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10 Years of Water Discourse in Bangladesh: The Contribution of Water Museum

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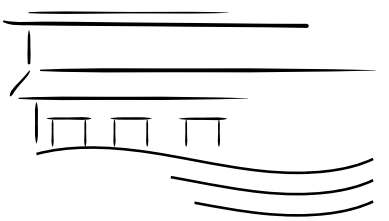

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Foreword

This publication is a testament to the collective commitment to addressing the pressing water-related challenges of our time. By bringing together innovative ideas and diverse perspectives, this book is now more than a collection of papers; it is a catalyst for dialogue and a beacon for solutions that can be applied both locally and globally. ActionAid Bangladesh (AAB) hopes to inspire action and collaboration to drive meaningful change.

Water and the relationship of communities with it has never ceased to amaze me, and it has created awe and frustration, given that the human species lacks respect for this resource on earth. For Bangladesh, a delta with over 800 rivers and tributaries flowing through its landmass, it is the lifeblood that shapes the nation's identity, culture, and survival. The intricate and profound relationship with rivers and water streams has been both a source of sustenance and a challenge, especially in the face of repeated disasters and, in recent decades, climate change. The increasing frequency of floods, salinity intrusion, and erratic weather patterns have complicated the intricate relationship between people and the river, profoundly affecting millions of lives and livelihoods.

AAB, with a uniquely comprehensive relationship with communities living with rivers and water, closely observed the impact of too much water or the absence of water on many occasions across Bangladesh. AAB established the first-ever community-led Water Museum in Bangladesh and the region. Located in Patuakhali, Kalapara, since 2014, with the intent to highlight water issues, the Water Museum fosters critical awareness and inspires conservation and policy reform efforts. The Kuakata Declaration (2016) underscored the need for equitable river management, the entitlement to natural water resources, and transboundary water collaboration among adjacent nations while urgently urging the mitigation of environmental and human consequences of river mismanagement. It became imperative to escalate the advocacy for water justice, water commons, water governance, and Indigenous rights to rivers through various initiatives over the years.

A concerted and collective campaign effort strengthened legislative advocacy, resulting in the 2019 Appellate Division of the Supreme Court of Bangladesh affirming that all rivers in the country are "living entities," conferring legal rights comparable to those of "persons." This significant verdict corresponds with the declaration to preserve water resources as a collective and safeguarded heritage.

To move the advocacy at the regional and international levels, AAB has annually

organised the International Water Conferences since 2016 to foster the issues of challenges and solutions related to water governance and justice extending to national, regional, and global contexts. It led to AAB joining the Global Network of Water Museums, which created opportunities for sharing the experiences of the community museum and learning from a global fraternity.

AAB is organising the 10th edition of its flagship event, International Water Conference in January, 2025. The conference will focus on youth, researchers, academicians, water practitioners, and river experts' participation in identifying and spreading breakthrough ideas critical to addressing water-related concerns.

I extend my heartfelt gratitude to all the contributors, participants, and readers committed to this vital cause. Together, we can navigate the complexities of our relationship with water and work towards a sustainable and equitable future for all.

Farah Kabir
Country Director
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Acknowledgements

This book, a comprehensive documentation of the International Water Conference 2025, represents the collective efforts and dedication of numerous individuals and organisations. ActionAid Bangladesh expresses gratitude to those whose commitment and leadership since 2016 made this publication possible. Their vision for promoting water justice, sustainable development, and the rights of communities dependent on water resources has been the cornerstone of this endeavour. Also, heartfelt thanks go to the esteemed speakers, researchers, and contributors who generously shared their expertise and insights during the conferences. Their contributions have enriched the discussions on critical issues such as transboundary water governance, the geopolitics of water, and oceanic futures, providing a foundation for this book. Also, we would like to thank the ActionAid Bangladesh organising team, whose meticulous planning and execution ensured the conferences' success. Their dedication and teamwork have been pivotal in creating a platform for meaningful dialogue and collaboration.

Special thanks are due to the attendees and participants who actively engaged in discussions and shared their perspectives, further broadening the scope and impact of the conferences. We extend our heartfelt gratitude to the local community members and the esteemed participants from the various programme teams of ActionAid Bangladesh for their valuable input. Congratulations to the expert contributors of this book for their dedication and insightful contributions. Their expertise and commitment have been instrumental in upholding the highest standards of excellence, ensuring a comprehensive and impactful review process. Their efforts reflect their professionalism and inspire us to strive for continuous improvement and innovation.

Finally, we acknowledge the unwavering support of our partners and sponsors, whose contributions have been instrumental in facilitating this important event and its subsequent publication. This book is a testament to the collective commitment to addressing global water challenges and fostering sustainable solutions. We hope it serves as a resource for policymakers, practitioners, academics, and communities striving for a just and equitable future for water.

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Introduction

A social influencer and author once remarked, "So many brilliant people believe that ideas move mountains. But bulldozers move mountains; ideas show where the bulldozers should go to work."[1] This is an apt assessment of what ideas can do or, more precisely, how, where, and when ideas ought to materialise and make a difference in reality. But for things to materialise, ideas must be, above all, grounded in reality. As Karl Marx said, "Men make their own history, but they do not make it just as they please; they do not make it under the circumstances chosen by themselves, but under the circumstances directly encountered, given and transmitted from the past."[2] The idea of imagining, thanks to Imtiaz Ahmed, and then ActionAid Bangladesh under the leadership of Farah Kabir, establishing a water museum in Kalapara, Patuakhali, just like the bulldozers, is no different. In the case of the water discourse in Bangladesh and the subject matter of this volume, the 'circumstances directly encountered, given, and transmitted from the past' are not so difficult to comprehend.

Bangladesh is a land of rivers or *nadi-matrik* (river-centric) country. The exact number of rivers is hard to identify as new ones arise while some old ones die. Sometimes, two rivers join and become one. At other times, a river channel becomes too small to hold to its waters as it exceeds its bank-full capacity and causes flood or becomes two or three rivers. Two factors are mainly responsible for this. One is related to the fact that 75 percent of the Himalayan run-off drains through Bangladesh in only three months,[3] although it consists of only 18-20 percent of the flow from the melted glaciers of the Himalayas. And this brings us to the second factor. The bulk of Bangladesh's river water comes from rain, with about 20 percent of streamflow generated from the rainfall within Bangladesh. The remaining 80 percent flows from catchment areas outside the country, overwhelmingly via three main rivers: the Ganges, the Brahmaputra-Jamuna, and the Meghna.[4]

This makes Bangladesh a massive drainage system, indeed, a country with hundreds and thousands of rivers. Still, the Bangladesh Water Development Board identified 813 rivers in 2013 - a figure good enough to mainstream water discourse if we were to make the people of the land survive, reproduce, and prosper.[5] After all,

1. Remarks by Peter Ferdinand Drucker. Cited from https://www.linkedin.com/pulse/so-many-brilliant-people-believe-ideas-move-mountains-zak-kuder. Accessed on 12 November 2024.
2. Karl Marx, *The Eighteenth Brumaire of Louis Bonaparte* (Moscow: Progress Publishers, 1972), p. 10.
3. Jayanta Bandyopadhyay, *Water, Ecosystems and Society: A Confluence of Disciplines* (New Delhi: SAGE Publications), p. 73.
4. Based on the rain flow calculation cited in Sifatul Quader Chowdhury and Md. Sazzad Hossain, "Flood," *Banglapedia: National Encyclopedia of Bangladesh,* Volume 4 (Dhaka: 2003), pp. 156-157.
5. See https://www.bwdb.gov.bd/page/361. Accessed on 12 November 2024.

Farah Kabir, Country Director of ActionAid Bangladesh, and Dr. Imtiaz Ahmed, Executive Director of the Centre for Alternatives, inside the Water Museum in Pakhimara, Kalara

the land and the people owe to the rivers because life and living in this piece of land mainly result from the flow of water, energy, biodiversity, and sediment in the rivers from time immemorial. Ten years of water discourse is a critical contribution to recognising the decisive truth that without water and rivers, there is no Bangladesh. However, the journey of contributing to the water discourse began with the idea of establishing a water museum in Bangladesh.

The volume is divided into six sections. The first section is the Introduction. Section two narrates the origin and modalities of the birth of the water museum in Bangladesh. The water museum has had a remarkable journey in the last ten years, maybe not so much in the physical construction of the museum, which needs urgent attention and substantial financial investment, but certainly in providing space for brainstorming and contributing to the water discourse in Bangladesh and the region. Section three flags this contribution, uncovering the varied themes of the water discourse. Section four highlights the stakeholders, including researchers, diplomats, students, civil society organizations, women, young people, grassroots communities, foreign experts, policymakers, and the private sector; all were passionately engaged in building and contributing to the water discourse by combining research with insights. Section five summarizes the policy recommendations at the last ten years' water conferences. The recommendations are worth exploring for research, activism, and policy framing. The concluding section focuses on the way forward, mainly on what else can be done to mainstream the water discourse in Bangladesh and the region while commemorating the water museum's birth. The appendix at the end is also worth noting. Not only does it include critical documents related to the water discourse thought afresh, but it also includes abstracts of the papers presented at the annual water conferences.

II

Roots of Change: Evolution and Approaches

A group of conference-goers first mooted establishing a Water Museum in Bangladesh while relishing a piece of black forest cake at a luxurious hotel in Kathmandu, Nepal. The year was 2014, still trying to figure out what was in the cake; although the German chocolate cake is known to include chocolatey layers, kirsch-infused cherries, and a light whipped cream, the chocolatey layers alone could have ignited the thought process. Cocoa, after all, has health benefits, which have been known to humans for over 5,000 years, thanks to the Mayo-Chinchipe people of the Amazon rainforest. The black forest cake must have energised the blood flow of the conference-goers enough to make them think out-of-the-box and contribute to the water discourse in South Asia, including Bangladesh.

Blood flow is particularly relevant to water discourse. The South Asian word for river, *nadi*, is etymologically linked to the blood flow. Put differently, etymologically, 'river' and '*nadi*' differ. In fact, 'river,' 'rivera,' and even 'arrive' all have common linguistic roots. The word 'river' originated from the Latin '*ripa*,' which meant the bank of the river instead of the water. In the early French, it became *rivere* and meant the banks and the water between them. And 'river,' the modern English word, emerged from the latter. In some European languages, the word still refers to the shore. In Italian, for instance, 'riviera' means the 'coastline' and is a region along the coast of the Mediterranean Sea. Also, in legal discourses, the older Latin version is still used. Even today, the word 'riparian rights' refers to the rights of those who control the banks of the river. The word 'arrive' also comes from the same root, *ripera*. When the river reaches its destination, the riverbank ends. Similarly, when we 'arrive' the journey ends.

Nadi, on the other hand, comes from the Sanskrit meaning 'tube' or 'pipe, and the best description is found in the *Varaha Upanishad*, a minor *Upanishad* composed between the 13th and 16th centuries CE:

> The *nāḍis* penetrate the body from the soles of the feet to the crown of the head. In them is *prāṇa*, the breath of life, and in that life abides *Ātman*, which is the abode of *Shakti*, the creatrix of the animate and inanimate worlds.[6]

River or *nadi*, therefore, must have three things: *prana* (life), *atman* (soul), and *shakti* (power or energy). In a more scientific language, as Jayanta Bandyopadhyay puts it, a river includes water, energy, biodiversity, and sediment, or what could be referred to as WEBS.[7] This is similar to conceptualising a river as *nadi*. Interestingly,

6. Cited from https://en.wikipedia.org/wiki/Nadi_(yoga). Accessed on 4 November 2017.
7. Lecture at the IUCN workshop on "Regional Capacity Building: Water Governance Project," in Gurgaon, India, on 30 October – 1 November 2017.

this is precisely how Wang Chong, the Han scholar, perceived rivers in the first century CE:

> Now, the rivers in the earth are like the pulsating blood vessels of a man. As the blood flows through them, they throb or are still in accordance with their own times and measures. So it is with the rivers. Their rise and fall, their going and coming, are like human respiration, like breath coming in and out.[8]

One can argue that the reconceptualisation of *nadi* as a 'river' has contributed to South Asia's dismal state of rivers. Indeed, if the river is obstructed, dissected, or diverted, it could dry up and die, just as it would be with mortals if no food or water were given to the living being. River water, otherwise, is an entity by itself and remains a 'common property' to be shared by all living beings.

Similar views are also found in Islam. The Arabic word for Islamic law - *shari'ah* - originally meant "the place from which one descends to water."[9] This is not surprising given the harsh desert climate of Arabia. In pre-Islamic Arabia, *shari'ah* consisted of a series of rules about water use. *Shir'at al-maa'*, for instance, referred to the permits given to individuals for the right to drink water.[10] The Holy Quran, it must be pointed out, emphasises the centrality of water: "We made from water every living thing" (*Surah Anbiyaa*, verse 30). Again, the Quran proclaims, "He it is who created the heavens and the earth in six days – and His throne was over the waters" (*Surah Hud*, verse 7).

Water, Power, and People: A South Asian Manifesto on the Politics and Knowledge of Water, published in 1997 and co-authored by Imtiaz Ahmed, Ashis Nandy, and Ajaya Dixit from Bangladesh, India, and Nepal, respectively (Appendix A), flagged the centrality of water, river, and ocean from an alternative perspective, indeed, in line with the reconceptualisation of river as *nadi*. After perusing the *Manifesto* almost two decades later, ActionAid Bangladesh found a connection to their decade-long work on river rights. This put ActionAid Bangladesh on a journey of appreciating the alternative discourse on rivers and water and putting their minds and resources into establishing the Water Museum in December 2014.

But then, while establishing the Water Museum, ActionAid Bangladesh embraced the alternative discourse with critical conceptual and organisational innovations. Five of them could easily be identified:[11]

Firstly, the concept of water. In 'pure science,' the formulaic representation

8. Philip Ball, *The Water Kingdom: A Secret History of China* (London: Vintage, 2016), p. 18.
9. Francesca De Chatel, "Water in Islam," *ONISLAM*, http://www.onislam.net/english/reading-islam/understanding-islam/islam-and-the-world/environment/446281.html, p. 2. Accessed on 11 February 2015.
10. Ibid.
11. For a closer exposition, see Imtiaz Ahmed, *Rights, Rivers & the Quest for Water Commons* (Berlin: Springer, 2021).

of water is hydrogen *plus* oxygen, but such water can only be found inside the laboratory, which is not helpful from the standpoint of 'social science.' Therefore, a reconceptualisation of water is required. In social science, water could be reformulated as H_2OP_4. The meaning of water in social science would include twice hydrogen + oxygen *plus* pollution, power, politics, and profit.[12] A more comprehensive and critical approach is required to understand the social and political implications of water and rivers, nationally and regionally.

Secondly, reframing the discourse on human rights by mainstreaming the human as a multiverse being. Since humans are as much political beings as they are economic, cultural, ecological, technological, and psychological beings, it is critical that their rights, indeed, the rights of each of them, are ensured in all possible domains—politics, economics, ecology, culture, technology, and psychology—if dissent and conflicts are to be contained. The multiverse human being alone can consciously change the future to its requirements and aspirations.

Thirdly, water commons must be critically examined from the standpoint of both humans and rivers. Nature, including waterways, has rights as much as humans. Humans, otherwise, in ensuring their rights, cannot create conditions of human wrongs, whether against fellow humans or nature. Limiting human wrongs, therefore, becomes as much a task for fellow human beings as it is for human nature relationships. However, humans must recognise the dialectical confluence between rights and duties to make this work. This would otherwise imply ensuring the rights of the disempowered while the state and the empowered must perform duties for the benefit of the disempowered.

Fourthly, sharing water or rivers across national boundaries should be operationalised by collaborating with local stakeholders. This would foster regional cooperation on water. In this context, statist approaches have inherent limitations, as water, like air, can never be contained within the state's territorial boundaries. A de-territorialised approach is required, and this would demand a more extraordinary voice of those using the water, the local stakeholders, both within and across national boundaries.

Finally, serious efforts should be made to create a critical mass of scholars and activists dedicated to the alternative discourse cited above. To pursue this goal, ActionAid Bangladesh decided not only to establish a Water Museum but also to hold an annual international conference on water in Bangladesh to sensitise people at home and abroad on issues related to water and rivers. The first such conference was held in Kalapara, Patuakhali, on 15-17 March 2016 (Annexe D).

This volume celebrates the 10th International Conference on Water, organised by ActionAid in January 2025. However, four points of uniqueness remain central to the previous annual conferences. The first one is related to the diversity of themes.

12. Imtiaz Ahmed, *Futures Beyond Nationalism*. Special Issue of *Futures: the journal of policy, planning and futures studies,* Elsevier Science, Exeter, UK, Volume 37, Number 9, November 2005, p. 905.

This included topics ranging from the "Right to Water and Defending Commons," "Water Democracy," "Water Roots Innovation," "River: a Living Being," "Legalising River Rights: People, Politics, and Practices," "Water, Climate and Justice in the Wake of COVID-19," "Teesta River Basin: Overcoming the Challenges," "Water and Rivers for Life and Living: The Role of Youth," to the "Politics of Climate Change." The second one is locational. Although the first conference and a few more were held near the Water Museum in Kuakata, Patuakhali, there have been instances of holding international conferences in Dhaka, Sylhet, and even two online during COVID-19. This allowed researchers, policymakers, media reporters, and activists from various parts of Bangladesh to join and contribute to the event. The third uniqueness was the participation of researchers and activists from outside Bangladesh, including India, Nepal, China, Ethiopia, Japan, and several other countries, both online and in person. The combination of national and international participants extended the discourse on water and rivers internally as well as externally, making credible the contention that water and rivers can never be territorialised.

However, the uniqueness that needs special mention is the cultural event - music, dance, poetry, painting, and performance – held during the annual conference, all related to water and rivers. This has allowed arts, science, jurisprudence, business, and social sciences to blend in a way that could be best labelled as post-disciplinary. Indeed, the uniqueness of the annual conference since 2016 lies in the fact that it not only sensitised the participants to issues related to water and rivers but also contributed to knowledge production, with the young and not-so-young from various religious, ethnic, linguistic, and gender backgrounds mingling and discoursing something so precious and fundamental for life and living. This is where the judgement in the Bangladesh High Court of calling the rivers 'living entity' in 2019 (Annexe E) made a difference, contributing simultaneously to the alternative discourse that the organisers of the water conference cherished and advocated so much.

Water bodies: The heartbeat of local culture, livelihood, and the ecosystem – A reflection of life's vital essence

III

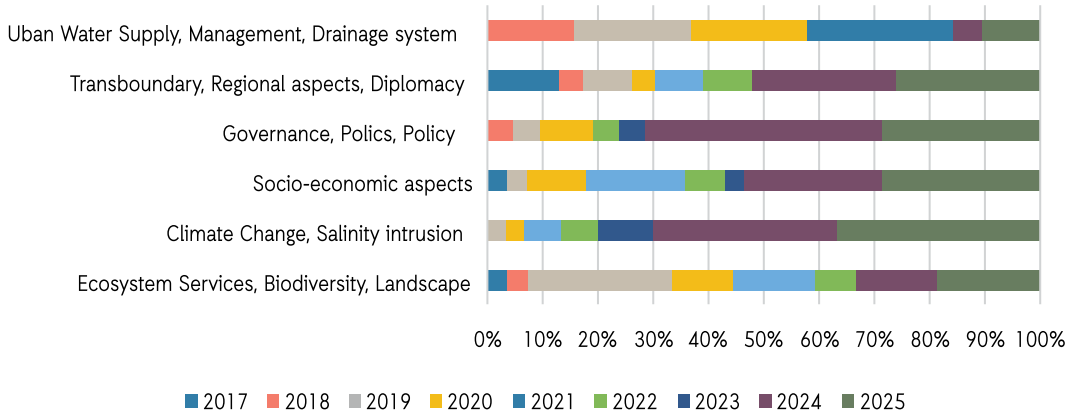
Thematic Expositions

The past nine and the forthcoming 10th International Water Conferences have been arranged differently. For example, a keynote speech is followed by several panellists diving deep into a session topic, several experts making formal presentations in a session, or a moderated panel discussion, without any presentations, explores the theme of a session. In the following paragraphs, we considered formal presentations that were already presented or expected to be presented at the 10th edition to explore several essential aspects by conducting a light-touch analysis of the abstracts or the presentations. Here, we look into one or several significant issues that each presentation broadly covers. We also look into how some significant themes evolved over the past decade. The nature of the presented studies, methodology used, geographical locations covered (globally and within Bangladesh), and types of aquatic ecosystems these focused on are also highlighted below. Where possible, an attempt is made to explain the results we found.

Major issues covered: The presentations covered many issues over the years (Annexe F). *Governance, political, and policy* issues were most widely highlighted (34%), followed by *climate change*, including *salinity intrusion* (27%), and *socio-economic aspects* of water (25%). Other dominant themes include *ecosystems, their services, biodiversity, landscape*-level studies, and, in recent years, *social-ecological systems* (24%). *Transboundary and regional* issues appeared in 21% of presentations, while *hydro diplomacy* was highlighted in another 13% of cases. Studies on *water supply, use, and management in non-urban contexts* were also seen (23%). Dominant urban issues were *urban water supply and management* (17%) and *urban drainage system* (6%). *Community-based action, gender, and social inclusion,* including *youth* (together 23%), were also noted in the research presented at the conferences. Other notable issues were *water pollution and wastewater treatment* (15%), *health* (10%), and *technological aspects or innovations* (10%).

Other research topics included in 5-10 pieces of research are *hydro morphology*, *engineering solutions/infrastructure/mega projects*, *agriculture*, *drinking water treatment*, *disaster risk management*, *culture/heritage/Indigenous People*, and *legal aspects/justice/river rights*. *Fisheries*, *aquaculture*, *humanitarian elements* (including the Rohingya crisis), *finance*, *economic valuation*, *navigation*, *transport*, *awareness*, and *business/industries* had 1 to 4 studies each.

The Figure 1 shows how six significant themes have changed (2017-2025). The annual percentages under each theme are against the total number of papers covered by that particular theme over nine years—a few interesting trends to note. More papers are being presented lately on most of these issues. *Urban* and *ecological*



Proportions of six major themes as these appeared in different years (2017-2025)

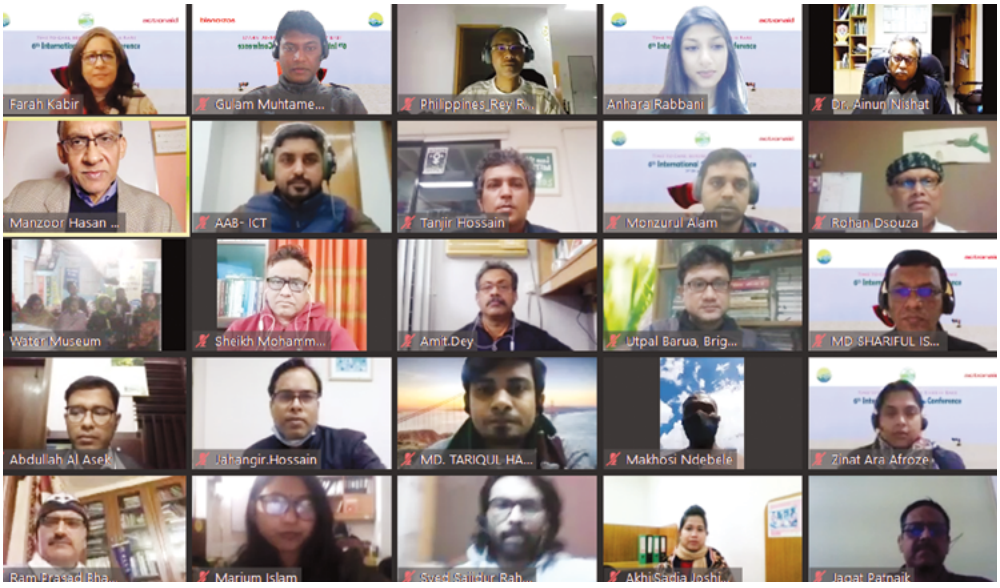
themes show consistency in annual proportions, but the rest of the themes have increased significantly in recent years. *Climate change* has significantly changed over the last two years despite the initial absence. A similar significant shift is valid for the *governance* theme. Presenters participating in the Water Conferences have always shown interest in *transboundary* issues, as well as in *socio-economic aspects*.

Nature of research presented: Social science research methodologies (i.e., qualitative, quantitative, or a combination of both) dominated most of the research presented. Nevertheless, advanced, scientific, data-driven studies have also been seen on many occasions where GIS, remote sensing, modelling, and, in recent years, artificial intelligence (AI) have created an additional dimension. While most presenters presented primary data or actions on the ground, 19% of the presentations underscored a wide range of theoretical perspectives on water.

Geographical distributions: Most presentations explicitly covered Bangladesh (74%), followed by India (9%). Other countries are Ethiopia, Nepal, the Netherlands, and Pakistan. A significant portion (19%) of the presentation considered multi-country aspects and often did not mention any specific country in the abstracts. Of Bangladeshi studies, the dominant districts were Rajshahi (9 presentations), Dhaka (7), Chattogram (5), Khulna (4), and Patuakhali (3); other districts specifically covered include Barishal, Chittagong Hill Tracts, Cox's Bazar, Cumilla, Naogaon, Pabna, Rangpur, and Sylhet. Besides the multi-country, transboundary, or diplomacy studies, most of the studies covered rural areas or natural ecosystems, and urban issues were covered by 23% of the presentations, as noted above.

Aquatic ecosystems focused: Among Bangladeshi rivers, the Teesta was the most dominant river exclusively covered in nine pieces of research, followed by the Padma (5). Other studied rivers include the Buriganga, the Gomti, the Halda, the Jamuna, the Karnafuli, the Sangu, and the Turag. Only a few different types of wetland ecosystems were exclusively studied, except Durgasagar in Barishal or

The International Water Conference fosters the participation of diverse stakeholders from various backgrounds, reflecting different themes. This image captured a moment from the 5th International Water Conference



Due to the COVID-19 pandemic, physical gatherings were not possible. However, ActionAid Bangladesh continued its journey toward water justice through the online format of the 6th and 7th International Water Conferences. This photo captured a moment from the 6th International Water Conference

ponds of Cumilla, for example. While the whole coast of Bangladesh was explored in many research, the Sundarbans appeared only on one occasion.

The theme of a conference, its venue (Patuakhali, Dhaka, or virtual), or its year did not influence the topics of papers presented in that conference, the methodology they followed, or the geography or ecosystems they covered. These depended on the session themes and session format of a conference. That's why, for example, although the COVID-19 pandemic and youth were the thematic focus of the conferences of 2021 and 2023 respectively, presentations were not exclusively or dominantly focused on health or young people.

