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# Navigating water discord: a review of water conflicts in the common resource management system in coastal areas

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Water disputes are a prevalent global concern because of the scarcity of freshwater supplies and intricate interplay between hydrology, environment, and society. Water disputes can arise due to a variety of factors, including interests of stakeholders, allocation of resources, process of decision-making, power dynamics, and governance system. If left unresolved, these confrontations have the potential to escalate into acts of violence. This review focuses on the evolution and dynamics of local-level water conflicts that received limited attention but has significant impact on Community-Based Natural Resource Management, with a deep-dive focus on coastal Bangladesh. We examined the history of water management and causes and impacts of water conflicts in coastal polders from macro to micro scale along with identifying the strategies and approaches to eliminate water conflicts at local-level. The findings emphasize the need for stakeholder engagement, collaborative approaches, and improved water management strategies to mitigate conflicts and promote sustainable water resource management. The findings emphasize on the redistribution and decentralization of power and interest-based resource management system, collaborative approach and stakeholder engagement, a mix method approach presence of Irrigation Management Transfer, participatory irrigation management, transformative analysis, and improved water management strategies to mitigate conflicts and promote sustainable water resource management.

## KEYWORDS

water resources conflicts, water management, local level water conflicts, community-based natural resource management, coastal water governance, local level water management, sustainable water conflict resolution

## 1 Introduction

Globally, water holds an immense significance and is recognized as an essential natural asset ([Millennium Ecosystem Assessment, 2008](#)). However, the restricted supply of fresh water complicates the utilization and management of this resource. The management of this shared and collective natural resource is consistently challenging due to the interconnectedness of hydrology, ecology, and society within the context of limited water availability. This limitation poses a universal concern that often gives rise to conflicting situations among individuals, groups, institutions, and even nations, regarding the utilization, management, and accessibility of water ([Connor, 2015](#)).

Water conflicts worldwide arise as a result of disputes over land, rivers, forests, or rights to access natural resources. Conflicts initially arise as implicit and dormant conflicts, wherein

stakeholders and various groups may be unaware or fail to take action to address their decision-making processes or assert their rights (Antonio et al., 2019). However, if left unresolved, these conflicts can escalate into a state of manifest conflicts, and in some cases, even lead to violent events. Particularly concerning water resources, these issues become more critical and can occasionally result in conflicts (Heady, 1998). To address this crisis, global water management is experiencing unprecedented transformations (Tamas, 2003, p. 15). One such transition involves a shift away from centralized command and control methods towards decentralization through institutional reforms and the introduction of community involvement. This is achieved through the adoption of Community-Based Natural Resource Management (CBNRM) approaches, which empower communities as distinct social units to effectively manage natural resources (Shackleton and Campbell, 2001). While CBNRM initiatives in Africa have shown positive advancements, it is worth noting that they are not universally regarded as successful, as the process is intricate and the path to achieving successful CBNRM is not straightforward (Shackleton and Campbell, 2001). Similarly, the experience of community-based water management in Asia has been marked by numerous failures, with only a few success stories, as highlighted by Mukherji et al. (2009). In response to this, the government of Bangladesh has undertaken several initiatives, including the implementation of participatory-based water management guidelines. Supported by this participatory approach, the government has established various institutions such as the Ministry of Water Resources (MoWR), the National Water Resources Council (NWRC), the Bangladesh Water Development Board (BWDB), the Water Resources Planning Organization (WARPO), and the Local Government Engineering Department (LGED), among others, to manage its water resources (Dewan et al., 2014; Dewan, 2012). They have also implemented nationwide macro-level water resources planning through a combination of structural (engineering) and non-structural approaches. This includes activities such as embankment construction, operation and maintenance (O&M) of water control structures like embankments, polders, and sluices, as well as dredging and re-excavation of rivers/canals, land reclamation, and river training, among others (Blue Gold, 2021).

Although water conflicts and management issues occur globally, the focus of this review is specifically on the coastal context of Bangladesh. This coastal region serves as a distinctive example, as it grapples with the challenges of salinity issues and freshwater scarcity (Abdullah et al., 2017). Furthermore, the higher water-related authorities in Bangladesh have weak or non-existent connections with other government ministries (such as agriculture, fishery, environment, and forestry) and with local water consumers, particularly in terms of project planning, implementation, infrastructure development, and policymaking (Chan et al., 2016). As a consequence, water resource management in the coastal areas of Bangladesh suffers from mismanagement, persistent crises, and increased vulnerability to natural disasters and upstream diversion. These factors hinder the ability to meet the water demands of a rapidly growing population, as well as the subsequent expansion of agriculture and industry (Homer-Dixon, 1994). Additionally, the seasonality of water availability poses numerous challenges, with an abundance of fresh water during the monsoon season (June to October) and scarcity during the early summer months (December to May) (Rahman et al., 2022). This situation is influenced by the impact of trans-boundary rivers, as most

of the major rivers are shared with either India (54 rivers) or Myanmar (3 rivers) (Khalequzzaman, 2019). Moreover, the complexity of the local water management system is amplified by water-dependent livelihoods with seasonal variations and the existence of numerous illegally possessed water bodies (Antonio et al., 2019).

While there is much discussion on the water crisis and trans-boundary water sharing issues, there has been limited reviewed documentation on local-level water management, despite its significant impact on the local economy and people's well-being. In this review paper, amidst the numerous challenges of water management, we specifically concentrate on local-level water conflicts, which have received minimal attention from previous scholars. We contend that water conflicts, spanning from macro to micro levels, have undermined investments and excluded a significant portion of the community from community-based local-level water management. Therefore, this study seeks to answer the central research question: *"How can local level water conflicts in Bangladesh, influenced by governance, resource allocation, and community participation, be understood and addressed through effective strategies and approaches?"* The study evaluates water conflicts by examining shifts in water management and governance, potential influencing factors, as well as exploring potential strategies and approaches to address water conflicts at the community level.

