari* river and that expensive dredging and constructing a regulator in the *Gengrail* river would not be necessary. In response to this learning, EIA in 1998 concluded that "rotating basin" option was the best from an environmental perspective. Modelling suggested that the potential tidal basin did not need to be very large in order to maintain drainage of the *Hari* River. Meanwhile the global discourse of climate change started to reflect the local evident of climate change impact and adaptation need. Rapid horizontal expansion of shrimp farming through converting rice farms reversed the functionality of polders from 'preventing salt-water' to 'allow salt water'. Strong competition for the rapidly diminishing resource base heightened tensions and conflicts between sectors of society and created a volatile social situation. Funding constraint, non-implementation or delayed implementation results poor maintenance and embracing of the infrastructures. The existing plan and policies was criticized for their sectorial approach, focusing solely on the water resource development, neglecting the impact of other sector and not involving public opinion. At the current economic and political context it is unlikely to implement stand-alone responses for climate

change adaptation; thus strong advocacy was for mainstreaming adaptation with investment projects.

The natural disaster, changing environmental condition, non-implementation, funding constraint, conflicting livelihood preference of rice and shrimp, inability to account the social voice and social (un)acceptance triggered the occurrence of ATP while the counter ATP shaped with the global discourse, new opportunity, updated knowledge and donor influence.

Integrated Water Resource Management, O&M participation (2000s)

In line with the global concern of wise use and effective management of water, the strategies opted for the benefit of all users of all sectors. The focus was on the integrated development of water resource planning, management and coordination by a single authority among multi-sectors and multi-agency across ministries. Public participation was ensures at early stage of the process. The long term planning horizon for 15 years set as short term firm activity, medium term indicative plan and long term perspective plan, with an option of updating in each five years. This paradigm shift in water sector includes: *'Decentralized water management; cost sharing and cost recovery; private sector participation; community participation; non-traditional financing modality; regulation separated from supply; and new rights, obligation and accountability.' (*WARPO, 2001)

The global advocacy for mainstreaming climate change adaptation shaped the response of climate change implication in project implementation (NWMP, 2001), integrated coastal zone development strategy (ICZMP project, 2005), framework of adaptation (NAPA, 2005) and strategy to mainstream climate change adaptation within development project (BCCSAP, 2009). The community participation at all stage of project has made competent criteria for all projects with the Guideline for Participatory Water Management (GPWM). Participation defined in GPWM as an important process in which local stakeholders influence decisions concerning a water resource project/sub-project/scheme at all stage of project cycle. (MoWR 2001). Participation promoted as a mean of local stakeholder responsible for and cost-sharing of the minor maintenance, periodic repair and regular day to day operation. This approach of participation was a shift in terms of 'the state of the maintenance of infrastructure' from 'empowerment of community' or 'their voice in decision making'. During this period, the public protest and donor influence shaped the acknowledgment and adoption of indigenous river basin management in KJDRP project. This indigenous approach, later termed as Tidal

River Management (TRM) adopted and re-shaped in techno-centric management; decided (forced by public) for temporary basin opening at *Beel Kedaria* for around four years. The result was not as positive as *Beel Bhaina* but there was no sedimentation and drainage congestion in the *Hari* River whereas the sedimentation started after basin closing. But this example revealed the differentiated priorities among implementing agency, donors and local communities. The SSWRDSP and IPSWAM projects have piloted with dedicated objective, among others, to ensure community participation at all stages of water resource management and to transfer management responsibilities from implementing agency to local community. Dewan, et al (2014) observed in practice that the communities are rarely consulted on periodic maintenance e.g. where to excavate canals or repair the embankment. Moreover BWDB use external contractors rather than hiring local people, a practice seen as removing rural employment opportunities. The difficulty of incorporating local feedback revealed with inadequate technical solutions i.e an unsatisfactory number of regulators, placing regulators on private land, too low or weakly constructed embankments etc. The implementing agencies institutionalized community engagement i.e. local contact at sub-district level, permanent coordinating unit at headquarters but still suffered from flawed technical problems. Rather providing a high degree of citizen power i.e. to exert control in decision-making this arrangement seems to be near 'tokenism' (Dewan, et al., 2014). However the 'water-plus' approach that combined water management with micro-credit and income-sharing activities, a financial incentive perceived to facilitate the longevity and continuity of their WMOs proved popular. Two major Foods at 2004 and 2007, Cyclone *Sidr* in 2007 imposed a remarkable reconstruction and rehabilitation. The tidal surge *Aila* in 2009 has brought damage from breaching the embankments for long time. The anti-shrimp movement, along with the impact of *Aila*, production loss from shrimp has been resulted a number of farmers to grow rice again; has created demand for a more planned approach of livelihood optimizing the use of limited resources. In the meantime, funding constraint, delay/ non implementation of NWMP projects, limited shift in institutional culture and willingness of agencies across ministries has challenged the multi-agency, multi-sectoral approach. Meanwhile, the long term adaptive planning to address future uncertainties with respect to climate change and socio-economic development have been accepted as promising approach in developed delta context i.e. Netherlands, England. A number of studies evident that Bangladesh will be confronted with increasing flood risk, challenges regarding water quality, droughts and salinization due to climate change, increased land subsidence and socio-economic challenges. Hence need for an

integrated long term adaptive planning approach has been perceived to deal with such uncertainties, instead of only focusing on short-term 'trial and error' actions and projects.