This brief analysis of presentations at the International Water Conferences shows how we have covered different water-related issues over the past decade. Many findings, such as the geographical or ecosystem coverage, seem unintended. Nevertheless, this light-touch assessment may help the organisers in designing a similar conference in the future.

IV

Inclusive Water Solutions: Stakeholders' Role and Participation

Since the beginning, the International Water Conference (IWC) of ActionAid Bangladesh has emerged as a premier event, addressing significant water-related challenges that impact both Bangladesh and the international community. Annually, the conference designates a specific focus that encapsulates the prevailing difficulties, policy dialogues, and novel strategies concerning water management, river rights, climate justice, and sustainability. The themes, from "Right to Water and Defending Commons" to "Water, River, and Climate Change: Creating Space for Resilience," aim to investigate many characteristics of water, including ecological, economic, social, and legal facets, by including participants from diverse fields and sectors.

The principal objective of the IWC is to unite various stakeholders to promote dialogue, information sharing, and cooperative initiatives. The stakeholders include scholars, diplomats, students, civil society organisations (CSOs), women, youth, grassroots participation, and international representatives. Each group plays a crucial role in contributing to responses and discussions essential for tackling the complex water challenges. ActionAid Bangladesh has effectively established an inclusive, participatory, and solution-oriented platform for water-related challenges by including many stakeholders across its previous nine IWCs.

Diverse Participants by Considering Different Themes

A significant asset of the IWC held by ActionAid Bangladesh is its capacity to draw diverse participants year by year, mirroring the variety of its selected subject matter. As the conference progresses, ActionAid guarantees that each subject aligns with diverse stakeholders, ranging from local communities to international specialists. Incorporating varied players establishes a strong foundation for interactive discourse and issue resolution, guaranteeing that perspectives from many sectors are acknowledged, comprehended, and included in practical policies and practices. This variety encompasses participation and viewpoints, ensuring a thorough discussion on water-related problems.

The IWC topics have continually mirrored global and local water issues, including river rights, water governance, climate justice, and transboundary water politics. Each subject is carefully chosen to address the urgent water-related problems of the period, prompting ActionAid Bangladesh to deliberately invite people who resonate with the thematic emphasis. This guarantees that each stakeholder has meaningful contributions and, more significantly, may get practical insights relevant to the sector.

Objectives of Diverse Participant Engagement

- To foster global views by advocating for cross-border solutions to water issues.
- To enhance collaborative networks by establishing relationships across various industries and geographies.
- To promote inclusion by integrating multiple perspectives, especially those of excluded groups, in water discussions.
- To enhance policy advocacy by shaping policy via contributions from diverse stakeholders.
- To promote innovation by using varied knowledge for inventive solutions to water challenges.
- To augment knowledge dissemination via exchanging experiences and exemplary practices among international participants.
- To enhance capacity by providing participants with resources and expertise for sustainable water management.
- To promote young leadership by motivating and involving the next generation in water governance.

A Theme-Centric Approach to Participants

The 1st IWC included scholars, diplomats, CSOs, grassroots leaders, women, youth, and professionals to reflect on the people's water rights—insights on water rights, transboundary challenges, and community implications, with worldwide participants sharing best practices. "Water Democracy," emphasised at the 2nd IWC, inherently attracted scholars, community leaders, and politicians engaged in water governance challenges. It enabled a comprehensive examination of the establishment of participatory water management methods, enabling all stakeholders—from urban inhabitants to rural communities—to influence the allocation and management of water resources. Incorporating grassroots participants and women is essential since they represent the voices sometimes ignored in formal water governance dialogues. The participants participated by sharing their stories, emphasising the need for equitable water access, and advocating for community-driven solutions.

The focus of the 3rd IWC, "Water Roots Innovation," emphasised grassroots innovation and community-oriented water management solutions. Local communities, CSOs, and indigenous knowledge bearers were essential players. Their participation facilitated the exchange of excellent practices sometimes neglected in conventional water management discussions. The participants engaged in talks that included rainwater gathering, traditional management of flood methods, and sustainable agricultural practices essential for areas experiencing inconsistent water supplies and heightened drought risk. The emphasis on innovation attracted technologists and start-ups that showcased novel technologies and approaches for enhancing water access and conservation in rural and at-risk regions. The theme of the 4th IWC, "River: A Living Being," facilitated the participation of legal experts, environmental activists, and CSOs dedicated to the legal acknowledgement of rivers as living beings. Researchers and attorneys campaigning for river rights were crucial contributors to the discourse on the legal framework Bangladesh subsequently used to bestow personality status onto rivers. Civil society organisations collaborating with local communities provided grassroots insights on how legal recognition may enhance conservation initiatives.

Likewise, the 5th IWC's theme, "Legalising River Rights: People, Politics, and Practices," convened people capable of examining the interaction of policy, grassroots movements, and legislative measures. Diplomats and government officials were essential contributors to this meeting, mainly due to the transboundary characteristics of several water resources in Bangladesh. Their participation enabled the conference to examine how international treaties and regional collaboration may enhance river rights.

During the 6th IWC, themed "Water, Climate, and Justice in the Wake of COVID-19," the significance of the private sector was underscored, especially about the themes of post-pandemic recovery and water security. Private enterprises

engaged in water infrastructure and management were encouraged to contribute to presenting their technical innovations in water purification and distribution and deliberate on their corporate social responsibility (CSR) activities aimed at water conservation. The participation of government officials and policymakers guaranteed that these debates may result in tangible measures within public-private partnerships.

The 7th IWC, themed "Teesta River Basin: Overcoming the Challenges," included transboundary water specialists, regional government representatives, and diplomats. The geopolitical intricacies of the Teesta River Basin drew professionals experienced in negotiating bilateral water treaties, scientists focused on water-sharing mechanisms, and CSOs advocating for the rights of communities impacted by variable water levels. ActionAid Bangladesh facilitated debates rooted in policy and local reality by ensuring the participants were aligned with the conference's objective.

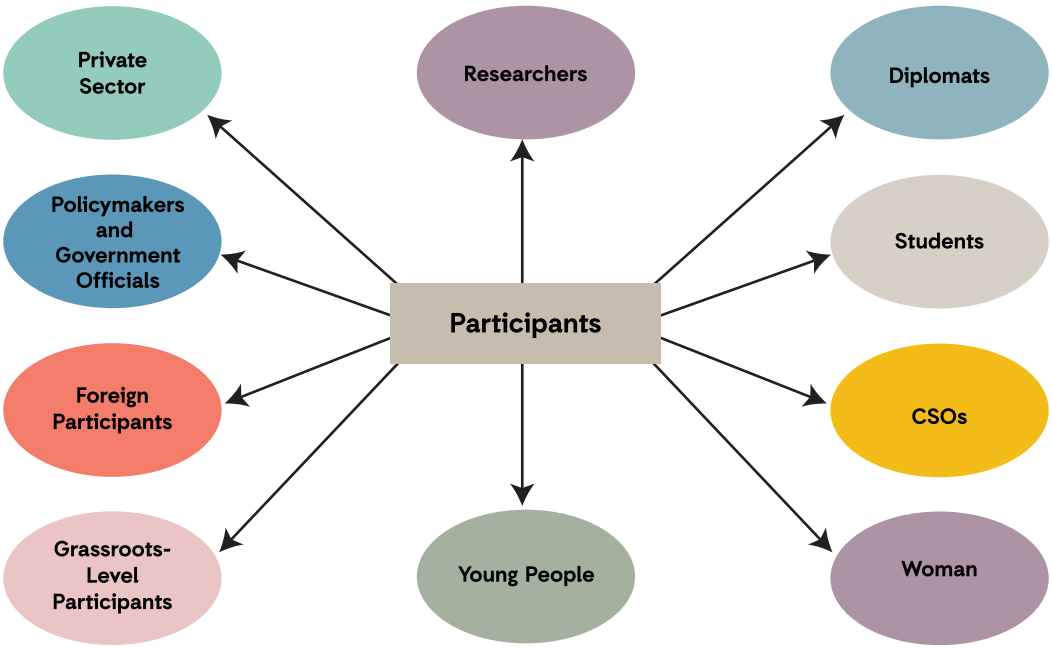
Conversely, the 8th IWC, emphasising "Water and Rivers for Life and Living: The Role of Youth," promoted the involvement of youth activists, students, and emerging scholars. This seminar highlighted the need to enable the next generation to spearhead the movement for water justice. The incorporation of youngsters in leadership positions at the conference highlighted the significance of cultivating future champions and specialists who would perpetuate efforts in water conservation and climate resilience in the future.

ActionAid Bangladesh has deliberately promoted cross-sectoral collaborations among its varied participants throughout all nine conferences. This facilitates a more profound discourse transcending individual sectors or areas of expertise, effectively bridging the divides between policy, practice, science, and community knowledge. At the 9th IWC, titled "Water, River, and Climate Change: Creating Space for Resilience," the involvement of environmentalists, climate change specialists, local leaders, and women's organisations facilitated a comprehensive strategy for tackling water-related issues within the climate change framework.

Incorporating international participants inside the IWC exemplifies the conference's theme strategy of participation. ActionAid Bangladesh has effectively included specialists from countries like India, Nepal, the UK, Australia, and Sweden, addressing global issues such as transboundary water management, climate-induced migration, and the significance of international law in water rights. This global engagement enhances the debates and situates Bangladesh's difficulties within a broader international framework, facilitating mutual learning and collaborative problem-solving. During the 9th IWC, dialogues about hydro-diplomacy and salinisation in the Ganges-Brahmaputra Delta included local and international specialists, establishing a cooperative forum for tackling these challenges.

Strategic Selection of Participant Categories for Comprehensive Water Solutions

The International Water Conference (IWC), organised by ActionAid Bangladesh, brings together diverse participants to discuss critical water issues. Each conference theme draws specific stakeholders who contribute valuable perspectives, ensuring comprehensive dialogues and innovative solutions. These participants come from varied backgrounds, including researchers, diplomats, students, CSOs, women, young people, grassroots communities, foreign experts, policymakers, and the private sector. The engagement of these diverse groups enriches the discussions and promotes the implementation of sustainable solutions to water-related challenges.



Researchers are fundamental to the IWC, offering critical data-driven insights and innovative approaches. Their involvement guarantees that scientific investigation and novel methodologies in water management remain central to debates. Researchers concentrate on transboundary water management, salinity intrusion, and community-driven governance. They contribute by disseminating their recent discoveries, which underpin concrete solutions in water conservation, climate resilience, and environmental sustainability. The IWC connects theoretical frameworks with practical applications by engaging academics and cultivating knowledge that may facilitate transformation.

The intricacy of transboundary water problems necessitates the engagement of diplomats. Diplomats promote dialogue on hydro-diplomacy and transnational collaboration to tackle common water issues across nations. Their existence

facilitates international discourse, encouraging the establishment of water-sharing treaties and legal frameworks. The IWC serves as a diplomatic forum to reconcile national interests with global water security, enabling the equitable management of transboundary water resources to benefit all participating states.

The participation of students in the IWC highlights the need to instruct the forthcoming generation on actual water-related challenges. Students from several educational institutions attend the conference to acquire knowledge on significant water issues, communicate with specialists, and participate in policy debates. Their participation fosters education beyond the classroom, motivating future leaders to engage actively in water conservation, environmental sustainability, and governance. Through interaction with professionals, students gain awareness of critical water-related concerns and the contributions they may make towards developing solutions.

Civil society organisations (CSOs) are essential contributors to the IWC, articulating the concerns and perspectives of communities directly impacted by water-related problems. These groups champion community-oriented solutions and lobby for legislative reforms that advance social justice in water management. CSOs often emphasise the fundamental realities of water issues and provide pragmatic views on river conservation, legal safeguarding, and sustainable governance. Their involvement guarantees that conversations are anchored in the daily problems encountered by local people, promoting a more profound understanding of how policies affect communities.

The involvement of women is a crucial element of the IWC, demonstrating ActionAid Bangladesh's dedication to fostering gender-inclusive discussions. Women are often disproportionately impacted by water shortages and pollution, especially in rural regions where women bear the primary water collection and management responsibility. By including women's perspectives in the discourse, the IWC underscores their distinct obstacles and advocates for gender-responsive solutions to water-related issues. The involvement of women is ensuring that policies address the needs of all community members, enhancing the inclusivity and equity of water governance.

Youth participation is a primary emphasis of the IWC, with young people seen as catalysts for change in water conservation and climate adaptation. The conference offers a platform for youth to showcase creative concepts, disseminate technical progress, and impart novel viewpoints. Youth-led efforts addressing river pollution management and disaster resilience have been extensively highlighted. By empowering young participants, the IWC is ensuring that the next generation has the knowledge and skills required for tackling current and future issues in water governance.

Members from grassroots communities provide essential insights to the IWC, conveying personal accounts of the impact of water concerns on their everyday

lives. These individuals, often hailing from rural, coastal, and char regions, provide insights into indigenous knowledge, adaptive techniques, and local resilience mechanisms. Their narratives influence climate adaptation, riverbank erosion, and water resource management dialogues. By incorporating grassroots perspectives, the IWC is ensuring that policy recommendations are shaped by the experiences of those most impacted by water problems.

The IWC draws worldwide participants with diverse views on water management and climate resilience. The attendees include professionals, academics, diplomats, and activists from several nations, facilitating international collaboration on transboundary water issues. Their involvement facilitates the dissemination of information and exemplary practices from many global regions. International participation augments the conference's worldwide significance, promoting cooperation on common water issues and facilitating the implementation of successful creative solutions from other locations.

Policymakers and government officials are integral to the IWC, linking conference deliberations with national decision-making frameworks. Their involvement ensures that the policies and suggestions formulated during the conference reach the highest echelons of government. Government leaders suggest how national policies might tackle water governance challenges, including enforcing water legislation and river protection initiatives. Their participation is crucial for converting the concepts and solutions deliberated at the IWC into implementable policies at both national and regional tiers.

The private sector is increasingly acknowledged as a crucial participant in water management, mainly due to its involvement in water-intensive sectors such as agriculture and textiles. Private sector representatives engage in the IWC to deliberate on corporate social responsibility (CSR), pollution mitigation, and sustainable business practices concerning water use. The participation of the private sector is essential for guaranteeing that industries aid in sustainable water management initiatives. By collaborating with civil society and governmental entities, the private sector may facilitate advancements in water conservation technology and pollution mitigation measures.

Furthermore the IWC includes environmental campaigners urging prompt measures for water conservation and pollution mitigation, with indigenous people providing traditional knowledge and methods for sustainable water management. Journalists and media representatives are integral to the IWC, facilitating the dissemination of conference findings to a broader audience and enhancing public awareness. International organisations, business sector leaders, and officials engage, contributing global views, corporate responsibility, and policy ramifications to the talks. This varied involvement guarantees that the IWC stays inclusive, tackling water issues from many perspectives and promoting intersectoral cooperation.

The Water Museum in Pakhimara, Kalara, Bangladesh, has played a key role in shaping international engagement with the global network of water museums. Recognized as the first community-led water museum at both the national and regional levels, this museum represents a pioneering effort in the fields of water conservation and cultural preservation. Its innovative approach not only highlighted the importance of water as a vital resource but also set the stage for global cooperation in water-related education and awareness. The museum's success opened doors for collaborative projects, fostering international partnerships and knowledge exchange. By blending local heritage with global issues, it has become a symbol of cross-cultural dialogue and a hub for sustainable water practices. This unique initiative continues to inspire both regional and global efforts to address water challenges.

Final Words

ActionAid Bangladesh's IWC is a model platform that encourages conversation, innovation, and cooperation among various individuals and organisations involved in the water sector. The IWC ensures that water concerns are handled in a way that is both comprehensive and inclusive by including a diverse range of participants, including academics, diplomats, students, civil society organisations, women, young people, grassroots-level communities, foreign delegates, politicians, and the commercial sector. To contribute to a comprehensive approach to water governance, climate resilience, and river rights, each stakeholder brings a distinct point of view to the table, which enriches the conversations that are taking place with them.

V

Blueprints for Tomorrow: Transformative Policy Insights

This section includes the key findings from each International Water Conference, which were, incidentally, already compiled in the conference's yearly report. However, key areas were identified and clustered, allowing us to provide key policy recommendations. But let us first summarise the key findings thematically.

1. Water Rights and Legal Status

- Bangladesh's 2019 decision acknowledges that rivers have the same legal status as humans. It is essential to consider rivers as legal entities. This perspective encourages a protective approach to river ecosystems by transforming water rights from strictly resource-based to intrinsic rights.

2. Community Engagement and Traditional Knowledge

- The engagement of the local communities, including indigenous groups, is crucial in river and water management. Furthermore, monitoring of community, grassroots-centric approaches, and intergenerational dialogues enable effective, locally based solutions.

- Initiatives from Atreyee Bachao Andolon (India) and Teesta Bachao Andolon signify the importance of community-driven actions. Museums dedicated to water culture, such as Kalapara's Water Museum, highlight the community's role in preserving heritage and promoting awareness.

3. Gender-Inclusive Approaches

- Policies should address gender-specific needs by incorporating social and gender indicators in natural resource databases. Acknowledging that water risks impact men and women differently, women's participation in water management should be increased to address these varying viewpoints.

4. Transboundary Cooperation and Data Sharing

- In addition to sharing water, cooperation on transboundary river issues should include sharing access to resources, including fish, sediment, and biodiversity. To resolve shared river concerns, it is recommended to use shared hydrological data, modern technologies (e.g., satellite remote sensing), and cross-border dialogues.

5. Sustainable Water and River Management Practices

- Development must shift from land-centric to river-centric, focusing on sediment management and river training instead of short-term solutions like dredging. To preserve biodiversity, it is essential to consider river flow regimes.

- Policies should address preserving rainwater and efficient water usage, focusing on reducing wastage, particularly during crises (e.g., pandemics).

6. Education and Awareness

- Educational reforms should incorporate concepts of water rights, climate justice, and river and natural resources studies into the curricula to promote early awareness. Youth education on river conservation and initiatives like the Riverkeepers network empower the next generation to serve as the guardians of water resources.

7. Cultural and Economic Aspects of Rivers

- Preserving culture is essential as river-centred arts, livelihoods, and heritage are declining. As a solution to this, living museums and water-centred tourism, such as water museums and cultural tourism, can celebrate this heritage while, at the same time, supporting local economies.

- Building partnerships through "Living Museums" promotes cultural ties to rivers and preserves community values while offering forums for collective knowledge and experience.

8. Policy, Infrastructure, and Governance

- Infrastructure development must consider ecological impact by maintaining river flow levels to ensure ecosystem health. Policies like the Water Act and the Act to Protect the River (2013) should be strictly enforced to ensure sustainable water use and pollution reduction.

- Strengthening the coordination between government and nongovernment bodies directly associated with water management is essential to promote a unified, holistic approach to river conservation and governance.

Based on the above themes, the following are the policy recommendations flagged at the previous conferences:

1. Formal Recognition of River Rights and Legal Protections

    - **Establish River Guardianship Frameworks:** Expand on Bangladesh's legal

recognition of rivers as living entities by establishing a guardianship structure to uphold their rights and monitor compliance. A dedicated legal body to defend river rights should be part of this. This will guarantee protection against pollution, unplanned infrastructure, and harmful water extraction practices.

- **Strengthen Enforcement of Existing Laws:** To secure the health and biodiversity of rivers, strengthen the implementation of or amend laws like the Water Act and the 2013 River Protection Act. Create accountability systems in government organisations to ensure strict compliance and prevent regulatory failures.

2. Community-Centric Approaches and Indigenous Knowledge Integration

- **Institutionalise Local Participation in Water Management:** Implement policies that necessitate the active participation of the community and consider their inclusion in water management and development projects. They integrate local and indigenous knowledge while planning processes are essential, particularly in river management and climate adaptation.

- **Support Community Initiatives:** Offer technical and financial support to community-based organisations to strengthen grassroots efforts, such as local water-saving campaigns to protect rivers. Government support for cultural and water museums could further increase engagement in and awareness of water conservation.

- **Public-Private Partnership:** Government support for cultural and water museums could increase awareness and engagement with water conservation.

3. Gender-Inclusive Water Management

- **Develop Gender-Based Water Policies:** Recognise the differential impacts of water risks on men and women by creating policies that address gender-specific water access, sanitation, and management needs. Encourage women's participation in water governance structures, particularly in decision-making roles, to ensure inclusive water management practices.

- **Incorporate Gender Indicators in Resource Valuation:** To ensure that water resource management considers gender inequality and deals with it somewhat, including social and gender-based indicators in national natural resource valuation is essential.

4. Transboundary Collaboration and Data Sharing

- **Promote Regional Water Diplomacy Initiatives:** Encourage regional

cooperation on transboundary water issues, with an expanded focus on shared resources like silt, fisheries, and biodiversity. Establish regular dialogue and resource-sharing forums between neighbouring countries to address shared environmental concerns and promote equitable resource allocation.

- **Implement Hydrological Data Sharing Agreements:** Adopt multilateral agreements among countries that facilitate data sharing on river flows, sedimentation, and water quality. Satellite remote sensing technology could support these agreements by enabling transparent, real-time environmental monitoring.

5. Sustainable Infrastructure and River Health

- **Adopt River-Centric Infrastructure Policies:** Restrictions should be imposed on the unplanned dam and embankment construction, and interventions that maintain river flow and ecosystem health should be prioritised. For critical infrastructure, mandate environmental impact assessments (EIAs) that include minimum flow requirements (e.g., 20% of flow regimes) to protect biodiversity and prevent ecological damage.

- **Encourage Nature-Based Solutions in Water Management:** Implement policies favouring sustainable practices, such as river training and sediment management, over short-term solutions like dredging. Incentivise local governments to adopt nature-based solutions, particularly in flood-prone or ecologically sensitive areas.

6. Water Conservation and Education Initiatives

- **Integrate Water Conservation into Educational Curricula:** Develop educational modules on river conservation, water rights, and climate justice, targeting both primary and secondary levels. Programmes should encourage youth involvement through initiatives promoting lifelong stewardship of water resources.

- **Promote Individual and Community-Level Conservation Practices:** Launch national awareness campaigns to inform the public about rainwater conservation and reducing water wastage. Policies can incentivise rainwater harvesting systems and efficient water usage in households and communities by lessening the demand for freshwater resources.

7. Economic and Cultural Revitalisation Through River Tourism

- **Support Cultural Heritage and Ecotourism:** Promote water-centric cultural tourism by supporting "Living Museums" and river heritage sites that engage communities and foster economic opportunities. Encourage partnerships

with local businesses and communities to sustainably develop river-based tourism that respects and celebrates river ecosystems and livelihoods.

8. Enhanced Inter-Agency Coordination and Resource Allocation

- **Strengthen Institutional Coordination on Water Management:** Provide a nationwide framework for cooperation between all water-related government and non-government organisations. This framework should enable integrated planning, transparent resource allocation, and effective crisis management across diverse water management functions.
- **Invest in Water Infrastructure for Vulnerable Communities:** Invest funds in enhancing water infrastructure, particularly in underdeveloped areas. Policies should prioritise investments in sustainable water systems to address fundamental water and sanitation needs and support the Sustainable Development Goals (SDGs).

Local community unites in riverbank reinforcement and preservation efforts

River ambulance service for the char community people as a result of efforts from ActionAid Bangladesh

VI
Conclusion: The Way Forward

Ten years is too short a time to claim to have impacted the water discourse in Bangladesh. Yet, one can say with some confidence, particularly given that the annual water conference is held either in the vicinity of the Water Museum or under the latter's umbrella, that it made some differences to those previously discoursing on water and rivers, not with water-centric but with a predominantly land-centric mind. This ought to have been natural for the people of the *nadi-matrik desh* (river-centric country). Still, years of colonial occupation and intellectual hegemony of the West robbed the erstwhile colonised people, including Bangladeshis, of the power to imagine and think independently. But this is just the beginning of the quest to deconstruct the land-centric modes of thought and practice and make

ActionAid Bangladesh also promotes local culture through the International Water Conference. For example, a folk song performance was arranged as part of the cultural program during the 8th International Water Conference

water and rivers central to our lives and living. Some of the ideas flagged in the water conference are worth pursuing not only for their creative insights but also for transforming the dismal state of our rivers.

Secondly, the water conference has attracted people of all kinds, regardless of age, education, ethnicity, religion, race, gender, status, and occupation. This is no mean achievement, especially when mainstream discourse on water and rivers has remained limited to the elite few. At the same time, the post-disciplinary effort to bring various disciplines, from arts, social science, business, jurisprudence, and science, made the participants realise that unless a collective effort is made, as is the case when people suffer from natural disasters, no amount of intervention would be able to transform the state of things and reproduce healthy, liveable rivers. This transformation would make the bulk of the rivers in Bangladesh and even South Asia worthy of their names after gods and goddesses. However, efforts must be made to carry this further, even making schoolchildren aware of the dismal state of our rivers and how a 'living entity' can reproduce and flourish.

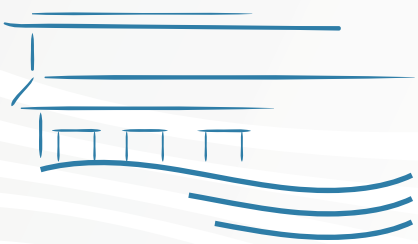
Finally, the time has come to reflect on the Water Museum itself. There are two sides to this. Given the number of rivers in Bangladesh and the latter being a

The Interior of the Water Museum (Nilganj Union, Patuakhali)

water-centric country, one could establish more water museums and not limit such museums to the one ActionAid has constructed in Kalapara, Patuakhali. After all, the eighth largest country in the world by population, or more precisely 174,326,037 people in 2024, cannot be expected to reproduce a water-centric mind just by one museum. A beginning could be made by establishing a water museum in each of the eight divisions in Bangladesh. Secondly, there must be a concerted effort to scale up the Water Museum in Kalapara structurally and functionally. Linking the Water Museum to a nearby university or an educational institution could be one idea. This could go a long way in making the Water Museum sustainable and creating space for reproducing and deepening the water discourse in Bangladesh.

Let us keep our dreams alive!