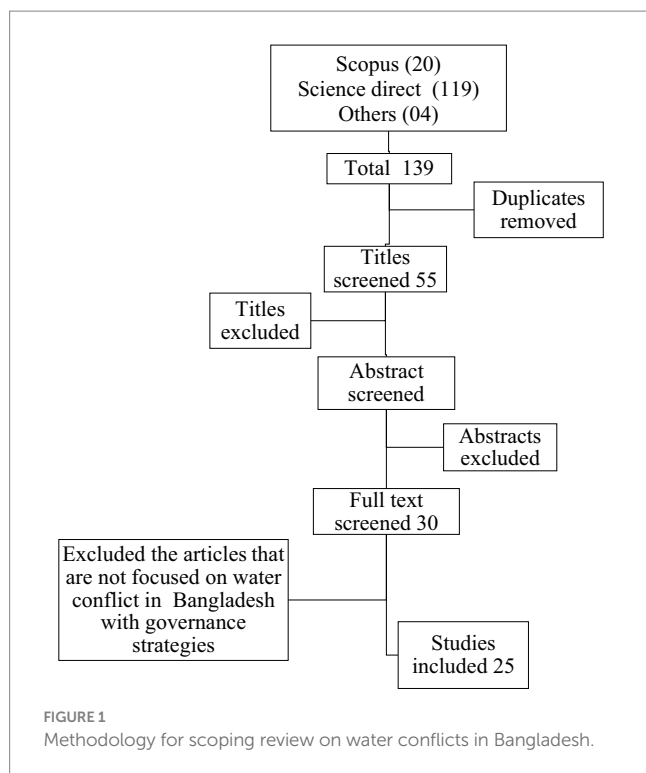
## 2 Methods

The methodology employed in this scoping review involved a multi-step approach to address the research question. A systematic search strategy was devised, encompassing four databases - Scopus, Science direct, and online government report/MSc/PhD thesis from 1995 to 2023, with a focus only on English language publications. Keywords were "Water conflicts," "Bangladesh." Searches were conducted covering titles, abstracts, and keywords, with further exploration of reference lists for additional citations. Inclusion criteria encompassed the literature on water management and conflicts, with a particular emphasis on conflict management and mitigation aspects.

Data were managed using Mendeley for citations and excel for full-text articles, with pertinent information extracted. Out of 139 initially identified articles and reports, 55 were selected following duplicate removal, title and abstract screening, and the articles that are not focused on water conflict in Bangladesh with governance strategies aligning with the research question (Figure 1). The collated data underwent synthesis and summarization to highlight findings and research gaps, particularly within the local water sector.

## 3 Conflicts in water resources management: global to local context

The conflicts diverse geographical regions and involve a range of stakeholders, including countries, communities, farmers, indigenous groups, and marginalized populations (Table 1). The drivers of these conflicts vary from economic development and population growth to environmental factors, power dynamics, and political controversies. Each case study sheds light on specific water-related conflicts, such as transboundary water sharing, irrigation-induced salinity, land use disputes, and the impact of climate change on water resources.



Water resource conflicts typically begin as implicit and latent disputes among stakeholders and different groups, remaining unresolved until action is taken to assert rights and make decisions. However, if left unaddressed, these conflicts can escalate into manifest conflicts and, in some cases, even result in violence (Antonio et al., 2019).

A significant portion of the Earth's land surface, approximately more than 45%, is located within international river basins, and there are numerous transboundary groundwater aquifers (Wolf et al., 1999). This distribution of water resources across borders has the potential to be a source of conflict among riparian states, as evident in conflicts (Homer-Dixon, 1994), such as the Jordan River Water Sharing, Transboundary water use in the Nile River Basin, and Water Management in the Murray-Darling Basin (Abel et al., 2016; Jury and Vaux, 2007; Merem et al., 2020). The transboundary water issues between India and Bangladesh also have an impact on the coastal region of Bangladesh, where a multitude of challenges arise due to climate change. These challenges include salinity intrusion, deltaic sedimentation, and water scarcity, which are further intensified by the backwater flow effect caused by low stream flow from upstream rivers (Baten and Titumir, 2016). Consequently, the local-level water management system within the coastal regions, particularly the southwest coastal region of Bangladesh, is significantly impacted, leading to conflicts among stakeholders (Baten and Titumir, 2016; Chowdhury, 2010). Disputes and conflicts exist among various local stakeholders and government institutions, including local farmers, shrimp-field owners, landless people, civil society organizations, daily-wage workers, NGOs, and local government bodies such as Union Parishads, Upazillas, and district administrations, as highlighted by Talchabhadel et al. (2021). With the stream splitting up, farmers from different areas would alternately construct and destroy temporary bunds to gain access to water. As rainfall declined, water crises

increased, leading to fierce conflicts between farmers (Sultana and Thompson, 2017). Another case study by Mutahara (2018) discussed the issues surrounding Tidal River Management (TRM) in Bangladesh, where conflicts grew over time between 1990 and 2014. In Bangladesh, the nature of disputes between the community and management authorities underwent changes over time, shifting in magnitude and form. However, subsequent years witnessed a transformation, giving rise to conflicts between farmers and fishers from 1995, landowners and management authorities from 2000, and landowners and her owners from 2005 to 2014 (Pokrant, 2014). While conflicts between agriculture and shrimp farming in coastal Bangladesh are well-documented (Mushed, 2008), additional conflicts emerge among various user groups characterized by their livelihood types or geographical locations. Furthermore, conflicts can result from the implementation of different water management projects (Mushed, 2008), controlling over water structures (e.g., drainage canals or sluices) driven by local power dynamics (Mushed, 2008). These conflicts contribute to water insecurity for specific groups of people, further exacerbating the challenges faced. These examples illustrate the complexities and ramifications of water resource conflicts, emphasizing the need for effective management strategies, stakeholder engagement, and collaborative approaches to mitigate conflicts and promote sustainable water resource management (Iglesias et al., 2007).