The natural disaster, changing environmental condition, non-implementation, funding constraint, livelihood preference, inability to account the social voice, social (un)acceptance triggered the occurrence of ATP while the counter ATP shaped with the global discourse, new opportunity, updated knowledge and donor influence.

Adaptive delta management, participation as multipurpose cooperatives (2010s)

The long term strategy formulation has been embarked on the adaptive delta management approach. Taking into account the climate change and socioeconomic uncertainties into scenarios, the Bangladesh Delta plan 2100 has been formulated as a roadmap towards desired future in 2100. The Vision is to "*ensure long term water and food security, economic growth and environmental sustainability while effectively coping with natural disasters, climate change and other delta issues through robust, adaptive and integrated strategies, and equitable water governance."* The delta vision is indicating both priorities and challenges for future that can be translated into action in the present time integrating current plans and policies. The process ensured stakeholder consultation from the beginning of the formulation process.

The community engagement in project shaped by learning from earlier development and climate change adaptation projects that argued for assessment of vulnerability embedded in the heterogeneous socio-economic context of community. Build upon learning and practical workable approach in earlier projects, Blue gold project initiated as multi-sector, multi-agency, demand-driven and bottom-up approach in water resources management for some polders (Gain, Mondal et al. 2017). Explicit objective is to reduce poverty of the people in the coastal areas by enhanced productivity of crops, fisheries and livestock and increasing incomes by improved processing and marketing of agricultural products including value chain development. Along with the proper management of water and water infrastructures for creating an environment conducive of improved production, the programme paid more attention to the producers' cooperative as a driver for economic development (Gain, Mondal et al. 2017). Researcher's field insights in polder 30 revealed that the WMGs are active, engaged in economic and livelihood development, and hired as working labor in construction schemes. The construction activities i.e. site selection, regulator/gate size etc. are shared with

WMGs. The scope of including community feedback in the decision making of water structure (e.g., location of structure) is often attributed as somewhat limited in the top-down lengthy bureaucratic system. The local community expressed that a new gate has been constructed at a location where both inlet and outlet canals are silted up. Dredging required along with gate was limited that resulted poor improvement in drainage for that catchment. Insufficient maintenance, changing exogenous condition i.e. upstream development, climate change and endogenous functionality i.e. conflicting livelihoods resources, illegal occupation etc. have led to a substantial degree of malfunctioning of infrastructure.

Discussion and Conclusion

The results in the preceding sections in identification of ATPs at the water management approach can be summarized as indigenous tidal basin management approach, structural engineering based flood control approach, combination of structural and nonstructural flood mitigation approach, Integrated water resource management approach and long term adaptive delta management approach. The approaches of community engagement have been advanced with water management approach. The key approaches found are community driven, pro-poor participation for empowerment, participation for operation and maintenance and participation at multipurpose cooperatives as shown in Table 2 observed meaning of community engagement in participatory water management (in table 1). The decision making we referred in the process of infrastructure decision of implementing agencies.

Table 2: observed meaning of community engagement in participatory water management

Community engagement	Observed meaning
community-driven	Led by community as found in temporary embankment.
Pro-poor participation for empowerment	Ensure access of socially marginalized group in employment, empowerment and decision making
Participation for operation and maintenance (O&M)	Focus to ensure O&M and financial contribution rather employment, empowerment and decision making
Participation at multipurpose cooperatives	Focus to engage in economic and livelihood development based on vulnerability rather decision making

The factors in reaching ATPs specific to southwest coastal region of Bangladesh represent a complex interaction of nature, society and political context. Extreme events i.e. floods and cyclone are most influential factors through visible damage and delay of current development thus made the current approach obsolete, while the impact of slow natural process like salinity, waterlogging etc. lagged behind to attract policy decision. Apart from this natural hazards and processes, dynamic tidal processes like sedimentation, river erosion etc., being out of lens and focusing only 'flood control' have made the management approach inefficient physically. The fund constraint, late or non-implementation of projects, lock-in raised from short term interventions, institutional capacity and organizational culture are found as key factors that trigger an approach insufficient. The counter approach in deeming ATPs are mostly directed by global discourse, donor preference and updated knowledge. Community livelihood preference and community response made policy, plan and intervention unacceptable. While public consultation and community engagement processes in place does not necessarily imply that the communities have influence or their concern 'has been taken' into the decision making of water infrastructure management. Hence the community preference in decision making either constrained in top-down bureaucratic system or captured by social elite or indirect through donor influence. In summery the key findings are –

4. ATPs have arisen not only from natural hazard and changing environmental conditions, but also from global discourse, new opportunity, donor influence, delayed or non-implementation of planned action and uncertain response of community.