Annexes



Annexe A

Water, Power, and People: A South Asian Manifesto on the Politics and Knowledge of Water, 1997

Imtiaz Ahmed[13]
Ajaya Dixit[14]
Ashis Nandy[15]

The last fifty years of water management in South Asia have been the story of an unfolding disaster. Throughout the region, the water and energy requirements of cities and villages have confronted a decline in the quality and quantity of water. These years have made societies in the region more vulnerable to environmental degradation and jeopardised the future international relations and economic well-being of each of the countries in the region. Particularly, unthinking attempts to mechanically bolster supply have almost invariably ignored existing scientific and social knowledge and ended up being a disgrace to the principles of good governance. Popular and journalistic writings on the science and politics of water have not helped matters, for they have endorsed perceptions that go against both the science of hydrology and the canons of ecological and economic rationality.

We make the following propositions with full responsibility based on present scientific and social knowledge. We believe that once the shibboleths of the past are shed, it may be possible to consider at least restructuring the political economy of water in South Asia.

I. Water and Governance: Water scarcity in South Asia results from abuse and wastage of water and general mismanagement of natural resources sanctioned by present styles of governance in the region. While human and ecological needs for water call for accountability at every level of the state, the tendency in South Asia has been to sacrifice good science for motivated management that ensures subsidised and

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14. Visiting Professor at Kathmandu School of Law, advisor to ISET-Nepal, and senior fellow at Niti Foundation Nepal. Dixit was educated in India and Scotland and was a visiting fellow at the Australian National University, Canberra.

15. Political psychologist, social theorist, and critic. Nandy was a Senior Fellow and Director of the Center for the Study of Developing Societies for several years. Today, he is a Senior Honorary Fellow at the Center.

copious access to water to those already privileged. It is a self-perpetuating cycle: the wealthy benefit more than the poor from government policies and can more easily bend the rules not only to misuse or wastewater but also to take water further away from both the neediest sections of the population and the environment.

Half a century of South Asia's construction-led water development has failed to address the basic sources of the suffering of the people. It has not provided wholesome drinking water to rural, urban, and suburban areas. On the contrary, misplaced development priorities have ignored the diverse social contexts of water to damage the foundations of social and community life. Farmers, artisans, and others in rural areas have been forced to migrate to overcrowded cities without adequate infrastructure, employment, housing, and sanitation, for they have been displaced from lands that can no longer sustain them. Meanwhile, overcrowded cities generate organic wastes, adding to the level of pollution and further straining the supply of fresh water.

II. Science, Uncertainty, and Risks: Unlike popular writers on the subject, good scientists know that science and technology alone cannot explain the complex, interactive processes shaping the relationships among water, nature, and human intervention. While the natural science-led approach to water tells much about the physical and chemical processes involved in harnessing or developing water resources for human use, it cannot explain the social contents of water management or the institutional responses needed for just and equitable water supply. Most water management takes place at the individual, household, and community levels. At that level, motivations to act or reluctance to change are formed, information is created and interpreted, and shared understanding is used as a basis for action development.

On the other hand, a social or political approach to water is also insufficient by itself. Purely social approaches to water are not informed by global concerns and cannot easily rise above crass empiricism. Better science, including traditional sciences, must inform and empower the systems of water use at the grassroots and sensitise the science of water management to social realities.

The natural sciences concentrate on large-scale alteration of the volume, timing, location, or quality of water available in a region. Yet, South Asia's hydrology is inherently associated with high uncertainty regarding precipitation, water flow, and sedimentation processes. The high seismicity in the region adds to the complexity and aggravates risks. Such uncertainty is exacerbated by the weak institutional linkages and partisan politics within which the data on water resources are organised, interpreted, and used. These data have now become more discrete than ever and can hardly qualify as information, let alone knowledge, though they are often vented as wisdom.

Decisions on massive water development projects are often modelled on water regimes developed in other regions and the limited or parochial database.

In the extreme climatic variations in South Asia, these models often do not work, particularly in the mountainous regions where several storage projects have been planned in recent years. Such borrowed models are even more sterile when they recommend using surplus monsoon water in lean periods to ensure the future supply of fresh water and energy to the region. However, due to high sedimentation rates, all such storage facilities get exhausted much faster than is usually assumed. This has already happened in the case of several high dams and multipurpose projects. Most cost calculations for such projects have turned out to be useless, misleading, dishonest underestimates. Given the present plans, access to wholesome water will remain a mirage for the majority.

III. The Hubris of Modern Technology and Global Capital: Decision-makers are incapable of thinking of water management except in terms of supply augmentation through technical interventions. New and sophisticated technologies allow control over the movement of natural water to meet its growing demands, but it cannot separate water from society. Water use continues to occur within the existing asymmetry of wealth, knowledge, and information, as well as conflict and struggle for power. Global capital, too, seeks quick returns, not bottom-up initiatives necessary for self-reliant change. The centralised culture of the institutions controlled by such capital is neither equitable nor benign. It is actually against participatory, democratic decision-making. The hubris of technology and global capital, ignorant of the contradictions inherent in their approach, guides the large water resource projects and drives a wedge between the investors and the mass of users dependent on water resources.

IV. Dams and Profitability: While the decision-makers, media, and modern intellectuals have remained dependent on the West in their orientation to water, ironically, the West has shown greater ingenuity in harnessing creative ideas and practices. Thanks to the colonial legacy, the South Asian elite continues to borrow ideas and practices from a bygone era of the West. Thus, when mega-dams in the West are increasingly being criticised for being economically unsound, socially harmful, and environmentally hazardous in South Asia, they are seen as symbols of development. South Asian schools, colleges, and universities remain among the last champions of the cause of mega-dams in the world.

For example, most large dams of the region are inspired by projects such as the Tennessee Valley Authority (TVA) in the United States, and their construction has been, virtually in all cases, totally uninformed by detailed and serious study of local conditions, communities, surviving traditional water management systems, local knowledge and practices. The legitimacy of projects like TVA has diminished dramatically in the West, and they are now considered extravagant mistakes. This awareness has not, however, seeped into South Asian public discourse. Uninformed policymakers, greedy contractors, and self-serving and inept politicians have taken advantage of this knowledge gap to pursue their self-interest through the myth that large dams are the only means of ensuring water security.

This has further strengthened the links between the unconditionally pro-dam attitudes of the elite, a sizeable section of the media, and the media-exposed public on the one hand, and those who stand to gain from its implementation on the other – local and foreign contractors experts and minions of the state. Any attempt to promote sustainable alternatives for meeting water and energy needs must acknowledge this relationship between knowledge production and knowledge diffusion and take into account the vested interests of politicians, bureaucrats, construction companies, academics, and technocrats. The consistent failures of the dam builders to ensure the proper relief and rehabilitation of those ousted from their lands and vocations are, therefore, not an accidental by-product of modern water management principles but one of the necessary corollaries.

V. Water and Equity: Water development in contemporary South Asia remains a majoritarian venture, organised and implemented mainly at the expense of the needs and welfare of minority social groups, particularly the Indigenous people. This is particularly true of dams, canals, and reservoirs. Such projects displace people from their ancestral lands with insufficient or no compensation. When they do receive some financial compensation, they are unable - especially if they are not a part of the monetised sector of the economy - to use the money meaningfully. Often, such compensation further impoverishes the community by encouraging alcoholism, gambling, extravagant consumption, and entry of land sharks into the communities. Such traumata may lead to increased frequency of various forms of personality disorders and even higher rates of suicides. Some victims react to such social and cultural disruptions destructively; they begin to build new identities. Some even embrace extremism and violence.

Historically, South Asian women have played a critical role in water conservation. As water-bearers, women had specialised knowledge of water conservation, purification, and treatment. The role of South Asian women in water conservation and management has shrunk with modernisation. Indeed, development has brought the subject matter of water management under the hegemony of "masculine reductionist science," as one scholar-activist calls the pathology, and helped displace women from water conservation and water management. This displacement, and the silence and powerlessness it has enforced on women, has distorted the basic configuration of the cultures in this part of the world and impoverished them.

VI. Water Insecurity and the Costs of Water: Insecurity about water is linked to environmental insecurity and social uprooting. Growing population, deforestation, overgrazing, conventional developmental economics, and unsustainable agronomy all contribute to the water scarcity that today plagues South Asia. For instance, most chemical fertilisers not only require enormous amounts of water to be effective, but they also contaminate water sources, making water even more scarce. The use of such fertilisers has now become routine in South Asia, given the fascination for the high-yielding varieties of crops. The issue of land security is closely related, and pesticides and chemical fertilisers constantly threaten it. One researcher has shown

that in the past, about 30,000 rice varieties were cultivated by South Asian farmers. Today, thanks to the modern technique and the desire for uniformity, only about 15 varieties are produced. Together, water and land insecurities underwrite food and environmental insecurities and destitution.

The situation is worsened by the rapidly growing cost of supplying water. Not only do people experiencing poverty have no easy access to safe water systems, but they also lose their traditional water management skills and local institutions oriented to such management; they even lose access to water commons. For instance, water pumps, usually set up with the aid of official agencies at subsidised rates, are frequently cornered by the village elite, who then sell water to poor farmers at exorbitant prices. The cost the poor pay is not merely economic; they are also the worst sufferers of water-borne diseases, often spread by mindless over-intervention in natural water systems. This overburdened the already meager health budgets of South Asian states.

VII. Decentralising Water Management: Decisions in water management are usually state-centric rather than community-centric. While successfully implementing large-scale, capital-intensive irrigation and hydroelectric projects, centralising water management and water development has led to bureaucratic neglect of local needs. Often funded by international donors through government agencies, such centralised water systems are hostile to local initiatives in matters of water crisis and water security. Such centralisation plays into the hands of those constantly trying to convert water into a national security issue. Consequently, decisions about water are dissociated from its actual uses. Those making such decisions begin to suffer from oversimplification, lack of transparency, and absence of accountability.

Because the resources are naturally decentralised, water management and water development must be brought under the control of local government and monitored by civil society. Devolution of political power for decentralised management is bound to trigger new, socially creative forces, including greater local participation and enterprises.

VIII. Denationalising Water: The South Asian states have nationalised their water, particularly their rivers and seas. They consider the water within their boundaries as "state property," even though such water remains under the jurisdiction of a national state only temporarily (like the "air" around us, which is yet to get "nationalised")! Such nationalisation, apart from producing inter-state conflicts, trivialises the water needs of the people. It also perpetuates the propensity for rent-seeking, as seen in eastern India in the case of the Ganges, parts of which have been leased out to a new species of "water lords."

Also, in their eagerness to safeguard the water under their control, to the point of turning water into a national security issue, the states ignore precisely those for whom the water is supposedly being protected. They place more emphasis

on the techniques of protection (on absurd secrecy and deployment of security forces, for instance) than on the water being protected and the people using it! This occasionally leads to bizarre developments. While people crave water, standing in queues for hours or travelling miles to fetch it, the states keep quantifying and debating their water needs. For instance, whether the Farakka barrage has harmed Bangladesh or not, the fact that it has meant devastation for many communities in Eastern India, particularly Bihar and West Bengal, is one of the better-kept secrets of the Indian state.

In South Asia, large dams particularly have become symbols of a nation's maturity and virility and a major instrument for their "national development." The status of such dams has not diminished an iota in policy-making circles; on the contrary, any criticism of mega-dams, even those that stress the welfare of future generations, is seen as an attack on the nation, its security, and its chosen path to modernisation. That is why the productive capacity and utility of a dam in the region are measured less in terms of environmental, economic, and cultural costs and benefits and more in terms of measures such as size, investment, financial outlay, height, and the majesty of its conceptualisation. So effective is the propaganda unleashed in the name of national development that a sizeable section of the common citizens - who otherwise would not trust politicians, bureaucrats, and contractors in matters of money - places its total faith in them when it comes to water development.

No wonder, therefore, that there has yet to be a genuine overall social and economic audit of the past water development initiatives in South Asia. Even India, which has built roughly 1500 large dams, has yet to comprehensively audit dams, not even of its prestigious ventures like the Damodar Valley Corporation (DVC) and the Bhakra-Nangal. Nor have even ordinary, commonsensical, fundamental questions about these dams been raised, except by environmentalists. For instance, there is no official explanation why, if the DVC was so successful, some of its projected dams were not built or why a huge proportion of electricity generated by the corporation is now thermal, not hydroelectric, in contrast to the claims of the project plans.

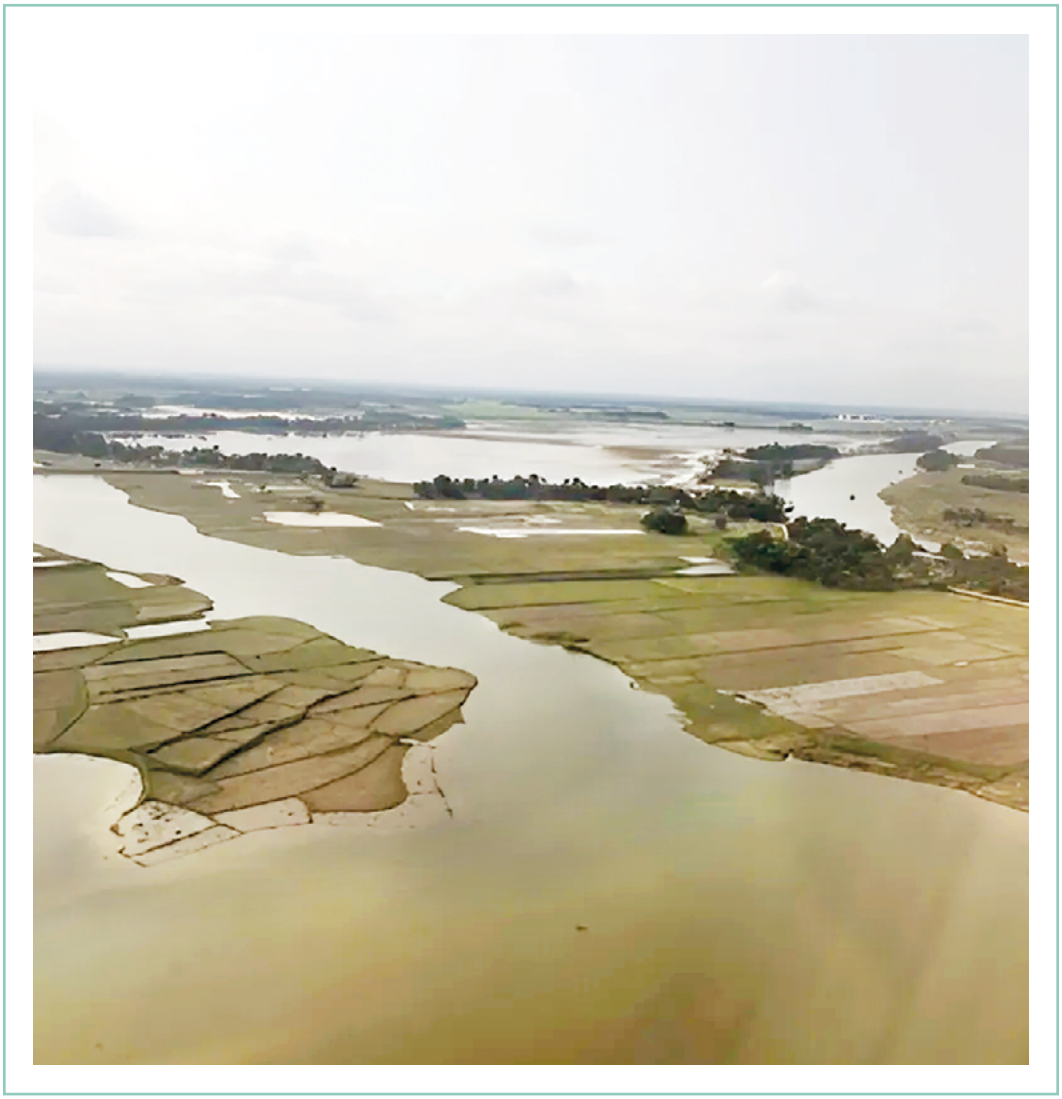
Nationalisation of water has also led to dishonest, contradictory positions, even in movements resisting large dams. Many who question the utility of large dams in neighbouring countries (such as the Farakka barrage) are perfectly willing to support similar ventures in their own country (such as the Kaptai project), and those who question such initiatives in their country keep quiet when they are promoted in the neighbouring countries.

Denationalising water means freeing water from the national state's power and culture.

IX. Rivers Rights: The state and the people must codify and guarantee the rights of the rivers. Such "rights" have already been codified for oceans and seas. Under the United Nations Convention on the Law of the Sea, it is now the "general duty"

of all coastal states to protect and preserve the resources and the riches of the oceans and seas, not simply for the consumption of future generations but for the reproduction of human life itself. River rights can be enacted with similar goals in mind.

In recent times, vast amounts of human and industrial waste have been dumped in rivers daily. The polluted rivers not only spread water-borne diseases but also raise the cost of drinking water treatment. According to one estimate, 114 Indian cities, of at least 50,000 people each, dump raw sewage into the Ganga. The same is true for rivers running through Kathmandu, Dhaka, and many other South Asian



A silent cry of the rivers beneath the weight of industrial waste

cities. This is an attack on a civilisation defined by its great rivers, where millions of people consider the rivers "holy" and worship them. Polluted rivers not only spread water-borne diseases but also raise the cost of treating drinking water.

Rivers also have their rights, including the right to be relatively pollution-free, to be a safe habitat for riverine forms of life, and, within limits, to flow freely. Dams and sewer out-lets into rivers interfere with these rights. Large dams and barrages permit the state to restrict and encroach upon the customary rights and practices of local or indigenous peoples and riverine forms of life. While interference with rivers has contributed to modernisation, bringing electricity and irrigation facilities to a wider section of people, such water diversion from its natural course has often led to disasters, their magnitude determined by the scale of interference. For example, while large-scale surface irrigation has worsened water-logging problems and soil salinity, unregulated water withdrawal by upstream dams has dried up several rivers' downstream beds. In places, this has meant an attack on the economic and other life-support systems of the people, in turn leading to the creation of environmental refugees.

X. Towards an Integrative Vision: Till now, the approach to water management and water development has been fragmentary. Not only has it dealt with sea, river, and groundwater separately, but it has also been "land-centric." Water management, we believe, should centre around water; it must be based on the recognition of the wholeness of water and its intrinsic function in nature. A comprehensive view also demands critical interventions in the curricula at all levels of education. The principal challenge is, therefore, to integrate the global and the local, to alter the structure and nature of current decision-making models and the educational context within which they are generated, not only to accommodate a plurality of views but also to generate options that would reflect the larger reality of water in nature and human society. The transition towards a more secure future for water begins with participatory, consensus-seeking, democratic, accountable governance.

We write this declaration in the hope that it will help free younger generations of South Asians from the stereotypes and clichés of the past and give them more confidence in envisioning the future relations among water, power, and people in a less encumbered fashion.

Annexe B

Time for Women's Water Resources Council in Every Country: By the Women, of the Women, for the Women for Water

Mansee Bal Bhargava

Can you spot the women at #COP 29 at Baku Azerbaijan? How many?
Only 6 out of 78 government leaders mentioned the impact of climate change on women.
4 of the 6 were women. We need women's equal representation at the decision-making table for #ClimateAction
Source: *UN Women*

Background

In the last decade, when several ideas and decisions were exchanged digitally, the presence of panels in workshops, seminars, talks, conferences, and committees has become more obvious in almost all sectors from war to water. Focusing on water, most boardroom and policy meetings/decisions are often among the panels even though there is an abundance of women professionals working in diverse fields

of water and there is a serious urge to engender the sector. The skewed gender representational situations maneuver and manipulate water as a technical-physical matter and do not address the critical and complex social-ecological aspects of water including gender inclusivity. Besides, the manel compositions highlight women mostly on the vulnerable side and missing the strong presence and stronger participation (leadership) side.

The discourse on women, water , women in water and women for water are mostly geared towards a lens of women being more impacted by the water crises. Amidst the climate change and urbanisation induced water distress across the world, it is well-known that women and girls bear the brunt of it more given the patriarchal setup of the society. From bearing the responsibility of collecting water for household to maintaining hygiene, women have been doing it tirelessly and selflessly showing great resilience and leadership as well. The cumulative proportion of distress is far from matching the gender share in water decisions.

What is missed in this discourse and the reason for the above can be attributed to the poor representation of women leaders and professionals in the water sector policies and practices. At the mainstream professional side, women are far from matching the gender share in water matters despite there being several women from science, technology, engineering, arts, mathematics (STEAM) and allied fields besides from grassroots to politics who are bringing change and making immense impact towards reducing the water problems and finding solutions. From bearing the responsibility of domestic water to engaging in the global science of climate change, women water professionals have also endeavored into leadership at all scales. Importantly, these women have brought the integrated and interactive approach to the fore believing that water management is social-ecological management and thus water governance must drive the discourse. They also highlight that the water ecosystem and women can no longer be minorities in the water matters if the water crises need to be addressed and that aiming for environmental justice and social justice are to be the core of water governance.

Women in the water profession and leadership

The limited presence of women professionals in the water sector in South Asia has received increased scholarly attention in recent years (Liebrand 2014, 2023; Narain & Goodrich, 2024). According to a World Bank (2019) study, there is only one woman among five water professionals around the world. India performs lower than the world average despite the fact that there are several women professionals undertaking exemplary work in the allied fields of water, such as natural resource management; WASH (water, sanitation and hygiene); new water technologies, pollution, wastewater, and even gender matters. However, when the professionals are weighed from leadership and decision-making positions, the percentage is meagre and concerning. Very few women are at the forefront of water institutions

despite their hard work in the background. Their contributions go unnoticed and their involvement in crucial policy-program decisions and actions is undermined. Then, when initiatives are taken to felicitate women's leadership in the water sector, often an approach of highlighting women's leadership from the rural and vulnerable community is noticed. For example, the UNDP-SIWI Water Governance Facility, Governance, Accountability and Learning for Water Sustainability (GoAL-WaterS) project[16] made a serious contribution in highlighting 'Women Water Champions: A compendium of 41 women stewards from the grassroots' of India. It is undoubtedly crucial that the efforts of the rural and vulnerable community women leaders are acknowledged and appreciated in order to motivate and support them to continue the hard work and influence society to solve water problems and bring societal change.

At the same time, it is crucial that professional women who have been playing an active role in the water sector in various capacities as scientists, entrepreneurs, educationists, planners, engineers, policy analysts, architects, grassroot practitioners, and activists, be acknowledged and appreciated (more than in place) for their presence and participation. It is noticed that the works of most women water professionals (barring a few) often go unnoticed, and do not get the due acknowledgement and appreciation besides, exclusion in the mainstream water decisions and actions which is crucial to bring a change in the way water management and governance happen.

The limited acknowledgement and appreciation have hindered the rise of women professionals into leadership and decision-making positions where they can be influential changemakers. Limited acknowledgement and appreciation also affect the motivation and career path of the women professionals besides slowing the process of partnerships in the absence of known role models in the public domain. Should we hope to arrive at a comprehensive understanding of the water problems and finding solutions change in the gender composition in the leadership and decision-making positions is crucial.

It is now clear that women are required at the forefront of the water sector as crucial 'agent of change'. It is thus, important that the presence and participation of women professionals is made more visible firstly, to influence and shape the discourse on gender mainstreaming in the sector; secondly, to identify challenges that still need addressing in this regard; and thirdly, highlighting the contribution of women in the decision-making to have a demonstration effect in order to bring more women into the mainstream water sector. There is also an urgent need to discuss more about women for water partnerships towards leaderships to address the women in water matters in big platforms like the COP, UN Water, World Water Week, etc.

16. https://siwi.org/publications/women-water-champions-a-compendium-of-41-women-stewards-from-the-grassroots/

Water Resources Council of WICCI

For women to rise to the leadership and decision-making positions partnerships are crucial which will also be useful in scaling their engagements and strengthening their social-political-cultural impacts. With this backdrop, a Water Resources Council was formed in the Women's Indian Chamber of Commerce & Industry (*abbreviated as and from hereon,* WICCI-WRC) in January 2020 to influence and increase the representation of women in the water sector in India. It is aimed at influencing water inclusivity in all sectors – the government, business, industry, and community. The objective is to further influence women to engage in the water sector and thereby increase the presence and participation of women for partnerships towards leadership besides engendering the water through youth empowerment.

India being in the midst of severe water crises as well as exploiting serious emerging water techniques and approaches to address the crises, the engendering of the professional network through the WICCI-WRC will bring crucial social-ecological aspects into the discourse. This may also lay a path for other South-Asian countries to consider setting up their respective Water Resources Council taking women engagement more intrinsically than before.

The Women's Indian Chamber of Commerce & Industry (WICCI) is a National Business Chamber for Women and an association engaging women entrepreneurs and leaders from across various sectors life through advocacy, pro-active representations to government, implementing projects for women via funds allocated by various government agencies and corporates, plus bringing awareness on all issues that concern women. WICCI aims to boost and build women entrepreneurships through greater engagement with government, institutions, global trade and networks. It also aims to bring fundamental changes in the governmental policies, laws, incentives and sanctions to encourage and empower women in business, industry, commerce, research, education and more across all sectors. WICCI is supported by global networks of All Ladies League (ALL is a movement of sisters beyond borders), Women Economic Forum (WEF is a platform for business beyond border'), and SHEconomy (is an e-commerce for women in goods and services for commerce beyond borders).