## 4 Coastal Bangladesh: history of water management and water conflict

### 4.1 Shifts in water management and governance

Water management has been a prominent issue since ancient times, with evidence of water dams being constructed by Jordan and Egypt as early as 3,000–2,600 BC for water management purposes (Bansil, 2004). Throughout history, water has been recognized as a valuable resource and managed accordingly worldwide. In countries like India, water is often referred to as “liquid gold,” particularly in arid regions (Bansil, 2004). Bangladesh, being highly vulnerable to climate change due to its densely populated delta region, has also focused on water management. Significant public investments have been made since the 1960s to build water management infrastructure, such as embankments, to protect the land and people from floods, tides, and storms. Additionally, there is a history of informal collective action in water management within the country (Duyne, 1998). Since the early 1990s, Bangladesh has embraced participatory approaches to surface water management. The 1999 National Water Policy emphasized inclusive water management, and the Guideline for Participatory Water Management (GPWM) provided impetus to the participatory water management system in coastal Bangladesh (Blue Gold, 2021). Subsequently, best practices from the Bangladesh Water Development Board (BWDB) and the Local Government Engineering Department (LGED) were consolidated and formalized in a participation guideline for all publicly funded water resource projects (Dewan et al., 2015; Dewan, 2012; Blue Gold, 2021). Projects like the Blue Gold Project in 2016, working in 14 coastal polders with 339 water management groups organized into 31 associations, and the IPSWAM initiative in 2004 exemplify these efforts. However, Bernier et al. (2016) found that water timing and release often rely on local elites, who may require

TABLE 1 Synthesis of global water conflicts: a multifaceted analysis from various global basins.

Water associated conflict	Study area	Stakeholders involved	Victim	Associated drivers	Recommendation	Reference
Law of the River and Reservoir Operating system of Colorado River	Colorado River Basin	American Southwest States and Indigenous people	Indigenous People	Historical inequities, climate change, multitude of end users, growing demand of western city developments	Alternative reservoir operating rules to address the issue, design operating rules that prioritizes stakeholders' demand	<a href="#">Abboud et al. (2022)</a>
Colorado River Compact, Water inequality and Environmental Injustice	Sun Juan Basin of Colorado River	Navajo Nation and New Mexico	Communities of Color, Indigenous people	Settler Colonialism, historical segregation, unequal infrastructure funding	Equal funding opportunity, collaboration in decision-making	<a href="#">Bray (2021)</a>
Tigris-Euphrates Basin Water Conflict	The Euphrates-Tigris Basin	Turkey, Syria and Iraq	Kurdish tribe, local Farmers	political confrontation and rivalry, increase demand for water, Infrastructure: Southeastern Anatolia Project (GAP)	Joint security mechanism, developing new water governance principles, joint institutions and collaboration	<a href="#">Kibaroglu and Sayan (2021)</a>
Teesta water Dispute	Teesta River Basin	India and Bangladesh	Lower Riparian people of Bangladesh especially farmers	Diplomatic uncertainty, power asymmetry	Regional cooperation, proper implication of the 'Treaty'	<a href="#">Mahmud et al. (2021)</a>
Tidal River Management (TRM) Compensation	Bangladesh	Farmers, landless people, daily-wage workers, shrimp-field owners, NGOs, local organization, Government bodies	Landless farmers, poor fishermen	Not mentioned	Multiple-stakeholders-based inclusive planning, operation-management practice	<a href="#">Talchabhadel et al. (2021)</a>
Aquaculture vs. Agriculture issues	Bangladesh coastal areas	LG, shrimp farmer, agro farming group, households, fishermen,	Poor households, small farmers	Competition, poor governance, trans-boundary natural resource dynamics, power dynamics	Resource-sharing agreements and joint institutions, proper land use zoning over risk assessments, adaptation framework, strengthening capacity of civil society, supporting livelihoods through management of biophysical attribute	<a href="#">Abdullah et al. (2017)</a> , <a href="#">Faruque (2009)</a> , <a href="#">Mozahedy (2011)</a> , <a href="#">Mushed (2008)</a>
Transboundary Water Use in Nile River Basin	Nile Basin	Egypt, Sudan, Eritrea, Uganda, Tanzania, Kenya, Rwanda, Burundi, and the Democratic Republic of Congo	Inhabitants of Koka reservoir	Religious controversies, rapid increments in population, pollution, environmental elements	Reform current policies, adoption of water conservation strategies, collaboration, education promotion	<a href="#">Merem et al. (2020)</a>
Ganges water dispute	The Ganges water basin	India and Bangladesh	Local farmer of Bangladesh	Diplomatic uncertainty, power asymmetry	Regional cooperation, actual implication of the 'Treaty'	<a href="#">Rahman et al. (2019)</a>

(Continued)

TABLE 1 (Continued)