5. In addition to factors that trigger an ATP, the factors targeted for countering ATP or tapping new opportunities play an important role in development oriented governance.

6. The uncertain community responses have manifested in the form of shifts in livelihood preference and social (un)acceptance for a water management intervention. The influence of uncertain community response in reaching ATPs are either constrained in top-down bureaucratic governance system or captured by social elite or indirect through donor influence.

Last of all, it can be summarized that analysis of uncertain factors including community response that triggered ATP conditions in historical pathway can inform the new adaptive paradigm to deal with uncertainty. There is significant scope for improving the ability of new adaptive paradigm to deal with all the above uncertain factors. This is possible to define corrective actions that trigger a policy obsolete or new opportunity and thus can inform future

policies. This research also suggest that to get the full potentiality to embark with the adaptive management, the community engagement approaches need to be inclusive of local knowledge in decision making under uncertain future. Taking into consideration of local knowledge and livelihood preference of community may prevent uncertain community response, thus can improve social acceptance and ecological balance over time. Thus concluded for adaptive participatory approach, that is robust against future development of uncertain factors.

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Reference

Ahmed, F., B. Gersonius, W. Veerbeek, M. S. A. Khan and P. Wester (2015). "The role of extreme events in reaching adaptation tipping points: a case study of flood risk management in Dhaka, Bangladesh." Journal of Water and Climate Change **6**(4): 729-742.

Ahmed, Y., G. A. Choudhury and M. S. Ahmed (2017). "Strategy Formulation and Adaptation Pathways Generation for Sustainable Development of Western Floodplain of Ganges." Journal of Water Resource and Protection **9**: 663-691.

Ali, A. M. S. (2006). "Rice to shrimp: Land use/land cover changes and soil degradation in Southwestern Bangladesh." Land Use Policy **23**(4): 421-435.

Bernier, Q., P. Sultana, A. R. Bell and C. Ringler (2016). "Water management and livelihood choices in southwestern Bangladesh." Journal of Rural Studies **45**: 134-145.

Chadwick, M. and A. Datta (1999). "Water Resource Management in Bangladesh." A Policy Review.

Chan, N. W., R. Roy and B. C. Chaffin (2016). "Water governance in bangladesh: An evaluation of institutional and political context." Water **8**(9): 403.

Dewan, C., M.-C. Buisson and A. Mukherji (2014). "The imposition of participation? The case of participatory water management in coastal Bangladesh." Water Alternatives **7**(2).

Dewan, C., A. Mukherji and M.-C. Buisson (2015). "Evolution of water management in coastal Bangladesh: from temporary earthen embankments to depoliticized community-managed polders." Water International **40**(3): 401-416.

Dewulf, A. and C. Termeer (2015). "Governing the future? The potential of adaptive delta management to contribute to governance capabilities for dealing with the wicked problem of climate change adaptation." Journal of Water and Climate Change **6**(4): 759-771.

Gain, A. K., M. S. Mondal and R. Rahman (2017). "From Flood Control to Water Management: A Journey of Bangladesh towards Integrated Water Resources Management." Water **9**(1): 55.

Haasnoot, M., J. Schellekens, J. Beersma, H. Middelkoop and J. Kwadijk (2015). "Transient scenarios for robust climate change adaptation illustrated for water management in The Netherlands." Environmental research letters **10**(10): 105008.

Kwadijk, J. C., M. Haasnoot, J. P. Mulder, M. Hoogvliet, A. Jeuken, R. A. van der Krogt, N. G. van Oostrom, H. A. Schelfhout, E. H. van Velzen and H. van Waveren (2010). "Using adaptation

tipping points to prepare for climate change and sea level rise: a case study in the Netherlands." Wiley interdisciplinary reviews: climate change **1**(5): 729-740.

Lavery, S.& Donovan, B. (2005) FRM in the Thames Estuary looking ahead100years.Philos.Trans.R.Soc.A363(1831), 1455–1474.

MoWR (2001). Guidelines for participatory water management, Ministry of Water Resources, Government of Bangladesh.

MoWR (2005). Coastal Zone Policy, Ministry of Water and Resources, Government of Bangladesh

MoEF (2009). Bangladesh Climate Change Strategy and Action Plan (BCCSAP), Ministry of Environment and Forest, Government of Bangladesh

Nowreen, S., M. R. Jalal and M. Shah Alam Khan (2014). "Historical analysis of rationalizing South West coastal polders of Bangladesh." Water Policy **16**(2): 264.

Offermans, A., M. Haasnoot and P. Valkering (2011). "A method to explore social response for sustainable water management strategies under changing conditions." Sustainable development **19**(5): 312-324.

Rouillard, J. J., D. Benson and A. K. Gain (2014). "Evaluating IWRM implementation success: are water policies in Bangladesh enhancing adaptive capacity to climate change impacts?" International Journal of Water Resources Development **30**(3): 515-527.

WARPO (2001). National Water Management Plan: Volume 1—Summary, Water Resources Planning Organization, Government of Bangladesh.