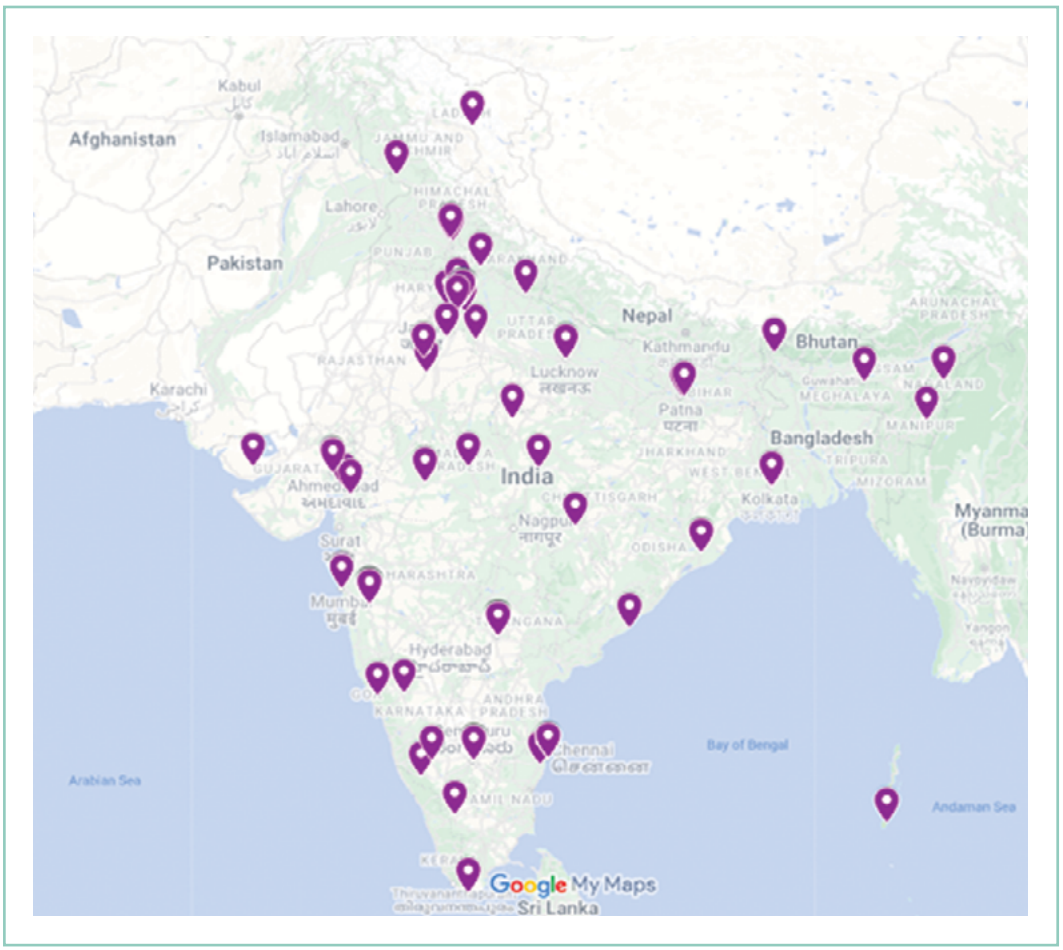
There are several councils formed in WICCI, the Water Resources Council being one of them. The WICCI-WRC represents women leaders engaged in exemplary activities around water and allied fields such as, water resource conservation, water utility, wastewater management, urban-periurban-rural water, local-national-global water management, modelling good governance, grassroots mobilization, legal action, access to clean drinking water and sanitation, hygiene, water injustice and ethics, pollution, waste, marine life, biodiversity, health, education, climate and water, water and food, water education, lakes and ponds, etc.

With a humble beginning in 2020 with twenty council members, today the

WICCI-WRC has hundred plus women water professionals including youth members and national, state, and city council members spanning from across the country. In addition, there are twelve council advisors including four male members and two international advisors representing Asia, USA, and EU. The council membership is invited as a call for nomination. Currently, WICCI-WRC is led by Dr Mansee Bal Bhargava (Founder Director of WforW Foundation) as National President (since March 2022) and Dr Nivedita Sahu (Scientist at CSIR-IICT Hyderabad) as Vice President. Before this, Dr Bhakti Devi as National President and Dr Mansee Bal Bhargava as Vice President led the council from its formation until the early 2022.

The growing WICCI-WRC Council Members 2022-24-26
Source: *WICCI-WRC teamwork*

In the current leadership, the WICCI-WRC aspires to be a think tank with a structure of a citizen collective with a vision to re-assert the role of women for water in policy, practice, and pedagogy on water. The mission is to increase the representation of the water leaders by amplifying their visibility in the mainstream water activities through documentation and dissemination of their water endeavors. Taking the Sisterhood concept, the network of the water broads (with efforts to continue expanding) is showcased as a Water Bank of India. The agenda set for building the WICCI-WRC platform is, 'Partnership towards Leadership'. The idea is that for women to rise to leadership and decision-making positions, partnerships are crucial as they enhance the presence and participation of women in the sector, besides shaping the social, political and cultural influence over water matters. The Council is geared to walk and talk together as a *'Neer-aur-Naari'* Abhiyan alias 'Water and Women' Movement.



Geo-spatial location of the water leaders
Source: *WICCI-WRC teamwork*

Some important and interesting ways of increasing collective learning and sharing are conducted to instigate engagement of council members and impact on future women/council members. One important activity of the council has been the, Monday Munching and Musing with Women for Water, an online conversation (video) series[17] to learn about the journey of women professionals. Some other notable activities are:

- Representation at the World Water Week Stockholm for, 2024 (onsite) for a Talk Show[18] on an ongoing research project on, 'Water anxiety over security: Distressed Women in disaster led displacement' supported by WODER; 2023 (online) for a panel discussion[19] on, 'Women Leaders: Leading Innovations for Change in the Water Sector'. Both the sessions were supported by the host Stockholm International Water Institute (SIWI).

- Panel on 'Role of Women in Commons/Asset/Resource Management: Case of Water Management' at the 3rd International Conference on, Maintenance and Intelligent Asset Management (ICMIAM2022)[20], hosted and supported by Institute of Rural Management Anand (IRMA).

- Partner in Water Fest 2023 (Theme: Be like Water) hosted by WforW Foundation and TISS Hyderabad.

- Partner in Water Fest 2024 (Theme: Water Connects) hosted by WforW Foundation and IIT-BHU Varanasi.

- WICCI-WRC Regional Workshops, February 2023 hosted (onsite) by CSIR-IMMT, Bhubaneshwar; March 2023 hosted (onsite) by Navjyoti-RMTI Gurgaon; April 2023 hosted (onsite) by Mool Shrishti- Parijai Genus, Chandigarh; November 2023 hosted (online) by SRM-IST, Chennai.

- The council members are regularly hosting and speaking at various platforms including the conversation series namely, Wednesdays.for.Water and Friday Waters hosted by WforW Foundation.

- Ongoing Research Project with youth council members on, Tracking and Tackling Plastic Pollution in Ganga Basin with Centre for Global Affairs and Public Policy (CGAPP) since March 2023.

- Ongoing Coffee Table Book about the short biographies of the WICCI-WRC members.

- Regular co-writing publications with youth council members.

17. YouTube series link: https://tinyurl.com/4s7st69h
18. https://www.youtube.com/watch?v=HQUcCTnc1mQ&list=PLI3myanJ6_jRefgSRJzt4_Euls7r8Bvaq&index=3
19. https://www.youtube.com/watch?v=Of8kaxC0h8o&t=827s
20. https://www.irma.ac.in/conference/icmiam-2022/overview

A council is good as long as the council members give to it and get from it. The council members are therefore, encouraged to engage in all possible ways. Council members are collaborating on research, academics and projects, keeping each other updated through the group messages and social media, receiving awards at various platforms, motivating and mentoring the young council members, etc.

Way Forward for Bangladesh Water Resources Council

What is there for Bangladesh in here? For Bangladesh, a country made up of water (delta, rivers and tributaries flowing through its landmass), shows a profound relationship with life and livelihood of women folk as a source of sustenance as well as challenge. Though professional women percentage remains a challenge there is a progress in the country like in most South Asian countries. The water sector has been specially advantaged with women professionals in Bangladesh. This may be attributed to both vulnerability from water crises where women are impacted more and more women engaging in the development sector.

It is a good time to advocate for a National Water Resources Council in Bangladesh with a specific initiative by the women, of the women, and for the women for water. All it requires is a concerted and collective campaign by all humanists (not feminists alone) to increase the presence and participation of women water professionals in a more organised manner to escalate the advocacy for water justice, water commons, water governance, and rights to the vulnerable communities and the indigenous being that is discussion here, the water. The National Women's Water Resources Council of Bangladesh (NWWRCB) may focus on setting up a platform to foster scholarships and fellowships to promote water education, research, and professional, policy, and community engagements, besides partnerships towards leaderships.

The ActionAid Bangladesh (AAB) may like to assess the readiness of the situation, initiate the process with its current network of women water professionals, and find it a house at one of the organizations namely, The Bangladesh Water Development Board, The Chamber of Commerce and Industry, and The Ministry of Water Resources. Since, AAB has inspired actions and collaborations to bring meaningful change in the presence and participation of professional women. In the last 9 International Water Conferences organized by AAB since 2016, there were nearly 50% women who participated in the presentations, and the subject of gender and women found just above 10% coverage in the submissions addressed by women and other presenters. While the participation sounds promising, the discourse on gender and women needs strengthening. The latter can be improved by mentoring more women professionals and youth to take gendered perspective besides, providing support for education, research, partnerships and leaderships. AAB is in good position to rope-in the Think Tanks, and like-minded associations and networks to pool-in resources to take this campaign forward. A simple way to start also is to acknowledge and appreciate the works of women professionals by documenting and disseminating their ideas, implementations, and impacts across

allied fields of water. This has to happen at both levels, individual and collective, for which such platforms become crucial for getting and giving insights. The planned 10th International Water Conference in 2025 may be a good time to launch the initiative to be ready with the framework and some members of the council by the 11th International Water Conference in 2026.

At a time of rising water crises, gender justice is crucial and concerning with every passing day. The gender justice will also trickle from the professional settings which at present requires serious overhaul with barely 1 in 5 water professionals in the world being a woman. A specific platform by the women, of the women, and for the women for water may become a vital voice for the many voiceless affected women and the marginalized including the biodiversity. Extending the phrase, "educating a girl child means educating a family" in this context to 'empowering a professional women means empowering a clan or a community of gender and generation besides the ecosystem'. It is no exaggeration that increase in the presence and participation of women as a significant mass in the decisions and developments of the water sector will transcend the STEM to STEAM perspective and further bring the social-ecological-moral compass into the fore of water management and governance, which is a need of the hour. It is important that the collective/consortia is formed for meaningfully scaling and strengthening the women engagement to make a larger social-political-cultural impacts on water as well as women decisions and developments. This is thus a call to all water professionals in/of Bangladesh to get on to the formation of a National Women's Water Resources Council of Bangladesh.

Acknowledgement:

All WICCI-WRC members for agreeing to come onboard. Megha Gupta and Anubhti Shekhar for helping through the nomination process and coordinating the documentation and dissemination. Harshita Sehgal for documenting the nominations. Dr. Harbeen Arora and Dr. Ritu Singh from the WICCI office for guidance in forming the council and carrying the admin works. ActionAid Bangladesh for accepting the idea of writing this essay and inclusion in the manuscript.

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Annexe C
Jal Satyagraha: Water Governance for Water Justice

Mansee Bal Bhargava

Source: *https://www.counterview.net/2017/05/madhya-pradesh-officials-threaten.html*
Source: *https://www.youtube.com/watch?v=3tNSlfzs6nM*

Background

Satyagraha revered by Mahatma Gandhi and *Swaraj* revered by Dada Bhai Naoroji in the early 20th century form the early ideas of participatory governance including the nonviolent civil disobedience during the colonial period of the undivided India. The idea of *Swaraj* is of freedom on both individual and societal levels encompassing individual empowerment, self-governance, and self-rule. The idea of *Satyagraha* practised as a nonviolent resistance and civil disobedience involving holding onto truth and seeking it through peaceful means with prolonged campaigns has been instrumental in highlighting the gaps in the top-down governing of societies. That, the path to *Swaraj* is through *Satyagraha,* is proven by India's Independence movement.

Satyagraha has been broadly carried out as movements, campaigns, and protests over a long time over any societal issue irrespective of winning or losing the battle. Post-independence, *Satyagraha* in the form of protest has been exercised as a tool of dissent against several large developments and modernisation that were/are anticipated as a cost to (social-ecological) resources degradation, disaster,

displacement, and distress especially, by the affected and vulnerable communities including indigenous people.

Taking the idea of *Satyagraha* to water, *Jal (Sanskrit-Hindi word referring to water) Satyagraha* has a long and innate history in India. A century of *Jal Satyagraha*, on the one hand, provides a bleak scenario of top-down water management excluding or tokenising community participation using producer patriotism; and on the other hand, provides bold situations when the communities rose against the might of the government and corporates for themselves and for water. While the former is the discursive hegemony of water management in India, the latter is seeking a dialogue for integrated and interactive water governance. The innumerable *Jal Satyagraha* spanning spatially and temporally across the country show that the grassroots water workers continue to stand for the rights and righteousness of the water and the people dependent or affected by the non-participatory water decisions/projects by the governments and corporations.

Much of the *Jal Satyagraha* in India and the world has been predominantly anthropocentric. *Satyagraha* gained more scientific and societal ground post the three main pillars of Sustainable Development[1] in the 1987 Brundtland Report by the World Commission on Environment and Development, economic growth, environmental protection, and social equality. Then, protecting and conserving the water bodies, rivers, streams, lakes, mangroves, and allied services also became central to *Jal Satyagraha* in addition to socio-economic causes.

There are innumerable conflicts that occur between the citizens and the government/s transcending the regional-local geo-political boundaries and scale of water; when the government pretends to be more powerful than the citizens and when the citizens presume their right to rise for the various social-ecological aspects of water. This is when citizens chose the path of *Jal Satyagraha* as a peaceful and non-violent means to dissent against some policy or project or set of those.

There are innumerable community-led water movements, campaigns, and protests currently ongoing around the world organised on various social-ecological aspects of water and even for humanity to survive. Those are waiting to be put together to better understand the pattern of rising water distress among communities alongside rising distrust between them and the government/s and corporations. Water being the connector, the water distress also percolates into the other social-ecological-economic-political spheres. In addition, climate change-induced water distress creates a higher probability and concern of increasing *Jal Satyagraha* at global as well as local levels.

Putting together the numerous movements, campaigns, and protests can help us relook at the possibility of restoring the community/participatory water management with facilitation from the policy and funding by the governments and the corporates instead of increasing the transaction cost of the conflict between the

actors and the water conservation efforts. It is also crucial to understand the nuances of the *Jal Satyagraha* to understand the attributes of the movements, campaigns, and protests to explore the room for improvisation in the decades of (failed) auto-technocratic water management approaches that have increased water distress from disasters like flood, drought, glacial lake outburst flood (GLOF), landslides and from discriminatory practices in access to water and sanitation.

While the access to water is divided between urban and rural and further to rich and poor, the *Jal Satyagraha* has been raised primarily by the deprived and vulnerable thus often the rural/hinterland communities. However, things are changing and *Jal Satyagraha* may slowly find a centre stage with the rising water crisis because the top-down discursive hegemony of water management is challenged to find solutions to the rising inequity in the access to water and sanitation for all. Also, the water crisis is seeping into everybody's life irrespective of location and people's status.

This essay is a brief on the history and the characteristics of *Jal Satyagraha* in India since 1900 and elsewhere in recent times in order to engage in a discussion on understanding the importance of movements, campaigns, and protests as integral parts of water governance.

Jal Satyagraha Around the World

Water movements, campaigns, and protests around the world have a long history. A few of those from this century are mentioned here to understand the situations and attributes to draw parallels with the *Jal Satyagraha* of India.

Water being a crucial component of complementing or conflicting relationships between a community and its government often gets entangled with other social-ecological-economic-political dynamics. For example, the water protests in northern Africa and the Middle East[2] in 2018 emerged out of the urban-rural divide, political instability, and distrust of the government; in the United States, the lead contamination[3] brought out the demonstration against racial discrimination in 2016, then the demonstrations in 2017 against the Dakota Access Pipeline (DAPL) project[4] over land rights became a global headline.

The water corruption-induced conflicts also get into religious, traditional, and cultural systems making the water governance weak and triggering unrest in the society. For example, the tribal clash in southern Iraq[5] in 2018 over water scarcity, and the government's inability and will to provide agricultural water; the Afghanistan[6] water crisis in 2018 got interwoven with the religious, traditional and formal system lowering the country's ability to handle distress; the control of mafia over the urban water of Pakistan (2021)[7] weakened the enforcement of water laws and economic development in the country.

Much of the differences between any community and its government are due to a

lack of trust in the government due to poor water governance. Issues like inequitable access, destruction of facilities, weaponising water, control of the decisions over water resources, water contamination, floods, droughts, displacements, urban-rural divide, class divide, water tariffs, privatisation, large construction projects (like dams), etc. have been the core issues of *water campaigns* around the world. For example, the famous Cochabamba-Water-Wars[8] of 2000 by the Bolivians against its government over the privatisation and rise in water tariffs. Similarly, the anti-privatisation campaign by the Nicaraguans[9] between 2001-07; the Egyptians campaign between 2007-10 led to the 2011 famous Egypt/Arab rise[10]; the Chinese rose to protest[11] over pollution in drinking water, fishery, waste pipeline in 2012; the 2021 Tunisian Khemir Tribes campaign[12] against the mining exposed the breach of tribal rights and services; and the South Africans have been fighting[13] for their rights to access to water for decades.

Jal Satyagraha in India

In the early twentieth century, among the many *Jal Satyagraha* the well-known is the Kandel Nahar *Satyagraha* (1920)[14] of Chhattisgarh led by Pt. Sundarlal Sharma (known as the Gandhi of Chhattisgarh) and Babu Chotelal Shrivastava against the high irrigation tax imposed by the British Raj; the first anti-dam Mulshi *Satyagraha*[15] (1920) of Pune led by Pandurang Mahadev Bapat (popularly known as Senapati Bapat); and the Mahad *Satyagraha* (1927)[16] (also known by Chavdar Tale) between the people of Maharashtra on the inclusion of 'then considered' untouchables (in principle, this nomenclature is unacceptable to me but quoting as written) for the basic human right to drinking water from village pond.

The success of Kandel Nahar *Satyagraha* is the genesis of the start of the 1930 Civil Disobedience Movement for India's Independence. The Mulshi *Satyagraha* on anti-dam was lost to the TATA group over providing electricity to Mumbai, can be seen as a beginning of the rise of capitalistic development and urbanisation over the rural lives where generations of the village community still cry for their lost land. The Mahad *Satyagraha*[17] fought by Babasaheb Ambedkar in the Maharashtra court for nearly 10 years was won but the win over the issues of caste (and class) division in the society is still afar which still denies access to basic facilities of water and sanitation to the poor/vulnerable in several parts of the cities and villages of the country. The Mulshi and Mahad *Satyagraha* also laid the foundation for a legal route for the people to fight for their rights over land and water against their governments and corporations.

Much of the *Jal Satyagraha* in India has been resistant to the making of dams and hydropower projects such as, in Tehri; port projects such as, in Enroe Creek, Vadhavan port; river pollution such as, in Ganga, Yamuna; sand mining from riverbed such as, in Ganga and in Shivnath River; besides, mishandling of money and poor implementation of compensation and rehabilitation across all large and small water infrastructure projects such as in, Sardar Sarovar dam and Omkareshwar dam.

Despite the overwhelming imposition of the dams and ports (and deforestation,

Mahad Satyagraha and BR Ambedkar on an Indian 1991 postal stamp

mining) post-independence, there have been several *Jal Satyagraha* across the country which the governments succeeded in intimidating with the support of the judiciary bringing the development narrative to the masses. The anti-Tehri dam[18] (and hydropower project) movement from 1980 to 2004 led by Gaura Devi, Sudesha Devi, and Bachni Devi, and Sunderlal Bahuguna included the forest protest namely the famous Chipko movement in 2001.

As the judiciary-backed development narratives continue to suppress the different *Jal Satyagraha,* the increase and recurrence of manmade disasters like landslides, floods, and droughts are pushing to reflect on the relevance of the local wisdom. For example, the continued *Jal Satyagraha* of over four decades led by Narmada Bachao Andolan and Medha Patkar on the dam levels of Narmada and the related disasters and displacements[19] are well documented. The campaign for the rights of the river and the people in its basin seems never ending and is getting from bad to worse including those suffering in the upstream to now even those suffering at the downstream at Sardar Sarovar dam[20]. Similarly, in most of the interstate transboundary rivers like Ganga[21], Yamuna[22], Cauvery[23], Brahmaputra[24], Mahanadi[25], and Godavari[26], people in their basins have undertaken several *Jal Satyagraha and Jal Panchayat* in the past several decades.

Another continued *Jal Satyagraha* of over two decades to save River Ganga from pollution, corruption, sand and stone mining led by Matri Sadan[27] Haridwar and Shivanand Swamy is documented through several legal pursuits. The 60+ *Satyagraha* at Matri Sadan lay their foundation in the ecological conservation i.e., saving the River Ganga for the river first, followed by the related social-ecological aspects, thus bringing back the original idea of *Jal Satyagraha.* Resistance through 'fasting' has been exercised as a tool to advocate for free flow and cleanliness of the River Ganga called '*Aviralta* (free/uninterrupted flow) and *Nirmalta* (clean)' which is now the tagline of most Ganga Campaigns as, *Aviral Ganga-Nirmal Ganga*.

Targets and Tools of *Jal Satyagraha*

Satyagraha, as prolonged campaigns/protests, have one thing in common- the urge for good governance towards a better social and ecological system. *Satyagraha,* in fact, is a result of poor governance by the government where the community after being pushed to the wall rests on *Satyagraha* as a last resort/fight for the rights and righteousness of the water and the people dependent on water. In all the *Jal (other) Satyagraha*, the implicit demand is on community consultation and participation as a necessary step for any large-small water projects besides, the explicit demand for transparency in the project transactions. During a conversation with Medha Patkar in 2022, she argued that *Satyagraha* is a continuum as a pursuit for seeking truth, it also means, it is a way to unearth the lies in the process.

Among the many tools used in *Satyagraha*, the 'fasting unto death' is the strongest approach in *Jal Satyagraha.* For example, the *Jal Satyagraha* of Matri Sadan by Professor GD (Guru Das) Agrawal[28] (also known as Sant Swami Sanand and Sant Swami Gyan Swaroop Sanand), conducted a fast unto death in 2018 and eventually laid his life for the cause. Besides, walking like the Barodians 'march' for the revival of the Vishwamitri River; and immersing oneself in the water like the residents of Gogalgaon village, and neighbouring hamlets in Khandwa district remained immersed in the Narmada River for days to protest against an increase in height of the Omkareshwar Dam project, are common ways to seek justice from the system and the society. Dharna or occupying space with speeches, hoardings, and signposts often in front of the concerned authority is a regular and popular approach. The judicial route and writing joint letters as campaigns are commonly used across all forms of *Jal Satyagraha.*

What makes *Jal Satyagraha* distinct from protests and campaigns is the sustained efforts over time. The short protests/campaigns are often for immediate relief by people but many a time politically motivated by party workers. For example, the recent *'Kale Pani Da Morcha'* (War Against Water Pollution), is a fight for the 'right to clean water' by a group of environmental activists, farmer unions, and civil society groups from, Punjab, Haryana, Rajasthan against the unchecked contamination of Punjab's rivers and groundwater amidst inaction by successive state governments to the persistent contamination of the Sutlej River by the polluted waters of the Buddha

Nallah. A recent example of the politics of water is the Indian National Congress taking Delhi's streets against the continuing water scarcity by staging a *'Matka Phod'* (breaking earthen pitchers that are used to fill water) protest and further a hunger strike by Delhi's Water Minister. Such events are aplenty but what is important to take from it is the coming of water matters into the political discourse which is crucial. Since, if that happens, maybe the demands for transparency and participatory water planning, management and governance will also get noticed which are fundamental to the pursuit of *Jal Satyagraha.*

Way Forward

Is *Jal Satyagraha* a successful water governance tool? Does success matter? Success matters, if going by the need for those concerned about water resources and the people dependent on them in order to set a precedent to stand/rise for justice. Successful completion of such campaigns matters from the Mahad, Mulshi to Matri Sadan. Success does not matter if going by the fact that there is no panacea to *Satyagraha* like any water governance approach. Each *Satyagraha* is a struggle and a narrative in its own virtue. It is crucial to reflect upon the give & take in these microeconomic, materialistic, and moral governance negotiations. The anti-dam and port movements may have been subject to suppression because of the governments backed by the judiciary, but the subsequent recurring negative impacts faced are testimony that those who rose/rise against these projects had/have some arguments which must be heard and be factored in these large developmental projects.

The continued pursuit of *Jal Satyagraha* as a tool to express disagreement/ dissent through peaceful resistance is a testimony of its effectiveness. Since protest is an important governance tool in a democracy for an alternate voice, the *Jal Satyagraha* also has acceptance as an approach to make water management and governance accountable and pro-people. Also, the biggest apathy of *Jal Satyagraha* and all environmental movements is that people have to fight for the protection of their own environment against their own government.

As long as there is a lack of substantial public participation and transparency in the decision-making and management of the grand developmental projects, *Satyagraha* is here to stay. Also, the engineering-technical solutions of mega water infrastructures continue to be challenged to factor the social-ecological components into the big economic dreams, resulting in a huge negative externality on society and biodiversity.

For long *Jal Satyagraha* has been the domain of rural, tribal and vulnerable communities. For example, the ongoing #SaveHasdeo[29] *Satyagraha* to protect the Hadeo forest that is home to 15,000 Adivasi (indigenous) people, who depend on forest produce and the Hasdeo River that irrigates their crops. Much of the urban populace has been complacent about the services and indifferent to the plight of the rural/hinterland population. However, with the rising flood, drought, other

disasters and asymmetric distribution of water besides the rise of water awareness and environmental stewardship, cases are now emerging of involvement of the urban population[30] in *Jal Satyagraha*. For example, the 2019 protest in Chennai[31] when the city ran out of clean drinking water; the 2019 movement against the displacement due to the Sardar Sarovar Dam at Barwani's Rajghat in Madhya Pradesh[32]; the 2021 campaign in Mahanadi by the people of Sambalpur and Cuttack[33] over the fear of displacement; and the March on revival of Vishwamitri 'Vaho Vishwamitri Abhiyan' by the people of Baroda[34].

So, *Jal Satyagraha* will continue to see leaders and community organisations rise to make people aware and mobilise. More *Jal Satyagraha* is anticipated in the days to come with the rising water crisis and increased awareness of the people. Water education will play its bit in this social engineering movement towards pro-humanity-biodiversity desired good and sustainable water management and governance policies and practices.

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Annexe D
Kuakata Declaration

16 March 2016 | Water Museum, Kalapara, Bangladesh

Free flow of rivers and precipitation are the main sources of fresh water in Bangladesh, and ninety percent of freshwater comes from rivers. In recent times, people of our country have been affected by the interruption in the free flow of fresh water from upstream during the dry season. As a result, some of the districts in the North Bengal region are showing signs of desertification. Natural resources, including the Sundarbans, are damaged because of salinity intrusion.

The Human Rights Convention gives special emphasis on taking development plan while ensuring the political, social and cultural rights of the people. Apart from that, Helsinki Rules on the Uses of the Waters of International River were issued in the UN Watercourse Convention in 1966, which was later approved as Helsinki Rules by the General Assembly (United Nations Convention, 1997). As per the convention,

Kuakata Declaration, drawn up by participating organisations and individuals in the "South Asian River Water Management and Initiatives" conference facilitated by ActionAid Bangladesh, was reinforced by all participants present on 10 March 2016

The theme of the 1st International Water Conference was "Right to Water and Defending Commons," focusing on ensuring equitable access to water and protecting shared water resources

there are specific provisions to ensure protection, preservation, and management related to the uses of those water-courses and their waters. For any construction in a transboundary river, all related countries, nations, societies, and stakeholders must be included in planning & implementation. Bangladesh, India and Myanmar are yet to ratify the convention.