Water associated conflict	Study area	Stakeholders involved	Victim	Associated drivers	Recommendation	Reference
Local level water management conflict	The Khulna-Jessore Drainage Rehabilitation Project, Bangladesh	Local stakeholders, LGIs, NGOs, BWDB, IWM, CEGIS, Ministry of Water resources (MoWR), Community groups	Small and marginal farmers, landowners, villagers	Power relationship, political groups, corruption,	Modification of management planning projects, social learning in adaptive delta management	<a href="#">Mutahara (2018)</a>
Water Management in Murray-Darling Basin	Murray-Darling Basin	Farmers, indigenous peoples, mining, environmentalists, tourism, urban use	Not mentioned	Overlapping interests, responsibilities, and powers	Development of multiple stakeholder-specific adaptation pathways	<a href="#">Abel et al. (2016)</a>
Jordan River Water Sharing	The Jordan River Basin	Lebanon, Syria, Israel, Jordan, Palestine	Farmers	Economic development	Water allocation according to economic value, minimizing the costs and disruptions, treaty governing water use	<a href="#">Jury and Vaux (2007)</a>
Se San River Basin	Vietnam's Yali Falls Dam	Cambodia and Vietnam	Indigenous communities	Power plays	Rethinking relationship between the river basin commission and the riparian actor	<a href="#">Hirsch and Wyatt (2004)</a>
The Aral Sea Basin Crisis	Aral Sea Basin	Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan	Disadvantaged poor	Unsustainable irrigation schemes, economic crisis, climate change	Cooperative and streamlined initiatives at the local, national, regional, and international levels	<a href="#">Peachey (2004)</a>
Euphrates-Tigris Basin Water conflict	The Euphrates-Tigris Basin	Iraq, Syria, Turkey	Marsh Arabs, Turkish farmers	Population rise, external influences,	Awareness, multisectoral partnerships, formal agreements	<a href="#">El-Fadel et al. (2000)</a>
Irrigation-Induced Salinity in the Colorado River Basin	Colorado River Basin	US, Mexico	Farmers	Technical complexities, political force	Solution to shift incentives so as to discourage excess salt discharges	<a href="#">Oyarzabal-Tamargo and Young (1977)</a>
Transboundary development in the Tijuana river valley	Tijuana River Valley	US, Mexico	Indigenous groups, farmers, fisherman, low-income urban residents.	Pollution, politics,	Enactment of environmental legislation	<a href="#">Dedina (1995)</a>

payments, leading to the diversion of water for their interests. This can result in reduced water availability during the dry season, affecting crops or fisheries in other parts of the system.

## 4.2 Evolvement of water conflicts

Most of the water conflicts study in Bangladesh focuses on transboundary and local water conflicts, addressing governance challenges and resource allocation issues (see [Table 2](#)). Notable examples include the Teesta water dispute ([Mahmud et al., 2021](#)), Farakka Barrage conflict ([Sood and Mathukumalli, 2011](#)), local level water conflicts ([Hasan, 2022](#); [Parven and Hasan, 2018](#)). These articles emphasize the necessity of strengthening bilateral treaties and establishing water-user committees to address regional disputes effectively. On the other hand, some of the articles captured coastal

Bangladesh water management domain focusing on socio-environmental challenges in managing coastal resources, including salinity intrusion and competition between shrimp farming and rice cultivation ([Huq and Easher, 2021](#)). Policy implications emphasize the integration of salinity management into national plans and the diversification of crops to build resilience in affected communities. [Dewan et al. \(2014\)](#) and [Nath et al. \(2022\)](#) captured community-based approaches, exploring participatory governance framework that empower local stakeholders and marginalized groups. These studies demonstrate the success of inclusive approaches in resolving water conflicts and propose mainstreaming such frameworks into national policies in Bangladesh.

In Bangladesh, water-related conflicts are indeed dynamic, much like the management of water resources, with a particular prevalence in the coastal areas, emanating from both macro and micro-level issues ([Pahl-Wostl, 2015](#)). At the macro level, these conflicts first



TABLE 2 Comprehensive overview water conflicts, water management challenges and governance strategies in Bangladesh.

Domain	No. of articles	Key references	Water-related conflicts	Focus summary	Policy implications
Water conflict studies	6	Mahmud et al. (2021), Chowdhury (2010), Sood and Mathukumalli (2011), Rahman et al. (2019), Parven and Hasan (2018)	Teesta and Ganges disputes; irrigation vs. fisheries conflicts; transboundary disputes between India and Bangladesh etc.	The papers primarily address transboundary and local water conflicts, focusing on governance, resource allocation, and conflict resolution between stakeholders like farmers, governments, and nations.	Strengthen bilateral and multilateral water-sharing treaties; Strengthen water-user committees to address regional resource sharing.
Water management/use challenges	9	Huq and Easher (2021), Sultana and Thompson (2017), Mutahara (2018), Hoanh et al. (2006), Dewan et al. (2014), Naz and Buisson (2015), Pokrant (2014), Ziaul and Akter (2018)	Shrimp vs. Agriculture disputes; upstream vs. downstream, waterlogging due to embankment failures; sluice gate operation conflicts, Conflicts over land use,	These papers explore challenges in coastal water management, including salinity intrusion, resource competition (e.g., shrimp vs. rice farming), and governance issues in maintaining coastal polders and livelihoods.	Integrate salinity intrusion management into national coastal development; Support localized crop diversification to adapt to salinity and climate pressures.
Governance strategies	10	Dewan et al. (2014), Talchabhadel et al. (2021), Mutahara et al. (2019), Dewan et al. (2015), Hasan (2022), Mushed (2008), Murshed-e-Jahan et al. (2014), Nath et al. (2022), Sultana et al. (2019)	Mismanagement in TRM projects; disputes over community resource (water) allocation, institutional conflicts	The articles emphasize participatory approaches to water governance, highlighting community involvement, stakeholder collaboration, and inclusive frameworks to resolve conflicts and enhance sustainability.	Mainstream participatory governance frameworks into national policies; Empower local governments and NGOs to act as mediators in resource-sharing conflicts; Ensure that marginalized groups are represented in decision-making.

emerge in relation to polder creation, the blocking of natural water flows, siltation, upstream intervention, and issues with structures such as the Farakka Dam (Roy, 2021). On the micro level, conflicts are often instigated by local actors, including political leaders and land grabbers, for personal or political gain, weakness in local governance structures, overlapping activities and jurisdictions among different institutions (Murshed-e-Jahan et al., 2014; Nath et al., 2020; Sultana et al., 2019). However, the creation of polders has contributed to an increase in these unpleasant water-related events (Nath et al., 2020) describes significant changes in livelihood strategies and practices since the establishment of polders, especially in the agriculture and fisheries sectors. The presence of numerous unplanned inlets into the polders has resulted in an elevated flow of salinity. Consequently, a significant portion of land use has shifted from agriculture and other natural resources (such as live vegetation, char<sup>1</sup> land, khas<sup>2</sup> land, etc.) to aquaculture (Nath et al., 2020). Most conflicts in Bangladesh,

particularly those related to resources, arise from water or aquatic resources (Sultana et al., 2019). Nath et al. (2020) alienate and identify certain instigators (e.g., political leaders, land grabbers, local administrations, and officers) responsible for creating conflicts within polders. Marschke (2012) discusses coastal conflicts, highlighting that the coastal region's diversity attracts various interest groups, leading to competition for water-based resources. The weakness of government and local institutions contributes to the emergence of latent water conflicts. Numerous studies have also focused on transboundary water issues, as conflicts in this regard have persisted since the country's inception (Parven and Hasan, 2018). Conflicts with India and Myanmar serve as notable examples of trans-boundary water conflicts (Parven and Hasan, 2018). The occurrence of conflicts in a particular area depends on factors such as resource control and usage, relationships among stakeholders and user groups, and the governance institutions that exist (Murshed-e-Jahan et al., 2014). Access rights to water resources are a crucial factor contributing to conflicts in Bangladesh. Furthermore, the lack of regulations on local-level conflicts during project design and implementation serves as a complex aspect behind conflicts. The absence of effective formal structures for water management and, more importantly, conflict resolution bodies, along with limited coordination and overlapping activities and jurisdictions among different institutions, can further fuel water conflicts. Additionally, victims of conflicts sometimes

1 The term "Char" is often used in various nomenclatures to denote sedimentary islands found within river floodplains.

2 The term "Khas land" pertains to land that is under the direct jurisdiction and supervision of the government. The definition of Khas land may be found in section 2(15) of the (Law of Bangladesh, 1950).

struggle to identify the appropriate authorities to address their issues for resolution, as mandated by law.

### 5 Causes of water conflicts in coastal Bangladesh

Water conflicts worldwide have been predominantly driven by disputes over land, rivers, forests, and rights to access natural resources (Antonio et al., 2019). Extensive research conducted globally has identified the main drivers of natural resource-based conflicts, particularly in the context of water conflicts. These drivers include sociopolitical and socioeconomic influences on operations, lack of transparency, diplomatic complexities, rapid and imbalanced land use and land cover changes, and competitive use of water resources (Sultana et al., 2019). The evolution of water conflicts in coastal Bangladesh reflects shifts in governance and resource management practices over the time (see Table 3). In the past, localized, community-based water management was able to minimize conflicts due to reliance on natural flows (Dewan, 2012). Later on, introduced centralized, large-scale projects like the 1964 Master Plan, leading to disputes such as the Teesta and Ganges conflicts over resource

allocation and land-use changes between shrimp and rice farmers (Mahmud et al., 2021; Chowdhury, 2010; Rahman et al., 2019). In the Participatory Era, decentralized policies like the 2001 Guidelines for Participatory Water Management sought to empower local communities but faced challenges, including mismanagement in TRM projects and resource allocation conflicts in participatory frameworks (Nath et al., 2022; Huq and Easher, 2021).

In the specific case of Bangladesh, researchers such as Abdullah et al. (2017) and Mushed (2008) have highlighted extensive shrimp farming, conflicting roles and unhealthy incentives among actors and stakeholders, and weak coastal infrastructures as major drivers of local-level water conflicts. Additionally, Sultana et al. (2019) have identified access disputes, power dynamics, environmental factors, and institutional settings as significant contributors to social unrest in coastal areas of Bangladesh (see Figure 1). It is noteworthy that while climatic issues are being partially addressed, other factors remain unresolved. Approximately 11% (over 17 million) of the country's population is engaged in fisheries, while the agricultural sector, which employs 51.88% of the labor force, contributes 14% to the GDP. Additionally, around 24% of the land is classified as khas water bodies, with about 2 million hectares of khas land. Unfortunately, most of these water bodies have been illegally occupied by influential

TABLE 3 Chronological evolution of water management policies, practices, and conflicts in coastal Bangladesh.