"Water is a natural resource; its rightful use and conservation are our own responsibility."

There are 800 rivers and tributaries in our country, of which 1 50 are transboundary. However, bilateral negotiations with neighbouring countries helped recognise only 57 rivers as transboundary. Some of these recognised transboundary rivers are facing obstruction due to the construction of dams in several places. Some rivers from upstream have already dried up. This has an adverse effect on the people living around the areas. They are suffering from both floods and drought.

The underground water level is going down due to the decreasing flow of water in the water body and too much groundwater extraction. This has a negative impact on our agro-based economy, cultural heritage, psychology, and social infrastructures. The river is a precious asset for humanity. Our duty and responsibility is to ensure this resource's conservation and maintenance properly.

The International Water Conference prioritises both internal and regional water management to uphold and sustain the water rights of shared resources and communities

We do not want to confine our water-centric cultural heritage and traditions within the scope of the water museum. Rather, we hope to preserve and uphold this heritage. Under these circumstances, we have the following demands and proposals to the concerned authority:

Internal Water Management

1. To secure the equitable flow of water in rivers, strong legislation should be made to remove all kinds of obstructions and prevent future disruption.

2. Prioritising our local knowledge and cultural heritage in the greater interest of people, we should refrain from taking on any harmful projects instigated by international donor organisations.

3. As per international practice, before initiating any project, we must ensure that all related parties and stakeholders are included in the decision-making process. Hence, adequate measures and remedies are taken for the affected people after the implementation of such projects.

4. In any bilateral and regional discussion on water issues, the public should be informed. Planned discussion sessions with the community people should be organised to create consensus.

5. All harmful sluice gates, dams, and other establishments around the rivers and other water bodies should be removed to ensure environmental sustainability.

6. By amending the Water Law 2013, the conservation of rivers, environmental and ecological sustainability, and people's right over water should be secured, followed by the prohibition of any commercialisation of water.

7. We should stop repleting the wetlands and create new wetlands to reduce our dependency on groundwater and increase the use of open water bodies.

8. Water resources are being affected, and the free flow of water is being interrupted because of water governance in the name of a water management programme, unlawful possession of riverbanks in the name of development, and excessive pollution. The authority should immediately take appropriate measures against such harmful and (to some extent) illegal activities.

9. We should consider issues relating to the free flow of water, rightful use of water, prevention of any pollution, food security, disaster management, and climate change while building massive and permanent establishments.

Regional Water Management

1. The government should ratify the United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses 1997 as soon as possible and encourage neighbouring countries to do the same.

2. The Joint River Commission needs to be converted into the South Asian River Commission so that the SAARC countries can establish a relationship based on mutual trust on water issues.

Annexe E
River as a Living Entity: Bangladesh High Court Judgement, 2019

On July 1, 2019, the High Court Division of the Supreme Court of Bangladesh proclaimed all rivers in the nation as living entities. This groundbreaking verdict, initiated by a public interest case filed by Human Rights and Peace for Bangladesh (HRPB), intends to tackle the terrible pollution and encroachment affecting the country's waterways.

Like others, the Turag River was given the right to exist, flow, and support life. The National River Conservation Commission (NRCC) was designated its legal guardian to ensure preservation and conservation.

Four fundamental decisions were taken by the court

Source : (*Rivers Are Now "Legal Persons,"* 2019)

- In pursuance of the doctrine of public trust, the court declared that State shall perform responsibilities of a trustee in respect with all the rivers, sea, mountains, forests, lakes, ponds and other receptacles of water within the territory of the State.
- In pursuance of its parents patriae jurisdiction, the court accorded 'living entity' status to Turag and asked the concerned authorities to remove all the structures from its banks in next thirty days. The Court also said that the status will be applicable for all the rivers of the country.
- National River Protection Commission is declared by the court as the legal guardian of all the rivers of the country.
- From now on, National River Protection Commission will take necessary measures to protect all the rivers of the country.

This choice is critical for a country that has traditionally relied on its rivers for agriculture, transportation, and culture and is now dealing with the erosion of these lifelines. With just 405 rivers surviving from the original, the verdict calls for harsher fines for polluters and better accountability procedures.

While comparable programmes have taken place in India and New Zealand, Bangladesh's comprehensive strategy encompasses all its rivers, demonstrating their linked nature and the necessity for holistic protection (*India's Ganges and Yamuna Rivers Are "Not Living Entities,"* 2017; Roy & Jong, 2017).

The verdict also included specific directions to improve river preservation (*Rivers Are Now "Legal Persons,"* 2019)

Those are:

- The government is directed to amend the National River Protection Commission Act 2013 for making the National River Protection Commission effective and independent and to submit a report after complying with the order before this court in six months.
- Election Commission is directed not to allow any person accused of grabbing river land to contest any election including local government and parliamentary polls.
- Bangladesh Bank is directed to take steps so that any person, accused of grabbing river land, cannot borrow money from banks.
- The Ministry of Education is asked to take steps so that an hour-long class is taken once in two months in all government and private academic institutions including schools, colleges, universities and madrasahs in order to raise awareness regarding the rivers.
- The Ministry of Industries is asked to take necessary steps so that meetings are held for at least one hour in every two months among the labourers of mills and factories across the country for raising awareness concerning the protection of rivers.

This decision creates a worldwide precedent, underlining the need to conserve rivers for ecological sustainability and long-term water resource management.

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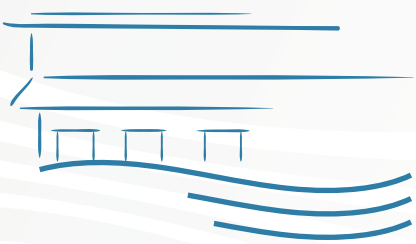
Annexe F

Abstracts of the Papers Presented at the International Water Conferences

Governance and Policy



Water Governance in South Asia

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For many years, water has been one of the most commonly contested bilateral and multilateral issues among South Asian countries. Conflict over water has strained India's relations with three of its neighbours: Bangladesh, Pakistan, and Nepal. The rapid retreat of the Himalayan glaciers, increasing effects of climate change, deteriorating river ecology, and growing urbanisation of the region have all impacted the freshwater flows in South Asia. India's unilateral approach to the problem has also made maintaining good relations among South Asian countries more complex. As a result, major transboundary rivers, including the Indus, Ganges, and Brahmaputra, which straddle international borders and support the lives of an estimated 700 million people, desperately need improved water governance. In the future, diminishing and degraded freshwater resources could lead to internal instability in many nations and possibly even spark interest conflict. In this regard, this article will highlight the impact of the water-sharing conflict on relations among the countries and the factors that give rise to the conflict on water sharing, explicitly focusing on Bangladesh-India-Nepal water issues. It will also focus on the measures that would ultimately ease the way towards improved transboundary water governance and mollify political and social tensions in South Asia.

Contextualising the Challenges for Effective and Equitable Governance of Water Resources in Urban Neighbourhoods

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The water crisis has become a crucial concern worldwide. As a megacity, Dhaka faces the challenges of meeting people's demands. Getting water is the right of every citizen. Equitable water distribution is needed but faces challenges due to socio-cultural factors. Equitable water governance means a systematic way in which each citizen can access water resources based on their rights and demands. Adequate and equitable water governance needs to get the people's (i.e. beneficiary groups') participation in the water policy; therefore, it would be easy to identify people's needs and rising challenges in the water distribution system. Dhaka Water Supply and Sewerage Authority (DWASA) has been playing a role as responsible authority in water distribution for Dhaka city dwellers since 1963 and falls into trouble maintaining equity in urban water governance. This paper tries to understand the urban water governance system, pushing questions on its effectiveness, efficiency, and relevance in urban neighbourhoods from the response of beneficiary groups. Besides, it demonstrates the class relation and water governance role using the group-grid theory by Marry Douglas and Max Weber's theory of bureaucracy to understand the socio-cultural challenges in the water governance (i.e. water distribution) system for Dhaka city dwellers. Furthermore, the role of Dhaka WASA and people's participation in water governance has been assessed by analysing the institutional environment, culture, and capacity from people's notions and choices. Thus, the institutional role and the arising challenges in water governance have been analysed to understand the context where people can make their notions and raise voices suggesting specific measures to solve equitable water governance problems.

Water Management for the Cities: A Review of Existing Policy Framework in Bangladesh

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Bangladesh has been experiencing unprecedented urbanisation over the last few decades. Water management is among the leading challenges posed by urbanisation. Compared to traditional water management challenges, the challenges are both formidable in extent and distinct in nature. High-density residential, commercial, and industrial development and accompanying infrastructure in urban areas interrupt the natural water continuum and flow paths of surface and geological water. Constraints arise in the demand and supply side of water use for human needs, and the ecology at large faces the risk of deterioration. Arguably, distinct urban water challenges also require distinct policy and management responses. From the view of the water continuum and flow path, regular water audits/assessments are needed for a customised framework. As regards the current policy, one typical policy response in favour of conjunctive use is likely to result in higher costs for tapped water, which will interfere with water rights issues. The outbreak of Dengue and Chikungunya and the underlying epidemiology strengthen the need for urban orientation of water policy. Despite the momentous importance, the urban orientation of water management still needs to be represented in water research in Bangladesh. Given the stated context, this paper will review Bangladesh's existing water-related policies and the water management practices of selected developing and developed countries to identify best practices for urban water policy. Examples include the National Water Policy, the National Water Management Plan (NWMP), and the Delta Plan. Meanwhile, the knowledge of managing urban water has developed significantly in different parts of the country. This paper will also compare the practices and policies of Bangladesh with the best practice examples.

Water in Chars: Social Justice for Resilient, Inclusive, and Productive Rural Economies

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The paper aims to discuss interfaces with the adaptive water strategies to achieve Sustainable Development Goals in Bangladesh since it has been taken as integrated documents for positive changes in Bangladesh, aligning with Delta Plan 2100. For comprehensive advancement, the Government of Bangladesh follows the SDG adage: "Leaving no one behind", but we see that 5% of the total population lives in the Chars are excluded in different government capacities. This study follows qualitative research design and the neoliberal trend, which follows the Capability approach to understand the versatile policy and strategy focused on water. Thus, the study uses in-depth interviews and participant observation to collect data from the northern Char areas to explore water-based social justice, resilient, inclusive, and productive Char economies — climate risk assessment, vulnerability investigation, and adjustment grid. Bangladesh is a waterway bowl land, and it has a few traps. Among those traps, Char-arrive is one, containing 1.2 percent of the nation's arrival territory; Five percent of the nation's populace lives in the burns, and 80 percent live in poverty. This research recommends an appropriate frame of a competent entity — Char Development Authority – to take care of the burn-related issues of the Char dwellers who live with either affluent or lack of water.

Artificial Intelligence and Computer Vision-based Flood, Flash Flood, Urban Waterlog Disaster Risk Reduction (DDR) and Policy Making: Bangladesh Perspective

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&
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Bangladesh is a highly flood-prone country, especially in riverside and coastal areas. Each year, on average, 31,000 square kilometres of Bangladesh go under flood, and lives, livestock, and wildlife are often lost due to poor flood prediction and flood alarms. In recent years, rainfall-induced waterlogs have become a common hazard in megacities like Dhaka and Chittagong. Due to poor drainage systems and lack of maintenance, these city dwellers often face heavy waterlogs during rainy seasons. Flash floods have frequently affected other divisions, such as Sylhet. Due to the adverse effects of global warming and climate change, the southern part of coastal areas, such as the Sundarbans, also face several challenges due to increasingly alarming rising sea levels. Floods, flash floods, and waterlogs can effectively be predicted, detected, and alarmed for early disaster response by Artificial Intelligence (AI) and Computer Vision technologies by utilising closed-circuit cameras covering vast areas. In this research, we propose an AI-based real-time flood-detection Disaster Risk Reduction (DRR) system achieving 95% accuracy in flood, flash flood, and waterlog detection in the first 60 seconds using Machine Learning (ML) algorithms and technologies. The study also focuses on identifying, assessing, and sustainable, effective policy-making for reducing flood-incident disasters.

Navigating Multipolarity in Water Governance: The Case of the Teesta River Basin

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&
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The Teesta River, originating from the glacial expanses of the Himalayas, traverses India and Bangladesh in its course. In this course, it embodies the trials and intricacies of water resource management in a multipolar world. The waters of the Teesta, relative to this course of approximately 414 kilometres, emerge as part and parcel of the socio-economic ethos of the regions it traverses, serving millions and diversified requirements from agriculture to hydropower. This study attempts to address the interplay of complexities in understanding water use across the Teesta basin, particularly emphasising the river's importance for agriculture in Bangladesh and hydropower generation in India. The river has been experiencing seasonal extremes throughout its length, and it offsets several challenges for sustainable management. In Bangladesh, the Teesta supports an irrigation duty of 200% cropping intensity in flood plains. The river then reinforces agricultural livelihoods, constituting a vital element of food and rural livelihoods. On the other hand, India's focus on maximising hydropower reflects a strategic effort to meet energy demands growing at unprecedented levels, creating installed capacities that promise economic returns that could make potential energy import dependencies attractive. However, multipolar uses of the Teesta waters have not been without disputes. The draft Framework Agreement on the Teesta captures all the brilliance of a breakthrough in the year 2011 but till now, it remains unimplemented, showcasing the possible avenues through which challenges may emerge in a scenario of diplomatic negotiation and regional cooperation. In summary, this study calls for an overhaul of cooperative governance structures that are attuned to the multipolarity of the river, advocating instead for an integrated approach to the management of Teesta resources wherein economic benefit is not at the expense of ecological sustainability and equity in resource distribution. Such frameworks are equally essential, not just for the Teesta, but as guiding models for other transboundary rivers in the region that are faced with similar challenges. The future of the Teesta, multipolarity notwithstanding, will largely be defined by the ability of India and Bangladesh to come together along a cooperative and mutually beneficial course that will make the river a source of life and an edifice for regional stability.

Climate Change and Water Scarcity: A New Dimension in Pakistan Politics

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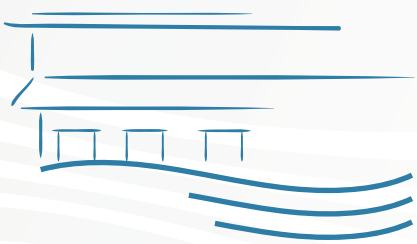
The intersection of global warming impacts and water scarcity has emerged as a critical factor affecting Pakistan's evolving politics. The scarcity of water has become a critical issue affecting health, agriculture, and the future stability of the economy associated with temperatures rising and changes in weather around the world. Pakistan is an agriculture-based country while water is its lifeblood that relies mostly on the Indus River. Apparent water scarcity has become one of the biggest challenges for the country, especially in recent years: the weak water supply and fast-growing population are increasing inequality and are at the base of the catastrophic vulnerability of the country, as clearly shown by World Bank studies. It can be safely argued that water scarcity has become a major source of stress and instability in Pakistan, even though global and national efforts have been made. So far, many studies have been conducted about the effects. However, the impact of these issues on the political arena and on policymaking is still a grey area in the existing literature. The main objective of this study is to fill this research gap as it aims to investigate the political effects of the water scarcity produced by climate change. An in-depth analysis of how climate change-driven water scarcity in Pakistan affects election results, political agendas, and policies will be presented. A focus on who are the key actors enforcing or legitimising the claims will also be given. This study is important because it demonstrates that climatic tractability seems to be an essential component of the political framework to sustain water supplies. In the end, it will provide a more articulated picture of the political dimension of the dehydration, knowledge that might ultimately help the economy, promoting more effective governance and policy response. A mix of methods have been employed in the study, based on the quantitative analysis of the water management regulation and on standard interviews with Researchers and Intellectuals.

Water Justice and Water Rights



Water Justice: Towards a Sustainable Water Solution

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&
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This paper presents a framework that considers water scarcity and abundance as key justice problems. A broad view of justice, including socio-economic and environmental concerns, can address water problems in seemingly better ways to spell out sustainable solutions to water problems. It is depicted that water justice may answer the metaphysical questions regarding water availability and accessibility along with its acceptable quality and quantity. The present paper can broadly be divided into two parts: in the first part, the justice will be addressed broadly with a special focus on the way justice may call for more attention to install water justice; the second part focuses on specific policy concerns and addressing the actual demands and utilisation of excess of water with upland water flow, in the context of Bangladesh, where some areas can be revisited –in the context of water justice –so that the fundamental water questions can be addressed in a more meaningful way.

Bangladesh-India River Water Sharing Justice on the Basis of International Law and Peaceful Measure

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Bangladesh and India share 54 major transnational rivers, but India is now blocking some rivers by making dams and diverting water from the rivers. Some crucial rivers, like the Ganges, Teesta, Monu, and Khowai, are the victims of the Indian projects, and the new Tipaimukh Dam on the Barak River will create water scarcity and other environmental problems in the eastern part of Bangladesh. Bangladesh and India solved the enclave problem in 2015, but after so many negotiations on river water sharing, this issue has always been unsolved. Based on these assessments, some questions arise: after so many attempts, why are the negotiations failing to solve the disputes over river water sharing between Bangladesh and India, and what are the steps to successful negotiation of peaceful settlement of disputes based on International Law? This paper aims to study long-standing Bangladesh-India river water disputes and their possible solution through international law and cooperation. Though Bangladesh-India signed the Ganges water treaty and renewed it several times, Bangladesh still struggles to get the actual amount of water.

Most importantly, India, precisely Mamata Banerjee, the Chief Minister of West Bengal, is unwilling and non-compromising to share the transboundary river water and sign any treaty to solve problems with Bangladesh. Some researchers argued that equitable water sharing and international law obligations would resolve the dispute. Others argued that Indian hegemony over the area, the Grand River networking plan in India, interstate and intrastate conflict on the river water, and state versus central tension in India are holding back the deal. Regional cooperation could also help to nullify the disputes, but Bangladesh and India are failing in this, though they are friendly states. There are several reasons behind the background of the conflicts and the failure of the negotiations, which depend on the lack of political integrity in Bangladesh, lack of regional cooperation on water sharing between two parties, Bangladeshi inconsistent foreign policy, poor water governance in Bangladesh, water scarcity in both sides made the deal uncompromising. There have been many negotiations on the water-sharing issue.

Bangladesh and India signed some treaties on Ganga's water sharing, but the

treaty on Teesta waste sharing failed in 2013 because Mamata Banerjee did not want to sign that. In addition, India is violating international law by withdrawing the waters of transboundary rivers on the upper stream. While searching for some case studies on successful settlements on transboundary rivers, the Indus water treaty and the Danube River environmental programme can be followed or reviewed to solve the disputes. Indian Central Government wanted to offer Mamata Banerjee water from the Torsha River instead of the Teesta River. Still, Mamata Banerjee wanted Teesta Water or a massive amount of funds to separate Teesta Water from the Indian Central Government. Moreover, if negotiations continuously fail, Bangladesh can go to the International Court of Justice for arbitration, or Bangladesh can file a case against India there. Bangladesh and India are friendly states and solved the enclave problem through negotiations and the maritime problem through arbitration, so there are particular possibilities to solve this problem peacefully.

Need for Teesta Water Sharing: A Question of Rights from International Laws

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Water-sharing of transboundary rivers is significant for Bangladesh, as 57 major rivers flow from India to Bangladesh. With the 57 transboundary rivers between India and Bangladesh, the Teesta River is a noteworthy river in northeast Bangladesh. Since the northeast part of Bangladesh is one of the major rice-producing areas, Teesta water is vital for Bangladesh, especially during the dry season. Bangladesh has the right to access Teesta water, recognised by many international legal instruments and customary international law. International law on water-sharing on transboundary rivers requires respective states to utilise the water sources equitably and reasonably. Considering these, Bangladesh demands an equitable distribution of water sources, but its share is lower every time than India's. This is why the dispute on Transboundary Water Resource Management (TWRM) has been one of the burning national issues between Bangladesh and India for a long time. The Teesta River disputes between the two countries make headlines every time. This paper focuses on the need for the Teesta River water-sharing agreement and illustrates the general understanding of water rights under the principles of international law.

Rights for Rivers? The Opportunities and Limitations of Legal Personhood for Rivers in Bangladesh

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In July 2019, Bangladesh became the first country to grant all rivers 'legal personhood' following a High Court designation. While legal rights for non-human entities are not new, they have recently been applied to nature. Applying legal rights to specific natural features, particularly rivers, built on more significant trends to pass legislation recognising the rights of nature, as in Ecuador and Bolivia. Through legislative action and judicial decisions, some bodies of water worldwide have been accorded legal rights. However, the practical implications of these rights still need to be better understood. Using a political ecology approach, this paper explores key questions, including: What actual rights does legal standing provide rivers? What resources may be allocated to protect its rights? And, centrally, what determines the effectiveness of legal rights for rivers?

To understand the application of 'rights for rivers,' this paper first draws from the experiences of other areas, including New Zealand (which granted specific legal rights to the Whanganui) and the Indian state of Uttarakhand (rights to the Yamuna and the Ganges). In Uttarakhand, where the designation of rights was intended to generate substantive changes in river management and protection, little planning went into practical application. By comparison, New Zealand prepared for the financial burdens of engaging in the judicial process by creating a contestable fund to improve river health and to allocate to litigation. This paper explores the relevance of these lessons in Bangladesh, adopting considerations from three perspectives: what communities demand, what the political economy can provide, and the intersection of conditions of struggle over the present and future trajectories of ecological change. First, the paper examines how recognising these rights corresponds with marginalised peoples' rights, interests, and perspectives. To determine the multiple pressures on Bangladesh's people and rivers and the sources of these pressures, the paper applies the 'risk triangle' to delve into the interactions between water pollution 'hazards,' the socio-spatial inequalities in 'vulnerability,' and the pollution 'exposure' pathways. In the second, the paper assesses the ability of the state to operationalise 'legal personhood,' which entails defining the river's features as a public authority, a charity, a corporate body, or a combination. In the third, I analyse

how the effectiveness of law depends on the broader framework in which it is embedded. The paper concludes by proposing pathways for the Government of Bangladesh to enact progressive environmental, social, and economic policies to advance the well-being of the rivers and society.

Abrogation of the River Rights: A Case Study on the Padma in Rajshahi, Bangladesh

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Rajshahi is one of the most ancient localities that stands on a transboundary river of Asia which entered Bangladesh holding the name of the Padma but is known as the Ganges in India from the origin, the Gangotri Glacier of the Himalayans. As one of the critical education hubs of Bangladesh, the student density has dramatically raised the economy and tourism in Rajshahi, along with the gradual degradation of the rights of the river Padma. The objective of this study was to find out the violation of the river rights from a close observation of the bank of the river Padma by Rajshahi City Corporation. The significant findings from this observation were:

1. Tourism-based pollution, directly and indirectly, by the tourists
2. Untreated municipal wastewater of Rajshahi City Corporation exposed to the river directly
3. Pollution due to the inhabitants of the bank of the river
4. Indiscriminate dredging to collect fine sand
5. Frequent river training works (embankment, unregulated sluice gates of the Farakka barrage).

This study will suit river rights activists, researchers, and policymakers who want to conserve river rights through effective decisions that can be sustainable and integrated with human needs.

Indo-Bangla River Sharing: Challenges and Opportunities

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Bangladesh is a fertile deltaic region crisscrossed by numerous rivers and subject to periodic and occasionally catastrophic flooding. It is located within the flood plains of three major rivers—the Ganges, the Brahmaputra, and the Meghna—and their tributaries. The Ganges-Brahmaputra-Meghna (GBM) river system is the second largest in the world (next only to the Amazon), serving Bangladesh, Bhutan, China (Tibet Region), India, and Nepal. Bangladesh and India share 54 rivers of water.

India is an upstream state in relation to Bangladesh and is, therefore, in a position to affect the flow of the Ganges and the Brahmaputra into Bangladesh. India diverted water from the Ganges by constructing the barrage at Farakka for the port at Kolkata, thus seriously affecting Bangladesh by depriving it of the water it needed during the dry season. After making several temporary agreements to allocate the river's water, India and Bangladesh entered the Ganges treaty in 1996, allocating the seas for the next 30 years. Despite the treaties, Bangladesh is still being deprived of its legitimate share of common waters, mainly due to the unilateral withdrawal of Ganges water by the Indian authorities, which violates the agreement.

Diversion of water at the Farakka barrage has also created problems for other states in India, and to solve the problems, the Indian government is contemplating interlinking major rivers flowing from the Himalayas and diverting them south to drought-prone areas. The Indian plan created a sharp reaction in Bangladesh, and Dhaka expressed its grave concern to Delhi on India's planned scheme of harnessing river waters by changing their natural courses. The plan for the Tipaimukh Dam also created tension between India and Bangladesh. The construction of this dam will leave the ecological diversity and livelihood of thousands of inhabitants of the area under threat.

Considering these circumstances, this research aims to determine the impacts of river sharing between Bangladesh and India, examining the water quality and its utilisation and demands in Bangladesh and India and see how these impacts affect Bangladesh regarding environmental concerns, security, and its relationship with India. The research also aims to determine whether the challenges of Indo-Bangla River sharing can be met through cooperation. Finally, this study aims to recommend

a policy intervention to overcome the difficulties and to ensure the rights over the water of both countries.

The research will be done entirely using secondary sources, including case studies, observation, and reviews of books, journals, periodicals, research reports, and other secondary materials. The methodology is purely descriptive and explanatory.

India's River Interlink Project: Disaster in the Making

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Bangladesh has 57 transboundary rivers and many smaller streams shared with India. Except for a few, all those rivers originated in the Indian Territory and passed through Bangladesh to their final outfall, the Bay of Bengal. All those rivers flow entirely during monsoon but become lean from winter to summer. Withdrawal of water from major rivers in India, such as the Ganga, the Tista, the Mahananda, and others for irrigation in dry months, turns their downstream lean in Bangladesh. To share the waters of the Ganga River in dry months, the governments of India and Bangladesh signed a water-sharing treaty in December 1996. Transferring waters from one basin to another has always been considered disastrous to the environment and humanity. Moreover, such efforts are against the natural rivers, so they cannot be cost-efficient or sustainable in the long run. It may be mentioned here that a project to link the Siberian Rivers in Central Asia to the drought-hit river basin of Syr Darya was abandoned by the Soviet government, which was facing such problems.