Era	Time period	Policy/framework formation	Change in practice level	Remarks	Examples of conflicts
Ancient to British Era	Before 1947	Zamindari system	Indigenous, community-based water management.	Informal, localized water management using traditional methods.	Limited conflicts due to reliance on natural water flow and minimal infrastructural interventions.
Post-British Era	1947–1999	1964 Master Plan; National Water Policy (1999), Delta Development Project (1995).	Shift from indigenous systems to mega structural projects; Transition from mega structures to smaller, localized projects; Focus transitioned to maintaining and rehabilitating existing structures instead of initiating new large-scale projects	Introduction of centralized water management focusing on flood control; Increasing emphasis on regional adaptations in water management; Policies aimed at long-term resource sustainability and deferred maintenance.	Rising disputes over resource allocation between upstream and downstream regions (e.g., Teesta and Ganges conflicts) (Mahmud et al., 2021; Rahman et al., 2019). Conflicts between farmers and shrimp farmers due to land-use changes in coastal regions (Hasan, 2022; Chowdhury, 2010). Disputes over irrigation versus fisheries in shared water systems (Mushed, 2008).
Participatory Era	2000–2022	Guidelines for Participatory Water Management (2001); National Water Management Plan (2004); Coastal Zone Policy (2005); Water Act (2013); Delta Development Plan (2018).	Participatory water management through initiatives like Integrated Planning for Sustainable Water Management (2003–2011), Blue Gold Project (from 2013 to 2021).	Enhanced focus on decentralization, involving communities in water management.	Mismanagement in TRM projects causing conflicts between technocrats and local stakeholders (Nath et al., 2022). Conflicts over resource allocation in participatory frameworks; shrimp vs. rice farming disputes (Huq and Easher, 2021).

individuals, leaving only 5% of the water bodies leased to vulnerable groups (Antonio et al., 2019).

## 6 Ways to address water conflict at local stage

There is significant potential for progress in improving water management strategies to ensure efficient and conflict-free water use within communities. These strategies can encompass technical approaches such as irrigation scheduling, integrated water resource management, and conjunctive management of groundwater and surface water (see Table 4). They can also involve institutional aspects such as establishing appropriate institutions with defined responsibilities and activities, taking into account economic and political considerations. Additionally, a social approach focusing on changing behavioral patterns related to water use and management is crucial. The success of these strategies relies heavily on the active involvement of stakeholders in their development and implementation (Jury and Vaux, 2007).

In order to address local water issues, it is important to emphasize improved crop rotations and the decentralization of technologies and techniques. These measures can have a significant impact not only on irrigated water resources but also on strategies related to rain fed water resources (Ochoa-Noriega et al., 2022). Cooperative management and a conservation ethic regarding shared resources, such as water, should be prioritized by Mirzaei and Zibaei (2021). To mitigate conflicts, it is highly recommended to implement policy implications that include the establishment of civil society organizations tasked with implementing a strategic plan to ensure the protection of human rights (Kuzdas et al., 2016; Sultana and Thompson, 2017). In Bangladesh, the Ministry of Water Resources formulated the National Water Policy in 1999 to ensure effective and impartial management of water resources, sustainable development of surface and groundwater, equitable access to water for all, and the establishment of institutional capacity for water resource management. The Bangladesh Water Act of 2013 is largely based on the National Water Policy of 1999 and aims to promote integrated development, management, distribution, utilization, protection, and conservation of water resources in Bangladesh (GOB, 2013). Several studies have identified measures to address conflicts through community participation, including workshops and meetings to ensure multi-stakeholder involvement in conflict management, the development of Participatory Action Plans (PAPD), the establishment of multi-stakeholder committees for conflict resolution, awareness raising among fishing communities, the use of informal institutions as conflict mediators, and regional cooperation (Murshed-e-Jahan et al., 2014; Mushed, 2008). Rijsberman (2006) suggests that addressing water scarcity can be achieved through a soft pathway that minimizes water conflicts. Stakeholder Analysis (SA) is particularly relevant in situations where resources, such as forests, land, water, and irrigation systems, are managed as common property or when traditional institutions governing communal use and management are deteriorating. SA is also valuable when resources are officially owned by the state but function as open access resources in practice (Renner and Opiyo, 2021). Moreover, stakeholders at different levels have distinct interests and agendas, ranging from government departments, environmental pressure groups, and commercial interests to local farmers. In such

diverse contexts, where stakeholders have varying interests, cognitive frameworks, and economic circumstances, SA can be particularly valuable compared to situations where stakeholders may have similar interests and homogeneity exists (Mutahara et al., 2020; Renner and Opiyo, 2021).

Since mid-1980s Community-based Natural Resources Management (CBNRM) has been an integral part of natural resource management and development discourse (Dewan et al., 2014). Community-based Natural Resources Management (CBNRM) is founded on the simple and appealing premise that communities, as characterized by their distinct and integrated social structure and shared interests, can manage their natural resources in an effective, equitable, and sustainable manner (Blaikie, 2006). In recent days, community-based organizations are participating in the water resource management sector and influenced recent water policy in Bangladesh through the Guidelines for Participatory Water Management (GPWM) (Dewan et al., 2014). This power-sharing decentralized and interest-based resource management system increases efficiency, equity, sustainability and democratic participation through the evaluation of cost and benefits of public services and goods (Dewan et al., 2014). However, Dewan et al. (2014) demonstrates that decentralization does not always involve democratic decentralization, the latter referring primarily to the transfer of powers to existing locally elected democratic government institutions.

Therefore, major financial donors such as the World Bank and the Asian Development Bank (ADB) advice that Irrigation Management Transfer (IMT) is best suited water management system for the developing and underdeveloped countries (Mukherji et al., 2009). They also suggest that since water service provision is the core management problem in government-managed irrigation systems, a mix method approach—presence of IMT, participatory irrigation management (PIM) and proper government provision should be present in water ‘service’ arrangements (Mukherji et al., 2009). Bangladesh was significantly involved in promoting CBNRM and decentralized water management in its water policy reforms. However, Dewan et al. (2014) contends that there is a gap between participation in policy versus participation in practice. In order to establish a proper water governance through CBNRM, democratically elected local governments in water management must be established, local government in water management should be formally recognized, and maintenance funds should be increased and made permanent through existing funding channels (Dewan et al., 2014).

Transformative analysis focuses on the “in-depth case studies; the acute assessment of existing arrangements; the interpretation of strategies to deflect transformation; the identification of destructive cooperation; and the strategic classification of opportunities for transformation” (Zeitoun et al., 2020, p.2). Even though ‘transformative analysis’ (Zeitoun et al., 2020) is a well-establish transboundary water dispute management system, it can be applied to local-level water conflict management as well. As Dewan et al. (2014) demonstrates, local level water conflict management requires decentralization, community engagement and participation, and transference of powers to existing locally elected democratic government institutions. Transformative analysis would be an ideal inclusion in local-level water management Community-based Natural Resources Management (CBNRM).



TABLE 4 Comprehensive strategies for addressing local level water conflicts.

Category	Strategies	Key benefits	Key references
Technical approaches	Irrigation scheduling; Integrated water resource management; Conjunctive management of groundwater and surface water; Improved crop rotations; Decentralization of water technologies	Enhances resource efficiency and sustainability; Supports both irrigated and rain-fed agriculture	Jury and Vaux (2007); Ochoa-Noriega et al. (2022)
Institutional approaches	Establishing institutions with defined responsibilities; Stakeholder Analysis (SA) to align interests; Incorporating economic and political considerations in water management	Improves governance and accountability; Ensures clarity in roles and responsibilities; Aligns stakeholder agendas	Renner and Opiyo (2021)
Social approaches	Changing behavioral patterns in water use and management; Awareness-raising programs; Workshops and multi-stakeholder engagement meetings	Fosters community involvement and cooperation; Reduces conflicts through participatory decision-making	Murshed-e-Jahan et al. (2014); Mushed (2008)
Policy measures	National Water Policy (1999); Bangladesh Water Act (2013); Establishment of civil society organizations for human rights protection; Participatory Action Plans	Ensures equitable water access; Strengthens regulatory frameworks and institutional capacity	GOB (2013); MOWR (2000); Annaraj (2012); Kurmanalieva and Crewett (2019)
Community-based management	Promoting Community-Based Natural Resources Management; Empowering local governments in water management; Democratizing resource governance	Enhances equity, sustainability, and democratic participation in water governance; Bridges gaps between policy and practice	Dewan et al. (2014); Blaikie (2006); Mukherji et al. (2009)
Collaborative conflict resolution strategies	Alternative Dispute Resolution; Transformative analysis for water conflict management; Peace-building processes for rural communities	Minimizes escalation of conflicts; Encourages peaceful and constructive resolutions; Adapts global methods to local conflicts	Zeitoun et al. (2020); Kuzdas et al. (2016); Nader (2002)

The four methods of Alternative Dispute Resolution (ADR) or Pacific way of dispute resolution is an effective way of water governance and conflict management and are well-known in international dispute resolution (Nader, 2002). These four ADR methods can also be applied in local-level water dispute management. A study in Guanacaste Province, Costa Rica, by Kuzdas et al. (2016) investigated the reasons behind local water conflicts and their escalation to violence. The findings revealed that violent actions occurred when rural groups opposed government agencies without mediating leadership. Distrust and ineffective rural stakeholder engagement diminished the credibility of water-related information, prolonging conflicts. The study outlines practical conflict mitigation strategies for local water governance contexts in rural Central America, emphasizing the need for peace-building processes in water management and development. This knowledge can help policymakers, water managers, and stakeholders effectively manage water disputes and avoid harmful conflicts in challenging regions.

## 7 Discussions

This review elucidates the intricacy and multifaceted nature of conflict in the coastal region of Bangladesh and suggests solutions based on previous scholarly works. The analysis identifies that the catalysts of water conflict in coastal regions of Bangladesh encompass

conflicting roles and discerning incentives among actors and stakeholders, inadequate coastal infrastructure (Abdullah et al., 2017; Bulleri and Chapman, 2010; Islam and Tabeta, 2019; Mushed, 2008; Naz and Buisson, 2015; Ziaul and Akter, 2018), power dynamics, environmental factors, and institutional frameworks (Sultana et al., 2019). Figure 1 illustrates the most common factors contributing to water resource conflicts identified by Sultana et al. (2019). These factors (e.g., access disputes, climate-related pressures, and institutional gaps etc.) resonate with the challenges faced in managing local water resources in Bangladesh. For illustration, access disputes, identified as the most prevalent conflict driver (60%), often arise in Bangladesh from competing demands between shrimp farmers and rice farmers. While climate factors such as salinity intrusion and cyclones exacerbate these tensions. Addressing these conflicts requires a multipronged approach that integrates technical solutions (e.g., salinity tolerant crops), institutional reforms (e.g., decentralized governance), and community engagement through participatory frameworks. It is further aggravated by climate change and its effects, including salinity intrusion, deltaic sedimentation, and water scarcity (Baten and Titumir, 2016; Mojid, 2020). The findings highlight that conflicts can result from the implementation of different water management projects such as polder creation, dam construction (Mushed, 2008), controlling over water structures (e.g., drainage canals or sluices) driven by local power dynamics (Faruque, 2009; Mozahedy, 2011; Mushed, 2008). The shift from traditional, informal

water management practices to more formal, but often fragmented, systems has also contributed to these challenges. These issues are also the potential reasons of conflict in the context of transboundary water resources especially in a situation of power asymmetries among riparian states (Dombrowsky, 2010; Gleick, 1993; Homer-Dixon, 1994; Klare, 2001; Zeitoun and Warner, 2006).