River Flows, Climate Change, and Food and Water Security: Experiences from the Philippines

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Climate change, especially extreme weather events, creates environmental conditions that require even greater vigilance in implementing adaptation and mitigation measures to ensure food and water security among affected communities. Although the Philippines has a plethora of environmental laws and a devolved local government system, there are many areas for improvement in the capability of LGUs, line agencies, and participatory monitoring teams to install mechanisms to minimise instances of food inadequacy and water shortage. Through participation in Environmental Investigation Missions and multi-stakeholder scoping studies and consultations with community residents, LGU officials, and technical experts from national government agencies, several practices, some of which were non-compliant with conditionalities stipulated in project operations permits and their renewal. Nonetheless, some community initiatives indicated the growing aspirations to address issues related to the management of rivers to avert localised food and water deficits. At another level, the experiences demonstrated that academe could play a significant role in building stakeholders' capability to manage better the complex tasks of maintaining river basin integrity in a changing climate and securing accessibility to adequate food and water supplies.

Changing Perception of Rivers in the Global South

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The fact that most of the civilisations of the world flourished on the riverbanks is more or less uncontested. The examples of early river valley civilisations range from Indus civilisation near the Indus River to Mesopotamia along the Tigris and Euphrates Rivers, Egypt on the bank of the Nile, and Chinese civilisation near the Yellow River, to name some of them. Even today, most of the major cities of the world are situated on the banks of rivers, viz. London is near the Thames, Paris is near the Seine, and New York is next to the Hudson, and the list is endless. Human beings have always relied on rivers as a source of livelihood in numerous ways. Navigation as a mode of transport could also become possible only due to the presence of rivers as waterways. No wonder rivers, as the essence of human life, are even worshipped in countries like India. I intend to argue that rivers as commons have long remained part of the collective consciousness of the people, but the advent of modernity and the arrival of the State as an actor have challenged the erstwhile understanding, and they are now seen merely as water bodies. Other actors, viz., civil society agencies (global as well as local), industries, and communities, have also played a significant role in shaping the fate of rivers.

The rivers as sources of water, which were earlier considered as commons, have now become the property of the state. However, there is a long debate as to whether the state is a trustee or an owner. For instance, in 2002, a 22.6 km stretch of the Sheonath River in Chhattisgarh was sold to a private company, Radius Water Limited, which suggests that in the Indian context, the state acts in the role of owner. Later, the contract was revoked after a massive protest by the local people and civil society activists from all over the country. Against this backdrop, this paper intends to capture the changing perception of rivers in the Global South. The main focus of the paper would remain on two countries, namely India and Bangladesh, to reflect on the interplay between state and civil society.

The perception of water as a natural resource and the politics around it are shaped by various positions, ranging from water as an economic good to water as a human right to water as commons. Here, I use the concept of 'rivers as commons' to denote the worldview that they belong to everyone and thus transcend ownership. Collective consciousness, a term introduced by the sociologist Emile Durkheim, is a concept often used in the various social sciences, especially psychology and sociology. It is "the set of shared beliefs, ideas and moral attitudes which operate as a unifying force within the society" (Collins Dictionary of Sociology).

Hydro-Politics in GBM Delta: The Case of the Gumti River for Life and Livelihoods

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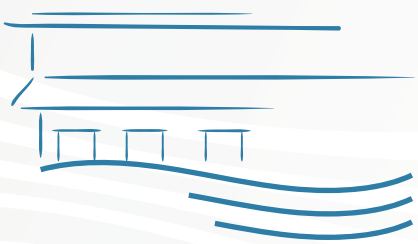
Bangladesh, a country with fifty-seven transboundary rivers, heavily depends on water from the upper riparian countries, particularly India. However, the hydro politics in this region are not just complex; they are urgent. The long-standing, unsuccessful dialogues have left the situation precarious, demanding immediate attention and action. Gumti originated from the hilly region of the Tripura district, and the river is considered an India-Bangladesh protocol route for transit to boost the national economy through waterways. The economy in the Gumti River basin is based on rain-fed agriculture. However, during the dry season, farmers face a lack of water for irrigation due to dam construction in the upper part of India. The study of hydro-diplomacy in this region was conducted using a mixed-method approach with observation, a survey with a semi-structured questionnaire, and published articles, newspapers, reports, etc. The study found that transboundary water diplomacy is exaggerating the current water quality and amount in this region as there has yet to be a signed agreement between Bangladesh and India for the Gumti River. Due to the gradual siltation, the bars increase and become stable when people cultivate crops in this fertile land. The fisherman is harvesting less fish than previously, putting their lives and livelihoods under serious threat. Hydro-diplomacy as a framework is essential for addressing shared challenges such as flood management, ecosystem destruction, etc., and promoting sustainable development. However, the study found that the sharing and managing of transboundary water continue to be a challenge, hindering any attempts to build peace and cooperation in the region. Despite bilateral treaties signed by Bangladesh and India, the water crisis remains an unsolved issue for Bangladesh. The lack of a regional or joint ecological framework for water governance exacerbates conflicts and mistrust. The Gumti River Hydro-diplomacy initiative can foster collaboration between India and Bangladesh in water management, ensuring the protection of the livelihoods of at-risk communities. According to the research, water charges for industrial users should be introduced to ensure affordability for marginal water users and produce cash for sustainable river management. A balanced approach prioritising environmental sustainability, equitable resource distribution, and inclusive governance can transform the Gumti into a source of cooperation and development rather than conflict.

Solutions and Water Management



River Responds

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The geometry of an alluvial river responds to changes in various physical parameters; some of the predominant parameters are dominant discharge, sediment load, valley slope, sinuosity of channel geometry, characteristics of sediment carried by the river, etc. Professionals must understand the relationship among these parameters before any intervention is planned and executed in any river system. Hydrodynamic and mathematical models are used to understand and predict river response. Often, physical models are developed to estimate the possible extent of river responses. In earlier days, reliance was on empirical relationships created based on field observations. Some of these straightforward empirical relationships are still valid for developing a preliminary qualitative assessment of river response. In this presentation, efforts will be made to explain the usefulness of these empirical relationships to create an understanding of the overall impact of physical interventions on river systems.

An Overview of the Demand-Supply Analysis of Water Utilities by the People in Living Squatter Settlement Beside the Padma in Rajshahi

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&
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With the progression of urbanisation and industrialisation, rivers are severely practised, affecting the natural characteristics of rivers adversely. Simultaneously, in the present world, water resources' capacity is declining daily due to climate degradation, pollution propagation, human unconsciousness and insensibility, and other human activities. In Rajshahi, the Padma River serves about 80% of the water demand in the Rajshahi City Corporation (RCC) area. It is continuously being contaminated by the daily activities of its active and passive users. Besides, the water supply treatment plants and other utility services could be more efficient in providing safe drinking water. Providing sustainable water and wastewater services is a critical and challenging issue across the country nowadays. This paper reflects a study on the user's practical utility experience at squatter settlements beside the Padma River in Rajshahi City Corporation. The study follows a questionnaire survey with a sample size of 90 households. The study's objective is to analyse the water demand supply and the extent of the water pollution performed by the people living in the squatter settlements near the Padma River. The paper's significant finding includes the efficiency of water sectors in supplying water utilities and their limitations, as well as different adaptation policies taken by the people to cope with the existing situation and pollution scenario of the water bodies. The study presents some ideas for improving the existing conditions that will assist the people residing in squatter settlements beside the Padma River in having a sustainable future.

Impact of Uneven Water Distribution at Teesta Riverine Areas

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The Teesta River has been connecting Bangladesh and India for many decades. It is the 4th largest national river in Bangladesh, which originated from the glaciers of the Himalayas in the Indian state of Sikkim. For decades, agricultural production has been influenced by Teesta's water in both countries, accounting for 23.50% in Bangladesh (MOA, 2012). The Teesta irrigation barrage project covers 5.12 million hectares of land. Recently, several indicators for sustainable livelihood have been in jeopardy due to uneven water distribution between Bangladesh and India. Bangladesh has been facing water scarcity for the conservation of natural resources. As a result, environmental risks such as climate variability, changes in water quality parameters, and aquatic biodiversity in the northern region of Bangladesh have risen (Mbugua & Snijders, 2012). The northern part of Bangladesh is plain land, and 90% of the population relies on irrigation water for sustainable production. This production directly depends on water flow, quality, and climatic parameters. This insufficient irrigation water is the indicator of poverty scale in the this region of Bangladesh compared to India (Sarker et al., 2011). This paper is focused on the effect of uneven water distribution and variation of climatic parameters on water flow, water quality constituents, and aquatic biodiversity at different locations across the Teesta Riverine area in the northern region of Bangladesh. About 41 million people live downstream of the Teesta River (Islam & Higano, 2001).

The depletion of aquatic biodiversity, climate changes, and degradation of water quality parameters are noticeable in North Bengal, Bangladesh (Rahman, 2013). The Teesta River flow has become five times lower than the current demand for sustainable livelihood. Among the water quality parameters, Total Dissolved Solid (TDS) was significantly correlated with conductivity ($p \leq 0.01$). The detected average analysed values of DO (Dissolved Oxygen), TDS, and EC (Electrical Conductivity) were found to be lower than standard values. On the other hand, humidity was significantly ($p \leq 0.01$) correlated with wind speed. It is concluded that water quality constituents and aquatic biodiversity have been negatively affected due to uneven water distribution and changes in climatic parameters. Therefore, equal water distribution between the two countries and regular monitoring of water quality parameters and aquatic species are crucial for maintaining a sustainable environment in the northern region of Bangladesh.

Promoting Rainwater Harvesting in Improving Access to Drinking Water and Sanitation in Coastal Areas of Bangladesh for Climate Resilient City Building

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Population growth and climate change have increased pressure on available water resources in the developing world. This is adversely impacting human, environmental, and economic sustainability. These concerns call for climate-resilient policies for sustainable development that focus on securing the future by working in tandem with the present. Due to high salinity in surface and groundwater and natural arsenic pollution, people in the coastal region of Bangladesh face a water crisis in many areas and are looking for alternatives. In Bangladesh's coastal region, rainfall in the monsoon season is abundant but almost absent during the dry season, leading to water scarcity for households and farmers. To address the water crisis in this region, rainwater harvesting practices can be considered one of the potential solutions to enhance water availability. Rainwater harvesting is a process of collecting and storing rainwater for later use. Rooftop harvesting is one of a kind, and it is the safest, the best, and the cheapest alternative to the traditional water supply system. Due to climate change and rising sea levels, the salinity of coastal areas is increasing daily; moreover, in cities like Khulna and Chittagong, where groundwater and supply water contain so many harmful ingredients, such as arsenic and iron, which are below the standard level of drinking water quality. Hence, rainwater harvesting can be one of the possible alternatives for improving access to drinking water and sanitation in the coastal areas of Bangladesh. This paper will identify the scopes and prospects of the RWH system in enhancing access to drinking water and sanitation through the RWH system in the coastal areas of Bangladesh. It will also emphasise assessing the existing RWH practices while analysing the possible framework to suggest an improved community-led RWH system management policy for building climate-resilient cities in Bangladesh.

Restoring Endangered Rivers in Bangladesh: A Case Study in Pabna City

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The river Ichamati is a blessing for the city of Pabna. The river is 44 km long and is located in the northwestern part of Bangladesh. In ancient times, it was the heart of the city. Trade, transportation, economic and commercial activities. They were mainly dependent on this river. However, nowadays, the life and flow of this river are in danger due to the irregular and unplanned activities to minimise those problems because of a lack of institutional capacities. This study aims to propose suitable solutions to restore the river and its flow. The solutions mainly focus on restricting the unplanned use of riverside, eliminating illegal settlements, and creating user-friendly recreational spaces to ensure economic return. The proposed solutions are based on local people's perceptions and suggestions from local government organisations. This study collected data from questionnaire surveys, key informant interviews, and focus group discussions. From the questionnaire survey and discussions with key personnel of Pabna city, two main issues have come to light: 1) people living beside the riverside are not aware of the importance of Ichamati River in their life and ecosystem, and 2) Government organisations have no development plan to save the river and beautify the riverside for receiving economic returns from this place. Moreover, dumping household waste and disposing of fiscal sludge through sewerage connections into the river generate severe odor in the riverside environment. The study proposed some effective policy measures and a riverside recreational space design approach based on the findings. The policy recommendations will help to restore the river, and the design approach will ensure economic benefits from this place. Additionally, the local authority will be able to construct a development plan for the Ichamati riverside with the help of the people who proposed those approaches. The successful implementation of the development plan and design approach will attract more visitors to the Ichamati riverside and contribute to the economic development of Pabna City.

Community-Led Rainwater Harvesting for Climate Resilient City Building in a Metropolitan City: A Case Study of Rajshahi City

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The deficiency of potable water is one of the major drawbacks for emergent nations like Bangladesh. As Bangladesh has a monsoon climate, reserved rainwater can be contributed as an alternative to extracted groundwater. Rainwater harvesting (RWH) is a procedure for accumulating water from an impervious surface for domestic purposes. The point of this study is to focus on how appreciable rainwater harvesting can be in meeting people's diurnally prescribed amount of water for household purposes and to ascertain the cost reduction using this method. As a metropolitan city with a vast population and settlement, Rajshahi is an ideal region for this study. The amount of harvested rainwater is determined by operating the Collected Rainwater formula, where BBS and the catchment area will provide the mean annual rainfall, which will be diagnosed using ArcGIS software. A questionnaire survey will be used to procure the yearly water used in a building. As consequential data, the annual water supply in every building will be obtained from Rajshahi WASA. Based on the following survey report, the volume of the reservoir can be measured, which will be sufficient to distribute the necessary amount of water. It is presumed that this method will promote efficient use and mitigate the cost of water in a settlement area. On the contrary, this method will decrease pressure on groundwater withdrawal, which can positively affect climate. At the same time, the rest of the preserved water in WASA can be utilised as an emergency supply in the dry season. The initiated study is expected to envision the functionality of the RWH system, which will transform Rajshahi into a climate-resilient city.

Household Water Management: Analysis and Statistical Way of Finding the Consequences, Flaws and Approaches Reducing the Loss in Urban Area

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Water is an essential part of livelihood. People need delicate access to safe water for drinking and household purposes. The world's population is rising. The depletion of groundwater tables and reservoirs creates a considerable risk to human life and the environment. Countries like Bangladesh, whose primary safe water source is groundwater, face problems collaborating with the safe water supply system. The condition seems more complicated in urban areas. As the capital city, Dhaka has significant household water supply system issues. The study focuses on the flaws in household water management, the consequences, and the approaches to reduce the losses. Two types of data were used in the study. Primary data was collected from 25 households through a direct interview and secondary data from different articles and reports. The field survey is conducted in Jurain, West Jatrabari, Dhaka. The study finds that the water supply condition from DWASA (Dhaka Water Supply and Sewerage Authority) is unacceptable as people must use the water after filtration. The people there use a secondary water source for drinking purposes. For that, they must pay 1 taka per litre of safe water. Despite having issues with water conditions, people tend to use wastewater.

There are several ways people waste supply water. As the field survey states, every household wastes about 292 gallons of water each year from the water leaking from the taps. The main reasons for this are similar in every house, and people are less careful when using the water supply. DWASA covers an area of around 496 square km, coping with 2616 megalitres daily, and they have assessed that they are losing 536 megalitres daily. It is predicted that around the year 2035, the demand will be 4741 megalitres daily to cover 617 square km. The groundwater is depleting at 2-3 metres per year, and it seems a massive problem to cope with. The authorities have already worked on the demand and proposed two groundwater

treatment plants from the rivers. However, the supply condition will worsen for the next generation as freshwater sources are limited. To reduce the problem in the upcoming days, there is no excuse for saving, reusing, and recycling water in our household. Saving in our daily household water usage, like every drop matter, reusing the waters which can be used in different households' work, and recycling the disposed wastewater by the concerned authorities. The study concludes that people have wasted a considerable amount of water, and they are concerned, but not everyone is taking any steps to reduce the amount wasted. It is high time we raise awareness; otherwise, the next generation will suffer from our mistakes.

Effect of Population Growth and Urbanisation on Urban Water System and Its Sustainability Challenges and Solutions: A Case Study on Old Dhaka

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This study investigated how population growth and urbanisation have affected the sustainable urban water system from the past 10 years to the present in old Dhaka and how to overcome the risks and challenges in this regard. Dhaka, the capital of Bangladesh, situated beside the Buriganga River, is "overpopulated," supporting more than 18 million people on less than 325 square kilometres of land and an annual population growth rate of 4.2%. Dhaka discharges about 4,500 tons of solid waste daily, and most of it is released into the Buriganga. Due to disasters such as floods, riverbank erosion, cyclones, droughts, etc., or basic needs like education, treatment, or search for jobs, every year, a large number of people migrate from rural to urban regions, especially putting pressure on the capital. An increase in population growth is the leading indicator that negatively affects the urban water system and its sustainability. Thus, this pattern of population growth rate restricts our country from achieving the goals of SDG, especially the 6th goal – "clean water and sanitation." The study used a mixed method, including qualitative and quantitative techniques. Primary data were collected through a questionnaire survey, focus group discussion, and interviews with the local people of the study area. Our interviews, other focus group discussions, and available secondary data and map representation through the use of GIS and RS show that increasing population growth and urbanisation have seriously affected the urban water system, which hinders us from creating a sustainable water environment in all aspects. In this study, we propose water-sensitive urban design strategies for mitigating water quantity and quality impacts on receiving waters and its sustainability in urban areas and alleviating the pressure of migration from rural to urban regions to make the urban water system cost-effective, more reliable, and sustainable.

Transboundary Water Interaction: Data and Information Sharing

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Water Resources Specialist

Reliable data and information on trends and conditions of water resources, climate and flow regimes, water use, and development practices provide the backbone for sound decision-making and effective water resources management. Information is essential in the case of transboundary water management. In transboundary basins, information exchange and data sharing between riparian countries is regarded as a first and crucial step towards fostering cooperation and trust. The existing hydro-meteorological networks in both countries have been playing a vital role in making possible effective and confident decisions by decision-makers and justified interpretations by scientists. Although there has been limited data and information sharing between the countries in the shared basins, restrictions on the availability of data and information beyond borders in South Asia continue to prevail. Countries must be more open and cautious about comprehensively sharing hydrological information. Global and continental satellite coverage can be highly beneficial in hydrological forecasting and water quality monitoring, particularly in regions of poor data availability. Remotely sensed monitoring represents less risk for both countries and will help to foster trust and cooperation. Satellite remote sensing techniques can increase efficiency and consistency in monitoring and solve problems with reduced human and monetary resources. Against this background, this paper looks at the importance of sharing data and information between riparian countries and identifies the use of modern tools and technologies to facilitate this process.

Adapting to Altered Waters: Strategic Approaches for Resilient Water Management of Transboundary Rivers like the Teesta and Ganga

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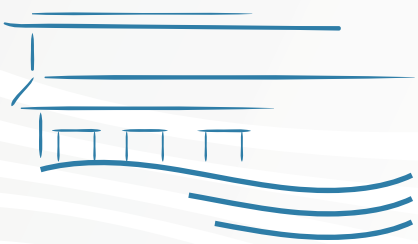
The impending expiration of the 1996 Ganges Water Treaty in 2026 adds a new parallel to the growing uncertainties in this time of Anthropocene for transboundary river management across South Asia, with critical implications for the Teesta and Ganga rivers.

These rivers are crucial to millions, particularly in Bangladesh, where challenges such as hydrological unpredictability, climate change, political tensions and complicated or absent equitable water-sharing are exacerbated by upstream infrastructure. These factors disproportionately affect downstream communities through reduced water flow, pollution, and altered river ecosystems.

This study explores strategies for fostering resilience in transboundary river management, focusing on adaptive, anticipatory, and flexible approaches. By integrating scientific data, satellite imagery, government reports and generational wisdom it examines how local insights can complement hydrological conventions to identify appropriate sustainable water management practices. Emphasising the role of indigenous practices, the study advocates for a holistic approach that blends hydrological insights with traditional knowledge.

The paper intends to move beyond conventional downstream proactive and reactive approaches for resilience, such as diversifying water sources and restoring ecosystems and implementing IWRM (integrated water resource management) by highlighting the importance of collaborative governance and community engagement. It concludes with a strategic framework for equitable, sustainable post-treaty water management, drawing lessons from the Teesta and Ganga rivers.

Community and Social Aspects



Community Innovation on Hydrology

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&
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Nepal is a water-resourceful country. Thousands of rivers flow from Nepal to India and Bangladesh. In monsoon, we are happy with river flows and water availability. This time, Nepal becomes green and clean. We produce organic vegetables and rice with natural water, but water scarcity is huge in winter. People in hilly areas use accumulated water on top of the hills through pipelines, using the siphon technic. On the other hand, people living in the Tarai area use groundwater as a traditional technique. One community innovated an idea in Tarai land on the irrigation system. They pass water from ponds to arable land using Devi cal. Devi cal is also used without human labor. This innovation saves labor and water transfer costs. This machine required a small boat, one devi cal, one 10kg stone, rope, and other spars. A channel is needed to pass water to the destination. There are no electricity, fuel, or labor costs. People are always creative when people don't have external or technological support. In most cases, technological promotion stops the creative thinking process. However, we are not against technological support to civic society.

The Sangu River's Contribution to the Livelihood of Local People

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The Sangu is a transboundary river located in both Myanmar and Bangladesh. The river is 294 kilometres of which 173 kilometres is located in Bangladesh. The people depend on the Sangu River watershed, an eastern hilly river in Bangladesh. Understanding the local people's socio-economic values from the wetlands and traditional mechanisms of managing natural resources form the basis of conserving those in the basin area is the focus of this study. A questionnaire survey was conducted to learn about the livelihood of local people and analyse hydrological data to learn about water availability in the river. This study was carried out over different periods in the years 2014 and 2015 and included collecting hydrological data, administering questionnaires, interviews, and focus group discussions by collecting an extensive data set to characterise the nature and agricultural contexts of the Sangu Valley watershed. The watershed has a contrasting topography, with mountains upstream and large plains downstream. It experiences high rainfall with a monsoonal pattern and an average of 3031 mm/year. From the hydrograph of the monthly average discharge of the Sangu River, the highest peak flow was nearly 165m3/s, and the lowest was nearly 18m3/s. Sixty-one residents from five villages on the bank of the Sangu River were interviewed. This report narrates about the river-based livelihood and economies of local communities throughout the basin area of Sangu, as well as the importance of rivers reflected in the knowledge and belief systems, stories, music, and arts of the local people. The Sangu River acts as a lifeline for the local people. The farming, transportation, and social-cultural values mainly depend on this river. Farming is the main economic activity of these people. From November to March, the water flow of the Sangu River is reduced, and it rises from April. Irrigation and transportation systems during the winter season are affected as the water flow declines. This study is expected to draw the attention of the officials and decision-makers of the Government of Bangladesh, local and international development workers, any individuals, and different non-government organisations to work on these issues related to environment and development in the Chattogram Hill Tracts and will contribute to the development of a more holistic and sensitive approach to growth in the Sangu River Basin.

Community Initiative Towards Sustainable Drinking Water Point Management

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Access to safe drinking water is an essential well-being and financial advancement issue at local, regional, and national levels. In recent years, groundwater-based water supply in the coastal areas has been experiencing various significant problems, principally arsenic contamination, bringing down the water level, salinity, and unavailability of reasonable aquifers. Arsenic and saline contamination make it challenging to supply potable water to the underprivileged people of the country. Another measurement of hard-to-reach areas is the need for more land to establish water technologies as they live on a small piece of land on a street or embankment. In the coastal regions of Bangladesh, the deficiency of drinking water is intense as the freshwater aquifers are not available at reasonable depths, and the surface water is profoundly saline and turbid. There have been a few interventions from government and non-government organisations to reduce the scarcity of safe drinking water in this area. Several water technologies have been instaled, such as PSFs, RWH, Reverse Osmosis (RO), and deep and shallow tube wells. However, due to inadequate maintenance and management and lack of ownership from the users, most water technologies need to be in order now. More effort must be made to form a self-sufficient, community-driven mechanism to ensure sustainability.

Considering this, AOSED, the Organisation for Socio-Economic Development, has established two water purifying and distribution centres in Hitampur and Mahmudkati village of Paikgachha Upazila. In these centres, the water gets purified through reverse osmosis (RO) technology, one of the world's most recognised technologies for purifying water. Among these two ROS, one is solar-powered, and the other is run by electricity. Before the initiation of the operation, AOSED formed two management committees for each of the centres. The committee is responsible for:

- Checking up the machinery of the water treatment plant periodically
- Assigning a caretaker to collect money from users
- Informing AOSED about repairing the water plant if required
- Maintaining a separate bank account for financial operations regarding the water plant maintenance.

So far, approximately 350 households are getting safe drinking water facilities from these two centres at a very affordable price (30 paisa/litre). Each household can collect 5 litres of water per day. The average production rate of each RO is 2000 litres/hour. The sales earnings have been regularly deposited into a separate bank account, from which the maintenance and management costs (machinery replacement, backwashing the filters, caretaker salary, etc.) have been borne. The committee regularly backwashed the media filters to ensure the optimum performance of the RO plants. The maintenance and management committee of the RO plants has accumulated BDT 300,000, which will ensure sustainable operation in the future. AOSED is involved in monitoring all the committee activities. A sense of ownership has been developed among the users. This concept of sustaining drinking water technologies through community-driven management became popular in the Paikgachha area, and other organisations are now also interested in replicating this method.

The Rohingya Refugees and Access to Clean Water

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As of 2020, around 860 thousand Rohingyas are living in the upazila of Cox's Bazar, primarily in the two camps of Kutupalong and Nayapara. While most refugees have access to clean water through tube wells, there are concerns regarding the number of them that still draw from shallow water sources and unsafe tube wells. It has been noted that most of the shallow water sources around Cox's Bazar are contaminated by bacterial flora that is dangerous to humans, in particular by Escherichia Coli and Vibrio Cholera (Ahmed, Rashid, & Faiz, 2018). The consumption of cholera-contaminated water, in particular, causes periodical outbursts of diphtheria among the refugees. The government and international organisations have conducted vaccination campaigns for the Rohingya refugees by administering oral versions of a cholera vaccine. However, these attempts do not guarantee the immunisation of the population unless the water consumed is also treated using standard water treatment techniques. The risk of a cholera outbreak among the Rohingyas also threatens the so-called herd immunity against the disease that the Bangladeshi population is believed to have acquired. This paper discusses methods for conducting mechanical water treatment of waters contaminated by bacteria that can be distributed to the Rohingya refugee population. The methods concern water treatment at the drawing point immediately before consumption. The first consists of an application of the theory of frugal innovation (Zeschky, Widenmayer, & Gassmann, 2011), which includes the identification of simple technology that can be developed by a population based on the material and knowledge that are available locally rather than being imported from abroad. In the case of water treatment in Cox's Bazar, this technology consists of developing mechanical water filters based on the xylem of certain plants (Boutilier et al., 2014). The second technique consists of the application of more traditional sand and gravel-based methods for water filtration (Mohamed et al., 2016), augmented by IoT capacities that would allow the remote identification of malfunctions and the organisation of periodical maintenance (Danh et al., 2020). At the end of the paper, we also discuss the necessary industrial and organisational steps to implement this technology and the theory of behavioural change required for its adoption.