Regarding the transboundary water backflow effect induced by diminished stream flow from upstream rivers (Baten and Titumir, 2016; Mojid, 2020). In the southwestern region of Bangladesh, the timing and release of water frequently depend on local elites, who may demand payments, resulting in the diversion of water for their personal purposes. This may lead to diminished water availability in the dry season, impacting agriculture or fisheries in other regions of the system (Bernier et al., 2016). The question of power dynamics is a crucial element in water-related conflicts within a transboundary framework. Conflicts between India and Myanmar exemplify significant trans-boundary water disputes (Gupta, 2020; Parven and Hasan, 2018; The Daily Star, 2012). Disproportionate and dubious resource management and utilization, interactions among stakeholders and user groups, and governance institutions are critical determinants (Murshed-e-Jahan et al., 2014). For instance, India, as a hegemon, regulates the majority of water discharge through the construction of 53 dams, leading to overflow during the monsoon and water scarcity during the dry season in northern Bangladesh (Islam and Mondal, 2017). As Marschke (2012) highlights that the water conflict in the coastal region of Bangladesh is also driven by the multiple stakeholders and their diverse interest and usage of water due to competition over limited resources. For instance, this competing demand and conflicting values and interest are significant factor of conflict in Colorado River basin (CRB) (Ingram et al., 2008).

This paper also emphasizes several techniques for managing local conflicts that might be further applied in a transboundary context. It asserts that a social approach, which requires the active participation of stakeholders in both creation and execution, is essential for effective water conflict management (Jury and Vaux, 2007). Similar approach can also be implemented in transboundary context. Bray (2021) emphasizes equitable funding opportunities and collaborative decision-making processes to address water issues among stakeholders in the Colorado River Basin. Furthermore, prioritizing stakeholders imposes the recognition of water as a fundamental human right within the water governance framework (Annaraj, 2012; Kurmanalieva and Crewett, 2019; Kuzdas et al., 2016; Mitchell and Zawahri, 2015; Sultana and Thompson, 2017). Abboud et al. (2022) stressed that implementing an improved water governance system in the CRB requires alternative reservoir operating rules or design operating rules that prioritize stakeholder demands. A power-sharing, decentralized, and interest-based resource management system enhances efficiency, equity, sustainability, and democratic participation by assessing the costs and benefits of public services and goods (Dewan et al., 2014), applicable in both local and transboundary contexts. However, in a diverse context, where stakeholders have varying interests, cognitive frameworks, and economic circumstances, i.e., in transboundary and in an area of highly competing demands, i.e., CRB this may have significant drawbacks where sustainable stakeholder participation is difficult and stakeholders have conflicting values and interests, different govt, or policy institutions.

## 8 Conclusion

Dynamics of water conflicts in Bangladesh, particularly in its coastal regions stem from various factors, including transboundary disputes, local level governance issues, competition among livelihood groups, and the impacts of climate change. For example, the Teesta and Ganges disputes exemplify transboundary tensions, while local issues (such as conflicts between shrimp farmers and rice cultivators in southwestern Bangladesh) underscore the challenges of resource allocation and governance (Mahmud et al., 2021; Rahman et al., 2019; Chowdhury, 2010). To address these conflicts, it requires an integrated approach, combining technical measures (adoption of salinity-tolerant crops and the implementation of conjunctive management systems), institutional reforms (decentralization, stakeholder engagement, establishment of clear governance frameworks), and social strategies (participatory water management and community-based conflict resolution, are crucial for fostering cooperation and equity among stakeholders).

Furthermore, the importance of aligning local practices with national policies, such as the National Water Policy (1999) and the Bangladesh Water Act (2013) need to be considered. Innovative frameworks like Alternative Dispute Resolution (ADR) and transformative analyses have the potential to address local and transboundary water conflicts effectively. These strategies not only promote sustainable water resource management but also emphasize the role of participatory governance in minimizing conflict and enhancing resilience. Theoretically, this review contributes to understanding the drivers of water conflicts and the interconnected nature of governance, community participation, and resource allocation. It may provide actionable strategies, including stakeholder engagement, participatory governance models, and conflict resolution mechanisms, to mitigate these conflicts. The study has several limitations as it relies heavily on secondary data and existing literature, which may not fully capture the evolving nature and localized nuances of water conflicts in Bangladesh. The geographic scope of the analysis is limited to selected regions, potentially overlooking other areas where water conflicts are equally significant but less documented. Though the study identifies actionable strategies, it does not include primary data or stakeholder consultations to validate these recommendations. To address these gaps, future research should focus on collecting primary data through field studies, involving diverse stakeholders (e.g., farmers, policymakers, community leaders). Longitudinal research might be a good option to assess the temporal dynamics of water conflicts and the effectiveness of implemented strategies. Expanding the analysis to include comparative case studies from other regions or countries facing similar challenges could further enrich the findings and strengthen the applicability of the proposed solutions.

## Author contributions

MHH: Conceptualization, Data curation, Methodology, Writing – original draft, Supervision, Writing – review & editing, Funding acquisition, Validation, Visualization. MJH: Writing – original draft, Writing – review & editing, Validation, Visualization. SAN: Writing – original draft, Writing – review & editing, Validation, Visualization.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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