People's Movement to Save the Atreyee River

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Atreyee is one of India and Bangladesh's most important transboundary rivers. This 390 km long river, out of which 58 km falls in the portion of Dakshin Dinajpur, West Bengal, India, is in big trouble. The problems are local and international. Students, civil society members, poets, theatre activists, and intellectuals fight for the river's rights. Dishari Sankolpo Environmental Organisation has been doing Atreyee Bachao Andolon since 2014. Atreyee or Atrai (the Atreyee River in the Bangladesh portion is called Atrai) is a heritage river that was once mentioned in Mahabharata and Devipurana's epics. Famous poet Rabindranath Tagore also mentioned this river's name in his Sahaj Path and Chinnopatrabali. Locally, the significant issues are river pollution, loss of depth, sand Mining, loss of fish diversity, and bank erosion. But in the portion of Bangladesh, there is a rubber dam in Mohanpur, which controls river water and creates problems for the river, fishermen, and peasants of Dakshin Dinajpur. The people of Dakshin Dinajpur organised a rally, seminar, and deputation for the river's sake. They demanded free-flowing Atreyee from the Chief Minister of West Bengal and the Prime Minister of India. The people of Bangladesh also joined hands to save the river Atreyee. They raised their voices for river rights and joint river management. It can be an example to the outside world regarding river conservation.

Community Initiatives to Conserve the Halda: A Unique River in Bangladesh

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Hundreds of rivers crisscross Bangladesh. Among them, Halda is a small endemic river that hosts the spawning ground of major Indian carp and is a unique habitat for the endangered aquatic mammal Gangetic River Dolphin. Hence, it is widely known as a natural gene bank. Due to unique physio-chemical and ecological characteristics, carp fishes release their fertilised eggs from April to June yearly, collected by local fishermen and egg collectors using their traditional and indigenous knowledge. Apart from the significant contribution to the fishery sector of Bangladesh, this river is the primary source of drinking water for the city dwellers of the Chittagong Metropolitan area and a source of irrigation water for the local farmers.

However, the resources of this tidal freshwater river have been depleting at an alarming rate. Notably, the amount of collected fertilised eggs has decreased dramatically due to mainly discharge of untreated industrial wastewater from different highly polluting industries, unplanned activities of Chittagong Development Authority, excessive use of agrochemicals in the upstream, water withdrawal through sluice gates and dams, straightening of oxbow bends, illegal sand extraction, the killing of brood fish, etc.

To address this issue, some river philanthropists started community initiatives to conserve its heritage value. As a part of these social movements, we developed the country's first river research and conservation-based website using ICT tools. We opened a *Facebook page* and made a video documentary named *"Halda: A Mysterious River."* Besides, we cordially supported the making of a movie named *Halda*. We also organised seminars, symposiums, workshops, press conferences, and human-chain programmes. Very recently, in 2017, we established a pioneer river research laboratory at Chittagong University with highly sophisticated research instruments and facilities. We publish regular research reports, popular articles, and journal articles. Therefore, the community strongly protested and took initiatives to protect river ecology and community livelihood. In recognition of the community movement, in 2018, the local people collected the most fertilised eggs in the last 10 years. Besides that, civil service organisations (CSO), media, and other stakeholders became allies of the community initiatives; moreover, research, studies, online, offline, and media campaigns have continued for the last couple of years.

Community-led Campaign for Natural Flows of Water

Md. Safiul Islam (Mukta)
Chairperson of GRCC & Co-Chair of NAM
Md. Minhaj Khan
Secretary of GRCC & Member of NAM
&
Ms. Shamima Aktar (Sumaya)
Organising Secretary of GRCC & Member of NAM

The river is the mother of civilisation and a gift of God. The Ganges is the largest basin in South Asia, contributing to all of Nepal, three provinces of India, and Bangladesh for conserving ecology and civilisations, including ensuring food security and livelihoods of riverine communities. The water flows of this river are being troubled by state-level intervention through the construction of dams and barrages. Therefore, Bangladesh has been experiencing drought during the dry season and flooding during the monsoon season, negatively impacting agriculture, fisheries, livestock, and transportation systems. Several distributary rivers are dead now, i.e., Boral, Mathabhanga, Gorai, Kopotakkho, etc. Thousands of arable lands became lost due to lack of surface water.

Moreover, it impacts the mangrove forest Sundarban and increases saline intrusion up to the Khulna, Bagerhat, and Satkhira districts. The community of the Ganges basin formed a community organisation named GRCC (Ganga River Conservation Committee) and a riverine network of South Asia named NAM (Nadi Adhikar Manch). The group has been campaigning to ensure natural flows of river water, Water Justice, community-centric river management, and the endorsement of UN law on Non-navigational use of water courses enacted in 1997.

GRCC is based in Rajshahi and has engaged 22 communities in a campaign since 2017. GRCC has organised several community meetings, an international conference, a workshop, policy advocacy, dialogue with local government and policymakers, networking with activists from India, Nepal, and Bangladesh, etc. GRCC has not received funds from external sources; all activities have been performed with community contributions.

Seen Yet Unseen Salinity Threats on Community Life: A Study on the Coastal Belt of Bangladesh

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Salinity has two dimensions: water and soil salinity. Water salinity is defined as the quantity of soluble salt in a water body or the saltiness of a water body. Several reasons are responsible for coastal salinity intrusion in Bangladesh, i.e., natural disasters like cyclones, tornadoes, and storm surges, the geographical location of the coast, upstream withdrawal of freshwater, and, above all, sea-level rise. Uncertainties driven by cyclones, river erosion, and outsiders' intervention-led consequences are the significant risks of the coastal zone in managing water. Besides, in the coastal belt, the increase of salinity is not only the outcome of natural disasters but also the socioeconomic (continued shrimp cultivation in agricultural land, weak structure, and poor maintenance) and political system (weak water governance system at the local level, cross-boundary river policy, lack of capacity of local government and Structural Intervention in Upstream Neighbouring Country) are liable. Local people are suffering from this natural and human disaster. They often suffer from waterborne diseases like diarrhea, malaria, dengue, and respiratory infections. In addition, women and girls experience sexually transmitted diseases, menstrual hygiene problems, and reproductive health problems resulting from using saline water. So, this study aims to elucidate the lived experience related to saline water of adolescent girls and reproductive women in the coastal area, which indicates their social insecurity in their community, following an eco-feminist perspective. A qualitative approach has been employed to gather data through Focus Group Discussions (FGDs), case studies, and Key Informant Interviews (KII). The findings of this study show that due to salinity, adolescent girls take injections and contraceptives for extended periods to stop menstruation, and at times of tragedy, parents decide to marry off their daughters at an early age, reproductive women face sexual health problems

that cause intimate partner violence, divorce and remarriage. This study could help take preventive measures to the brunt of salinity and support women's sexual and reproductive health.

Exploring Effective Methods of Awareness Building on Water Security: A Hydro-Social Approach

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Water security is an issue of water availability and the acceptable quality of water available to the community. Developing awareness regarding water security needs broad public support, raising awareness on surrounding water resources, and the general level of understanding on sustainable water use. This study aims to explore effective methods of creating awareness of water security for the community of the study area - Kalapara Pouroshova of Patuakhali district. The research was conducted through a semi-structured open-ended questionnaire survey, focus group discussion (FGD), and a review of journal papers and different reports to find effective awareness-building methods for developing water security. Also, the heads of households were interviewed during the questionnaire survey.

The study reveals that 80 percent of respondents need to be made aware of the pattern of water use and the need to develop water security. Awareness building on water security can be raised through various channels, which should be coordinated with a more significant communications strategy. Those channels include water campaigns, engaging with environmental NGOs and community groups, making information available to the general public through advertisement by television, radio, newspaper, poster, leaflet, billboard, SMS through mobile phone, interactive voice response (IVR) through mobile phone operator, water security-related training, meeting with community people, as well as inventories for example, providing information to the public through product labelling, etc. Almost half of the respondents preferred advertisement through television channels for building awareness regarding water security, while others preferred posters, leaflets, and billboard painting (20%), SMS through mobile phones (15%), water camping (10%),

or product labelling (5%). It is found from the study that advertisement through television channels is more effective than other methods for developing awareness of water security. Government and Non-government organisations can take necessary steps to advance these methods for raising awareness on water security among the community people.

Mainstreaming Water Education: Climate Change and Local Innovations in Water Management

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In Bangladesh, climate change presents escalating challenges to water resources, intensifying water crises across the country. This study examines the intersection of climate change impacts, local innovations, and education in advancing sustainable water management practices. By emphasising indigenous knowledge and grassroots-driven solutions, the research highlights adaptive strategies such as community-managed water harvesting systems, decentralised storage solutions, and eco-friendly agricultural practices. The integration of nature-based solutions with local innovations demonstrates significant potential to enhance resilience and sustainability in water resource management.

Key approaches explored include traditional practices like rainwater harvesting, floating agriculture, and indigenous irrigation systems, which leverage local materials and ancestral wisdom to address water challenges. The revival of village ponds, construction of check dams, and promotion of eco-friendly agriculture enhance resource efficiency and strengthen climate resilience. Training initiatives on these methods—encompassing wetland management and the cultivation of salt-tolerant crops—empower communities with the practical skills needed to adapt to climate impacts and safeguard water resources.

A central focus of the research is the role of education and capacity-building in amplifying these efforts. Targeted training programs and community education initiatives are identified as crucial for preserving and disseminating indigenous knowledge, empowering local stakeholders, and fostering scalable water management practices. Training sessions integrated education, grassroots solutions, and local expertise, with themes including Climate-Resilient Farming Practices, Women-Led Water Initiatives, Building Nature-Based Infrastructure, Documentation of Indigenous Knowledge, and Scaling Local Innovations Through Technology.

Through case studies and empirical analysis, the paper evaluates the effectiveness of these approaches and their potential for broader application. It underscores the critical importance of mainstreaming water education to address climate-exacerbated water crises in Bangladesh. The research advocates for policy frameworks that prioritise education, collaboration, and community engagement as pillars of sustainable, climate-resilient water management.

Acute Water Crisis is Threatening 'Chimbuk', The Cultural Landscape of Chittagong Hill Tracts, Bangladesh

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'Chimbuk' represents one of Bangladesh's most important cultural landscapes. This is a long-term residence of the Mro community. The Mro community has lived here over the years protecting their traditional way of life and culture. This cultural landscape represents the distinct value of Chittagong Hill Tracts. Currently, it is facing an acute shortage of water as a result of deforestation and climate change. This situation is forcing the Mro community to relocate. Then, this relocation occurs the cultural crisis also. A shortage of water during the dry season seriously impacts the livelihood and way of life of the local community. It also degrades 'Chimbuk''s cultural value. The objective of this study is to take a closer look at 'Chimbuk's cultural value as a cultural landscape. It also focuses on how the water crisis is affecting 'Chimbuk' and the Mro community severely. A qualitative method has been conducted to find out the reasons for 'Chimbuk's endangered status. Data sources included interviews, newspaper articles, and other sources. Additional sources of information included relevant documents, publications, and reports from different sources. The investigation was conducted in 'Chimbuk', which is situated between 22°3' 27.26" N and 92°15' 17.68" E in the Bandarban hill district. Along the Bandarban-Thanchi route, 'Chimbuk' is situated 26 kilometres from the district town. The way forward for the findings of this study are: community-based water management, awareness and capacity building, collaboration with NGOs and development partners, environmental restoration, and academic or public engagement for further research. The region is already losing its cultural character and biodiversity, despite being one of Bangladesh's most significant cultural landscapes.

Young People to Become Part of Water Management and Governance through Receiving Water Education

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Water is a resource when it is being properly managed. Bangladesh is a country with many rivers, and rivers shape our lives, livelihood, and culture. There is a notion that water supply is abundant in our country. However, that narrative has almost changed because of the consequences of climate change, as Bangladesh is one of the most climate-vulnerable countries, and mismanagement. That alters the country to a scarcity of fresh water in different areas, which was once a reality but is now a myth. Consequently, the decertification process has started in northern Bangladesh, and the groundwater level is rapidly depleting.[21] This is because of the indiscriminate use of groundwater, irregular rainfall, and efficient water management. According to "U.N. World Water Development Report 2022," by 2030, groundwater levels in the greater Dhaka area may drop between 3 and 5.1 meters every year.[22] On the other hand, the high-level salinity of river water in the coastal area contaminates natural water bodies that intensify during the summer.[23] All these developments negatively affect the livelihood of most marginalised communities and lead to many other consequences on the issues, i.e., food security, displacement, reproductive health and rights of women, and so on etc.

Although climate change makes fresh water supply sources dearer in the various parts of the country, mismanagement of the available water resources across the country has become a major setback on top of that. It is an outcome of ineffective governance practices where responsible government departments fail to maintain good practices and stop the influences of the locally vested interest groups. These powerful groups exploit water bodies, build unplanned dams, create barriers to regular natural flows, and often intrude saline water in the habitation sites, particularly in the coastal areas, for commercial shrimp culturing.[24]

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23. https://www.frontiersin.org/journals/water/articles/10.3389/frwa.2024.1220540/full
24. https://www.dhakatribune.com/bangladesh/nation/261374/grabbers-feasting-on-river-lands

The mismanagement of the water issues is also reflected in the pollution in the extreme level of ignorance. Because of the lack of awareness and regulatory practice, our rivers and water bodies in and around the city centres are polluted to an unprecedented level. The Buriganga and linked rivers receive about 60,000 m^3/day of toxic waste discharged. Bangladesh Poribesh Andolon (BAPA) reported that a total of 6000 tons of liquid waste is dumped into the Buriganga every day.[25] A similar situation for many other rivers and waterbodies. The high degree of water pollution even makes it impossible for aquatic creatures to exist. In that case, rivers

Youth-led advocacy resulted in the re-excavation of ponds in Shyamnagar Subdistrict

Youth-led water campaigner in Shyamnagar

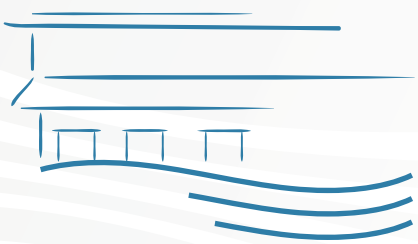
25. https://doe.portal.gov.bd/sites/default/files/files/doe.portal.gov.bd/publications/d5bb5df3_3e3e_40f9_bdd3_9a72d29c16b5/Surface%20and%20Ground%20Water%20Quality%20Report%202016-.pdf

and waterbodies, instead of becoming resources and essential parts of the natural ecosystem, have become a burden to the inhabitants.

Considering the challenges, ActionAid Bangladesh mobilizes young people to develop knowledge and take leadership to become a part of local water governance and hold the local powerholders accountable. In addition, these young people engage in the community to raise awareness about the responsible use of water and stop pollution, better uses of available resources, and treating water as a common good.

However, in the current context only developing awareness is not deemed sufficient to address the mismanagement of water bodies. Behavioral change is important in the wider community in terms of efficient use of water, and stopping wastage and pollution. That demands young people develop stewardship to manage water resources while they have technical knowledge and understanding in collaboration with government stakeholders. This is only possible when water education is part of the education curriculum from the primary to tertiary level in all disciplines, however, may vary on the degrees. In addition, this may include young people being able to take small projects to protect natural water bodies from grabbing and pollution, efficient use of the water to support and protect life and livelihood, and protecting the natural environment.

Gender and Women



Gender Disparity in Water Management & COVID-19 Presentation: Case Study in Bangladesh

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&
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Herd Immunisation is the population vaccine to protect against COVID-19. Adequate water, hygiene, and sanitation are essential to increase social immunisation and are a pre-condition in public health. Water, a vital nutrient, is necessary for cleanliness and is also an agent of maintaining proper nutrition and WASH. Water plays a key role in sustainable solutions for well-being and healthy living. Due to rapid urbanisation, clean water for drinking and washing is a significant concern in urban areas. Only 54.89% of households in urban areas are covered with piped water, 59% safely managed drinking water, and 35% have basic hand washing facilities. Water is also a major concern in rural areas, particularly in a few selected regions. Due to unequal distribution and poor access to pure water, unimproved sanitation, hygiene, and health services result in more female than male deaths. According to the World Health Organisation (WHO), lack of safe drinking water and poor sanitation contribute to about 80 percent of infectious diseases, particularly among women and children. Most research shows that women and girls categorically play three societal roles - reproductive, productive, and water collection for the family. Women and adolescents need clean water for proper hygiene during reproductive age, especially during menstruation. During the COVID-19 pandemic, the key component of water is managed by women to keep clean and hygienic, complying with the slogan "Wash your hand; stay safe," which increased workloads. In this context, gender norms and discrimination in water reveal, in an equitable manner, disaggregating sex and rights. Policies, authorities, and governance are the key stakeholders in strengthening water resources for effective and efficient management of a safe environment. Therefore, behavioural interventions in water and gender programmes are needed. Routine monitoring, analytical data, and information are required for inclusive results to SDGs. The formative research will review national and international research articles on gender, water, and sustainability. To examine the gender and water nexus in COVID-19, the study will adopt the mixed method as an observational approach. For each conformation, the study will follow content analysis to identify the relevant

WASH, gender, and public health relations, showing a few selected urban and rural areas of Bangladesh as case studies. Under the literature review, the study will also assess Bangladesh's water policies and governance, and key informant interviews will be conducted.

Understanding Women's Condition in the Context of Water Supply and Sanitation During COVID–19: A Case Study of Rajshahi City Corporation Informal Settlements

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Sandip Mandal Joy
&
Shams Nur Islam Badhon
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The COVID-19 pandemic engulfs the whole world, and it has not only created a public health emergency issue but also has had an impact on various fields such as water supply, sanitation, etc. Access to clean and safe running water is crucial, as washing hands and maintaining good hygiene is the key to preventing and controlling COVID-19. Clean water supply and sanitation have always been a challenging matter, especially for a developing country like Bangladesh, which has a large number of people living under the poverty level, and COVID-19 has worsened the situation, particularly for women. In a country like Bangladesh, women are usually accountable for managing household chores and water collection for daily needs. In informal settlements, women must collect water from tube wells, ponds, rivers, and public taps. With this pandemic, the requirement for water has multiplied, and so has the responsibility of women to collect water.

Consequently, women have become more vulnerable to public gatherings and COVID-19 while collecting water for household purposes. It has not only increased the health risks for women but also the risks of gender-based violence. The objective of this study is to determine women's health risks and security regarding water supply and sanitation in informal settlements of Rajshahi City. Water supply and scarcity will also be discussed to provide a clearer image of the present condition. The survey data are collected through both primary and secondary sources. A pilot survey is used as the primary source, and data from the Bureau of Statistics and WASA of Rajshahi are used as secondary sources. This study can provide us with a clear representation of women's overall condition, including health condition, menstrual condition, personal hygiene condition, gender-based harassment, and domestic violence, as well as water supply condition, water source, water collecting

process, and sanitation conditions in informal settlements during COVID-19. Some suggestions to improve women's health and water supply have been proposed that should be considered to minimise the vulnerability of the present COVID-19 condition in Rajshahi informal settlements. It will help grab the attention of the corresponding authorities and NGOs so they can take necessary steps along with our recommendations to keep the situation under control.

Feminisation of Hydro Diplomacy: South Asian Perspectives

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Hydro diplomacy is defined as "[...] the use of water as a means for the primary objective of preventing or peacefully resolving (emerging) conflicts and facilitating cooperation and enhanced mutual benefits between different political entities". It emphasises fostering peace and stability, using water as a tool for conflict resolution and peacebuilding rather than solely focusing on improved water management. Literature shows that the outcomes of water cooperation can create opportunities to tackle more contentious issues and serve as a platform for broader peace-building efforts whereas hydro-diplomacy employs a wide range of tools, both political (e.g., confidence-building measures, negotiations, and dispute resolution) and technical (e.g., data sharing, joint research, monitoring, and infrastructure projects). However, challenges exist in this field, such as the lack of a guaranteed link between water cooperation and peace-building outcomes, limited accessibility to knowledge on leveraging water for peace and stability, and the potential downsides of politicising water issues. This article states that the formation or re-formulation of diplomacy is closely connected to gender and the actions of excluding or including women and men throughout a period of time. Although there have been extensive discussions among scholars and professionals about the evolution and persistence of diplomacy throughout the past century, the topic of gender has been mostly overlooked or disregarded. The primary objective of this paper is to promote a fresh study agenda that can stimulate future gender studies and contribute to a reconsideration of diplomacy. The text introduces a unique account of three separate categories of diplomatic academic research, which include (i) the study of diplomatic history; (ii) the analysis of descriptive representation; and (iii) the examination of gendered institutions. In order to prioritise South Asia, it is necessary to shift away from Europe and North America. Furthermore, it is imperative to progress from merely describing individual instances to doing more methodical comparisons that can track the evolution of gender dynamics inside institutions over a period of time. Ethnographic research has the potential to offer fresh perspectives on the intricate dynamics of gender and the routine operations of institutions. Furthermore, international feminist theory can make substantial theoretical contributions to the transformation of diplomacy as part of the gender shift in the field.

Perceptions of School Children on Water Safety in Coastal Areas of the Barishal Division

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&
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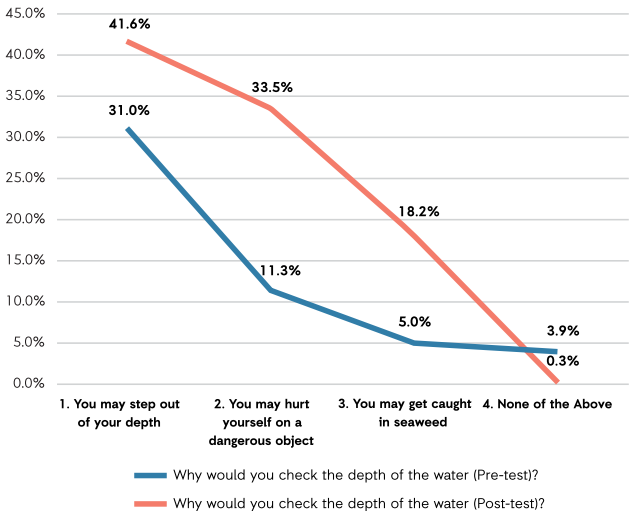
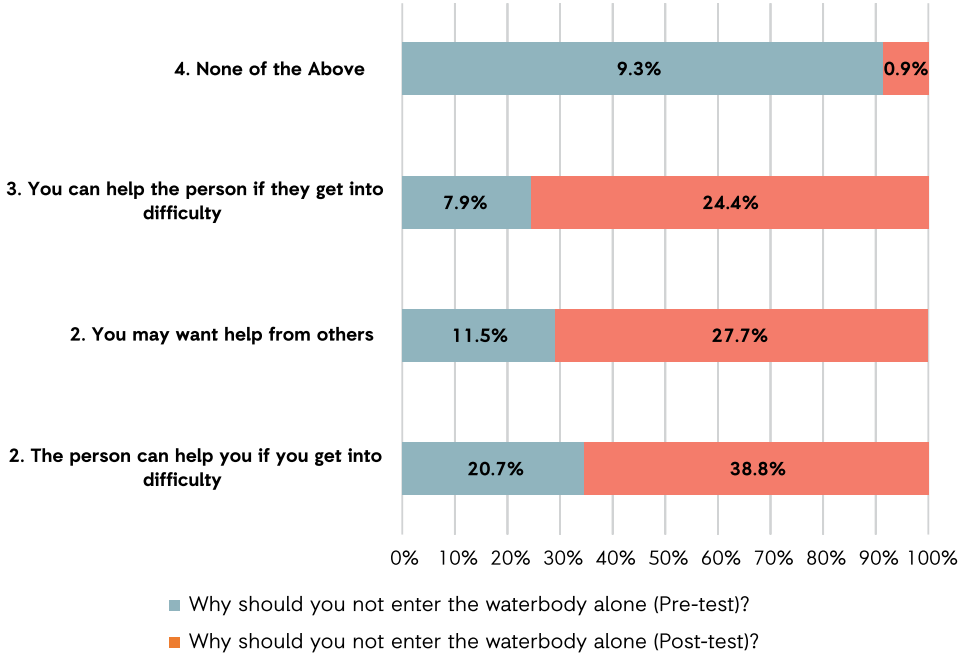
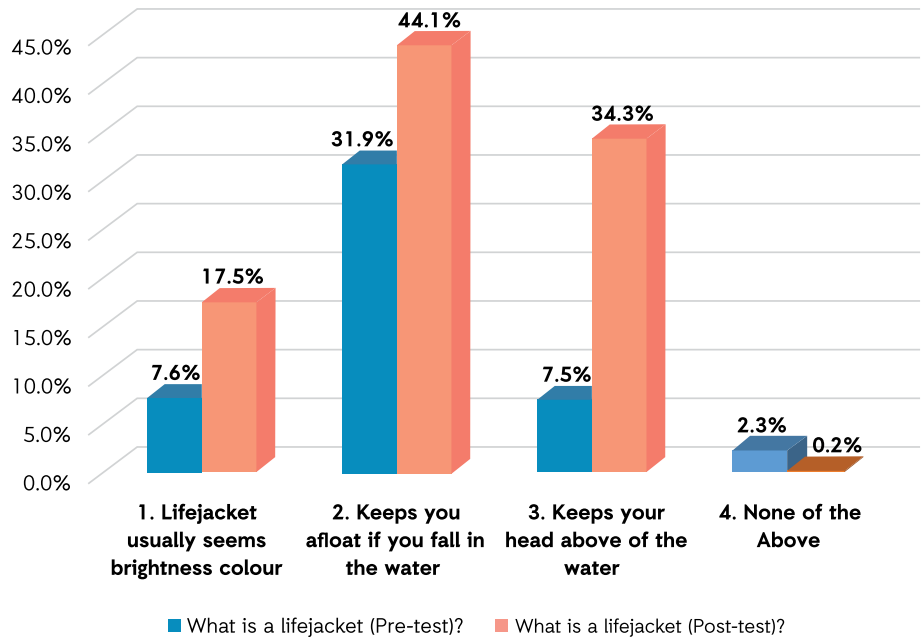
The southern part of Bangladesh is widely exposed to vulnerable for recurrent natural disasters & hazards like floods, droughts, cyclones, river erosion, tidal and storm surges, etc. To cope with frequent natural calamities, the school-going students have to perceive water safety knowledge gradually to adapt to climatic resilience in the coastal belt of the Barishal division.

In 2018-2019, the educators facilitated 448 sessions in 266 schools from grades 1-8 where 19,038 students (8,974 boys & 10,064 girls) attended to assess water safety knowledge about drowning magnitude in 3 intervention areas - Kalapara, Taltoli & Betagi. A total number of 2,908 students attended the pre-test session randomly where 44.29% of boys and 55.71% of girls participated. After perceiving the water safety message successfully, a total of 2,885 students also took part in the post-test session where 48.49% of boys and 51.51% of girls attended to compare.



The assessment on water safety knowledge shows 31% (pre-test) & 41.6% (post-test) participants focused on stepping out of their depth, 11.3% (pre- test) & 33.5% (post-test) respondents replied to hurting themselves on a dangerous object and 5% (pre-test) & 18.2% (post-test) students said that they might be caught in weeds to check the depth of the water.



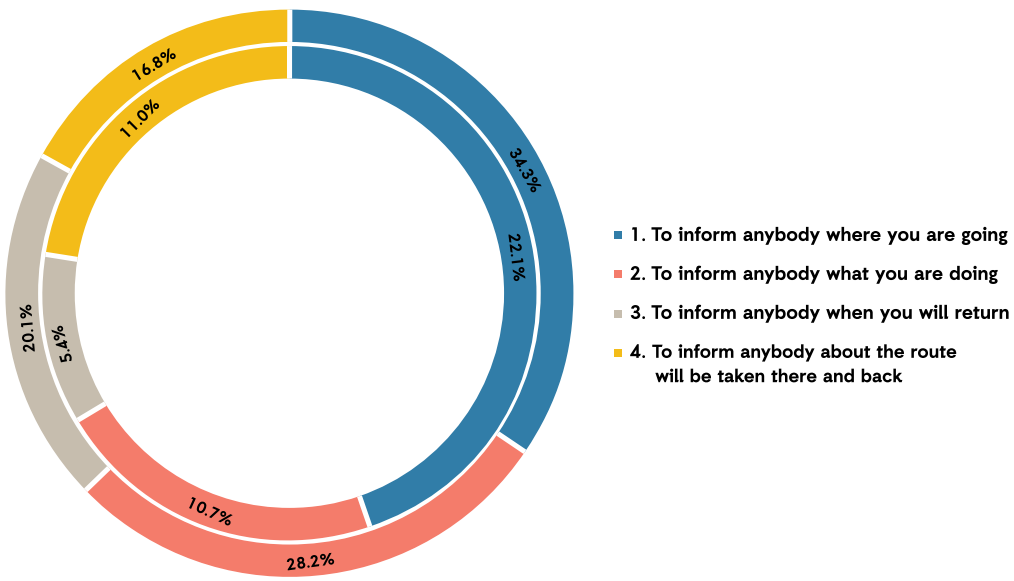


It was found that 20.7% (pre-test) & 38.8% (post-test) students opted not to enter the waterbody alone because the person could help them if they get into difficulty through the water while 11.5% (pre-test) & 27.7% (post-test) respondents answered that they might want help from others. 7.9% (pre-test) & 24.4% (post-test) participants emphasised not entering the waterbody alone because anybody could help the person if they get into difficulty through the waterbody.

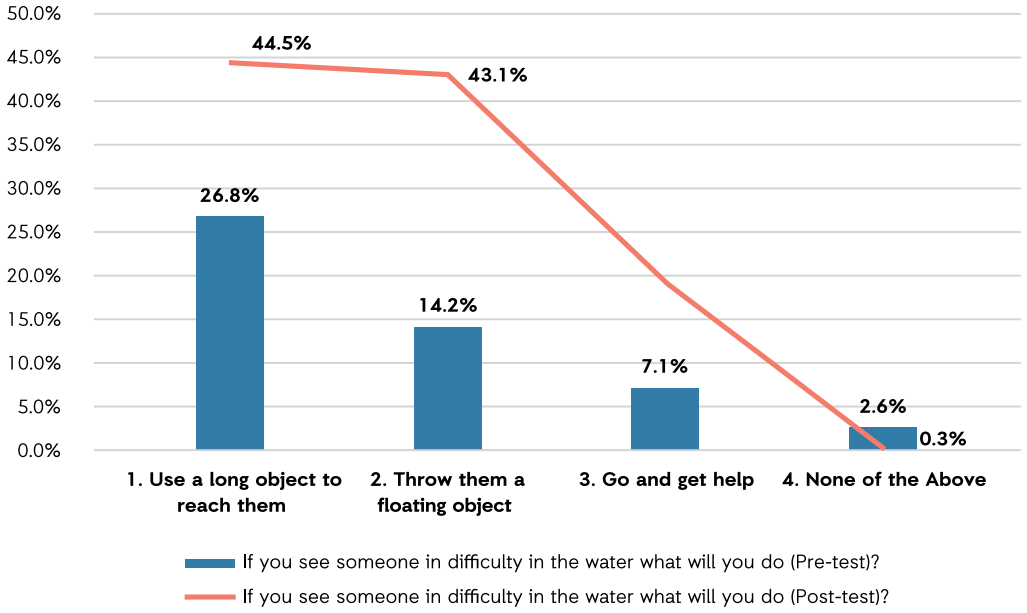
In addition, 7.6% (pre-test) & 17.5% (post-test) attendees said that the lifejacket seems usually bright in colour. 31.9% (pre-test) & 44.1% (post-test) respondents mentioned that the lifejacket kept them afloat if they fell into the water and 7.5% (pre-test) & 34.3% (post-test) students opted to keep their heads above the water.

The 22.1% (pre-test) & 34.3% (post-test) participants opted to inform anybody where they were going and 10.7% (pre- test) & 28.2% (post-test) respondents chose to inform anybody what they were doing. 5.4% (pre-test) & 20.1% (post-test) attendees emphasised informing anybody when they would return and 11% (pre-test) & 16.8% (post-test) students mentioned that they informed anybody the route would be taken there and back.

The findings show that 26.8% (pre-test) & 44.5% (post-test) students mentioned

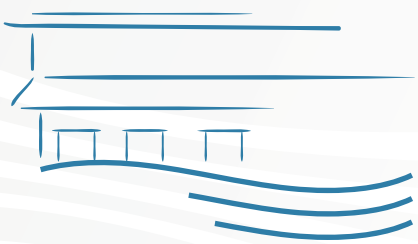


using a long object for reaching them, 14.2% (pre-test) & 43.1% (post-test) respondents opted to throw them a floating object, and 7.1% (pre-test) & 19.3% (post-test) participants chose to go and get help from others if they saw someone in difficulty into the water.



Water safety knowledge is important for school-aged children, especially in the drowning-prone areas of Bangladesh. It increases the knowledge of the students who also share it with their parents. Initiatives from relevant ministries of government are necessary to scale up the intervention in disaster-prone regions.

Water Quality and Pollution



Status of Water Safety Among Water Supply Users at Patuakhali Municipality Area of Bangladesh

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This study aimed to assess the present water safety conditions among the municipality water supply users at Patuakhali Pouroshova in Bangladesh. The study consisted of a semi-structured survey on the municipality water supply system at the household level and two focus group discussions, including one female supply user group discussion for the primary data collection. The supply user list was collected from the Pouroshova office of the municipality authority, and they were selected randomly from different administrative wards of the Pouroshova. The secondary data of the study were collected from related government and NGO documents and published research articles on the urban areas of the Patuakhali district. The study's findings revealed that 70.36% of the respondents were satisfied with their Pouroshova water supply system, and 59% defined it as suitable for safe water. The Pouroshova dwellers trusted that the water quality of the supply system could have been better, and very few percent of people drank the water due to some microbial contamination. Presumably, they mainly collected water from the tube wells for drinking purposes. It was found that, on average, every week, 13 episodes of water-related diseases had been occurring among the respondents of the municipality. The probability and frequency of waterborne diseases occurring among the age groups 5 to 10 years were higher in the Pouroshova than in the other age groups. This study will be helpful for future studies and provide a new view on improving urban water safety practices and enhancing the water security level in Bangladesh.

Pollution and Ecological Risk Evaluation for the Environmentally Impacted Karnaphuli River in Bangladesh

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The Karnaphuli River, rising in the Mizo Hills of Mizoram state in northeastern India, is a major watercourse of the Chittagong region, Bangladesh. It flows about 170 miles (270 km) south and southwest through the southeastern arm of Bangladesh to empty into the Bay of Bengal, 12 miles (19 km) below Chittagong. An extensive study was conducted to evaluate the assignment and concentration of different water qualities of the Karnaphuli River. Samples were collected during the low tide period from ten points in three seasons, such as the pre-monsoon, monsoon, and post-monsoon, during the Hydrological Year 2015-2016, for continuous monitoring. Collected samples were analysed to find some heavy metals Na, K, Ca, Mg, Fe, Pb, Cu, Zn, Co, As, and Mn. The investigated parameters were compared to national and international Standards. The concentration of some metals like Na, K, Ca, Mg, Fe, Pb, Cu, Zn, Co, As, and Mn was found to be 360.57 ppm, 24.67 ppm, 29.42 ppm, 44.34 ppm, 15.28 ppm, 15.52 ppb, 0.013 ppm, 0.057 ppm, <0.05 ppm, <0.05 ppm & 0.355 ppm respectively. The Water Quality Index (WQI) was found to be 931.4, which indicates Unsuitable for Drinking. Paper mills, fertiliser industries, leather industries, steel mills, based industries, garments industries, chemical industries, and shipping activities are responsible for the present scenario because these industries discharge untreated toxins directly through the Karnaphuli River.

Saltwater Intrusion in the Southwestern Coastal Zone of Bangladesh: A Case Study in Kalapara Upazila, Patuakhali

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Contamination of groundwater due to saltwater intrusion has become a significant concern for coastal communities that solely depend on groundwater as their principal source of drinking water. Electrical resistivity surveys with some exploratory bore logs and chemical analysis of groundwater were conducted to delineate the spatial extent of saltwater intrusion in the southwestern coastal zone. The vertical electrical sounding (VES) and hydrochemical studies are widely used techniques in geoscience to investigate the interaction between groundwater and saline water/ seawater in coastal aquifers. However, the VES method has some ambiguities in distinguishing the geological formations of similar resistivities, such as saline sand and saline clay. To minimise these ambiguities and to ascertain the efficacy of data integration techniques for investigating saline water intrusion, a combined geoelectrical survey and periodic geochemical analysis of groundwater were carried out employing resistivity sounding and hydrogeochemical studies. VES using the Schlumberger configuration was carried out at 19 locations to identify the vertical and spatial distribution of saline water in terms of resistivity results in different water-bearing horizons within the coastal plain sands. Analysed resistivity results show the presence of two major water-bearing horizons in the study area: (i) an upper zone (3rd geoelectric layer) at a depth from 85 to 100m consisting of fine-grained sands with some trace silts having apparent resistivity of 0.5-6.53 Qm and (ii) a lower zone (5th geoelectric layer) extends from shallow depth in the north to more than 160m in the south consisting of medium to fine-grained sands with 1.48 to 12.55 Qm apparent resistivity. Groundwater from 11 wells was sampled to analyse the electrical conductivity, with evaluations of different ionic concentrations and total dissolved solids (TDS) to determine the extent of the saltwater intrusion and significant ion concentrations. The trends of dominant cations and anions are Na+> Ca2+> Mg2+> K+ and HCO3-> Cl-> SO42->NO3- respectively. From the analysis of the spatial distribution of EC and chloride concentrations of collected groundwater,

the lower values are observed in the northern part of the study area. It shows an increasing regional trend towards the south primarily due to the saline water intrusion by the strong correlation (r2= 0.893) EC, TDS, and Cl- content. The deep aquifer is less saline than the shallow aquifer except for the southernmost part of the study area. Due to its proximity to the Bay of Bengal, seawater plays a significant role in groundwater geochemistry.

Pollution Status Monitor by Heavy Metal Analysis of Different Canals Chattagram City Corporation Area, Chattagram

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The Karnaphuli River is the lifeline of Chittagong City. The studied canals are all connected to this river. The result indicates the status of the canal water in the Chittagong Karnaphuli region, Bangladesh. Therefore, the water quality of different canals was monitored. Regularly, nine samples were collected from nine different canals in three different seasons during the hydrological year 2012-13. Eight results were analysed using an AAS (Atomic Absorption Spectrophotometer), and a flame photometer was used to measure Na and K. The statistical analysis was completed using Pearson correlation coefficients of heavy metals. The study included water analysis for ten heavy metals such as Zn, Cd, Cu, Fe, Pb, Na, K, Ca, Mg, and Co. In addition, data compared to the drinking water standards of WHO (2011) and EU (1998) in this respect. The concentration of Na ranged from 3484.6 to 4.58 mg/L, K 162.52 to 3.69 mg/L, Ca 111 to 6.1 mg/L, Mg 311.39 to 6.75 mg/L, Mn 2.476 to 0.064, Fe 144.7 to 1.81 mg/L, Co 0.044 to < 0 mg/L, Cu 5.183 to < 0 mg/L, Zn 5.821 to 0.027 mg/L and Pb 137.91 to 0.43µg/L during the three main seasons. The main reason for this study is to raise awareness for protecting river water and saving the aquatic environment and ensure the government takes necessary action.

Water Pollution and Water Quality Assessment of Padma: Causes, Consequences, and Prevention Method to Regain River Rights

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Water pollution is one of the emerging problems for all over the world. It harms the health and well-being of human life and the natural environment. The high population, unhygienic agricultural pesticides, and industrialisation are causing water pollution. The Padma is one of the major rivers in Bangladesh, and it is the second longest one. Since the river connects many urban areas, it ruins the water quality. The existing condition shows that the pollution of the river water directly impacts Bangladesh's economy and environment. The condition of agriculture and fisheries is facing huge losses due to the pollution of the Padma River. The study's objective was to calculate Padma's water quality index to analyse the quality degradation rate. The conditions over the water quality index assess the suitability of drinking, irrigation, recreation, and industrial use. The water quality index was calculated through six physio-chemical parameters by which the water quality can be easily explained. These are Dissolved Oxygen (DO), pH, Biochemical Oxygen Demand (BOD), Electrical Conductivity (EC), Total Dissolved Solid (TDS) and Suspended Solid (SS). The results show that the water quality index 2013 was 63.39, indicating that the water was of poor quality. However, the following year, in 2014, the index rose to 75.53, and in 2015, the index was 82.88, which seems deplorable. Unfortunately, the index rose to 149.25 in the year 2016. Before that, the water was in the suitability range for irrigation purposes. The higher number of BOD in the parameter indicates the drastic change in river water pollution. It is high time to rethink and find the proper water treatment and prevention methods to reduce water pollution. The government should play a good role in ensuring the goal is achieved so that the Padma can regain her rights.

Removal of Turbidity and Escherichia Coli from River Water Using Seeds of *Moringa Stenopetala* and *Cadaba Farinosa*

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Treatment of water is a significant concern in developing countries, where poor water quality and improper water treatment are standard. *Moringa Stenopetala* and *Cadaba Farinosa* are tropical plants whose seeds are anticipated to act as coagulants or disinfectants. So, this study is designed to test turbidity and *E. coli* removal efficiency of the matured seeds of the two plants and related determinant factors. A laboratory-based study was conducted. About 8L water samples were collected from a river. About 30, 60, and 100mg weights of seed powder dosages and 30, 60, and 90-minute settling times were used. Each 1 L water sample was treated with each of the dosages. *E. coli*, temperature, pH, and turbidity were measured. Treatment differences between plants and predictor variables were tested. After treatment of river water samples containing 15 *E. coli* colonies per 100ml of water, the result showed zero *E. coli* colonies per 100ml of water at a minimum optimum dosage of 30mg of *M. Stenopetala* seed and *Cadaba Farinosa* seed after 90 minutes of settling time. *M. Stenopetala* seed showed the highest turbidity reduction of 73.3%. The study showed a significant difference between *Cadaba Farinosa* and *M. Stenopetala* seeds in removing turbidity (P-value=0.011) but no difference in removing *E. coli* (P-value=0.785). Turbidity, dosage, and settling time were identified as factors. Seeds of both plants have antimicrobial properties against E. coli, but only *M. Stenopetala* showed the parameters within the recommended WHO standards. So, this study suggests *M. Stenopetala* as a promising natural disinfectant and coagulant.

River Side People and Their Suffering from Water Salinity and Climate Change

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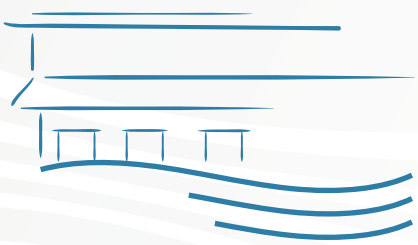
Climate change is one of the most talked about issues now. Because the world's climate is undergoing alarming conditions day by day. Most countries around the world are apprehensive about the impact of this change. This is more alarming for countries located beside the sea, like Bangladesh. Here, a small attempt has been made to discuss the effect of climate change in a particular area of Bangladesh named Gopalganj, located in the southern part of the country. This study aims to indicate some radical changes in climatic conditions and their effects on the living standards of the people within the area. The impact on the Modhumoti River and the matter of increasing water salinity in this area are examined in this study. An attempt has also been made to look for recommendations and policy-making against this problem. This type of work has been done here because of the radical change of climate and its effects on people within only the last few years. This research was done based on primary data collected from comparatively older and more experienced people who live on the side of this river, such as farmers. The study shows the analytical discussion and statistical charts between present and past conditions about the problem and the recommendations needed to protect this problem because climate change is very harmful in various ways, such as agriculture, the economy, etc. How can the government take the necessary steps to reduce the problem, and which policy types are needed for it? Interference of national and international climate-conscious agencies is also required here. Finally, the people of this area should be aware of it. However, it is most important to protect the world climate universally from the upcoming destructive conditions.

Water pollution is affecting the health and livelihoods of the community people

River water quality is very crucial to safeguard community health and ecosystems

Biodiversity and Ecology



Biological Impact Assessment on Rubber Dam to Conserve Natural Breeding Habitat of Major Carps in the River Halda Chittagong, Bangladesh

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Halda River is the only natural breeding ground for carp in Bangladesh, from where fertilised eggs have been collected by local fishermen and egg collectors every year since time immemorial. The collected eggs are hatched in the artificial mud-made scoop on the riverbank to produce carp fries. The fry from the Halda River is supplied to different regions of the country for aquaculture. During the last couple of years, the breeding environment, water quality, and aquatic life in the Halda River have rapidly deteriorated due to various human and natural reasons. Different human interventions on the Halda and tributaries have destroyed the spawning ground. The leading causes are the construction of rubber dams over the main river and charas, several sluice gates by BWDB, and tea estates, which also draw water from its reservoir for plantation. These interventions have affected the flow regime of Halda by altering its flow pattern and reducing its discharge, especially in the dry season while fish get ready for reproduction, with degradation in water quality posing a serious threat to the bio-diversity, especially pre-spawning of carps of the river. The impact of this habitat alteration was visible in the severe decline of primary carp fry production from 2470 kg in 1945 to 20 kg in 2004 and 47 kg in 2015. A rubber dam was constructed at Bhujpur in Chittagong in 2012 to facilitate irrigation in the upstream part of the Halda River during the winter season (December to March). This has resulted in the dry-up of the downstream part of the rubber dam, which occupies a portion of the river. Around a kilometre stretch of the river just downstream of the Bhujpur rubber dam remains almost dry for around 3-5 months in the dry season, which causes a serious threat to the river's ecological system and hydraulic behaviour, especially spawning. Another rubber dam was also constructed at the mouth of the Harualchari feeder canal.

In addition, the Chittagong Water and Sewerage Authority (CWASA) withdraws water at the Mohora surface water treatment plant, and another one with a capacity of 90 mld is under construction at Modunaghat. It was a common perception that the main reasons for the decreasing trend of seed production in the Halda River were

the construction of rubber and concrete dams. In this study, we aimed to critically evaluate the biological impacts of existing water withdrawal for irrigation purposes at this river. Based on this objective, a detailed biological analysis through plankton, benthos, and fish faunal study has been conducted to formulate a guideline for flow and improve the natural spawning success of major carp on Halda River.

The analysis results of the plankton, benthos, and fish fauna study show that the diversity of these biotic communities is also decreasing due to water withdrawal from the upstream. As a result, the abundance of fish food supply is also decreasing, and the livelihoods of egg collectors and fishermen are affected directly. Due to this, the gonad development of brood fish is hampered, seriously reducing the spawning capacity. Therefore, from this study period, it can be concluded that if such activity continues, the spawning heritage will face a real threat of extinction in the near future, and the whole biodiversity and ecosystem will alter in the long run.

Braided and Morphological Change Analysis of the Jamuna River and Its Impact on Biodiversity of the Surrounding Area: A Satellite Image-Based Approach

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&
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This approach attempts to detect the braided condition and morphological change in the Jamuna River due to braiding from the satellite image and its impact on the surrounding areas. Though braiding is a natural process, excessive braiding causes massive bank erosion and changes the ecological background as well as the biodiversity of the specific area. This study used nine selected images of Landsat MSS, TM, and OLS acquired from 1975 to 2016 with five-year intervals for analysis. This paper first investigated the scenario of bank line shifting. The correlation between bank width and shifting is very high. After that, the Plan Form Index (PFI) detected the braided changing scenario. Braided river habitats are colonised by diverse fauna and flora adapted to their dynamic nature, including a significant proportion of highly endangered species. Animals exhibit high mobility, short and asynchronic life cycles, and ethological and phenological plasticity. Dividing braiding phenomena into three categories – Low Braided (LB), Moderately Braided (MB), and Highly Braided (HB); probable biodiversity existence concerning the surrounding area is described. Ultimately, this paper figures out the historical trend of those points getting more shifted, whose points are more braided in time series, and how this phenomenon functions to turn ecological change and biodiversity.

Impacts of Human-Induced Hydrological and Morphological Changes on Aquatic Biodiversity in Transboundary Rivers of the Himalayas, Nepal

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River ecosystems are biodiversity hotspots of landscapes and means of socio-cultural and economic development of a nation. Harnessing gradient rivers to generate hydropower would likely be a key to Nepal's economic and social development. Hence, the country foresees to develop over 25000 MW in the next 10 years. However, the impacts of operations of such projects undermine the ecological preservation of downstream ecosystems and have led to contentious issues among water developers and environmentalists. Here, we have assessed how much water abstraction could harm aquatic biodiversity and river health. This study was conducted in transboundary rivers of Karnali, Mahakali, and Mohana in western Nepal. Aquatic macroinvertebrates were sampled seasonally in the year 2016 and 2017. The study showed that water abstractions varied seasonally in the region (Wilk's Lambda= 0.697, F(2, 28)= 4.215, P=0.025, n^2= 0.23) and the driest season of a year seemed critical for maintaining a population of aquatic biodiversity. Macroinvertebrates community patterns were found to be different across three categories of water abstractions: "none to slight water abstraction (<30%- Class 1)", "moderate water abstraction (>30% to < 80%- Class 2)" and "heavy water abstraction (>80%- Class 3) for the driest season. However, a significant decline in biodiversity was recorded only in sites with over 80% water abstraction of average river discharge. In general, abstracted sites were found to be colonised by pool preference biota such as genera of Mayflies (Torleya sp., Caenis sp., Cinygmina sp. Choroterpes sp.) and families of true flies (Limonidae and Ceratopogonidae). The study also depicts that macroinvertebrate abundance rather than diversity index is a valuable metric for assessing the impacts of hydrological and morphological changes in the Himalayan rivers. This study envisages that maintaining at least 20% of river discharge in the driest season of a year would likely preserve the ecological integrity of the river without compromising their services to livelihood and ecosystems.

A Taxonomic Study of Zooplankton Fauna in Lower Halda River, Chittagong, Bangladesh

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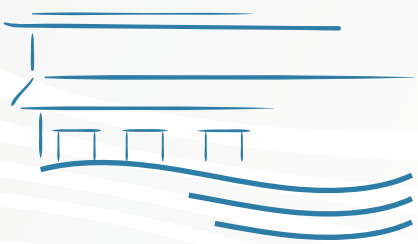
Halda is a unique, resourceful tidal river of Bangladesh, where Indian major carps (Catla, Labeo rohita, Cirrhinnus mrigala, and Labeo calabash) spawn during April to June when ecological conditions are auspicious from time immemorial, which serves as a natural breeding ground in the world. The present study was conducted throughout January-June 2017 to detect the main species of Zooplankton fauna by making its list in terms of zooplankton species composition and group dominance from five stations - Karnaphuli River (Estuary), Krisno Khal, Khondokia Khal, Garduara (Noyahat), and Madari Khal. The taxonomic study of zooplankton and their occurrence and distribution in the lower Halda River has become a prerequisite for fish production. The methodology of this study involves collecting samples, preserving, identifying, analysing, and computing data. In the investigation, three major Zooplankton groups, Rotifera, Copepoda, and Cladocera, were identified. A total of 42 species under six orders and 12 families showing the dominancy of the class Rotifera (36%) consisting of 14 genera were also recorded from five sampling stations. The lowest group was Cladocera (28%), comprising 12 genera. The composition and dominance of the Zooplankton community among five different spots in the lower Halda River showed some close inter-relationships. However, the present study suggests conducting further research to learn about the overall conditions and to make a complete list of available Zooplankton fauna impacting the water quality of the Halda River in Chittagong, Bangladesh.

GIS and Remote Sensing



Integration of Remote Sensing and GIS Techniques for Flood Monitoring and Damage Assessment: A Case Study of Naogaon District, Bangladesh

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&
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Recording of hydrological parameters of a flood with conventional means often fails due to an extreme event, especially in developing countries like Bangladesh. Floodwater causes a lot of property damage almost every year and demands control for economic growth through water management. The study's objective is to analyse the damages according to different land uses, such as urban areas or agricultural lands, flood height, and thus the economic loss in that corresponding year. Naogaon District has been chosen as the study area for this analysis. Remote Sensing data has been used in this context as remote sensing technology, along with Geographic Information System (GIS), has become a key tool for flood monitoring in recent years. Satellite images have been collected from Landsat 4-5 Thematic Mapper for 2002, 2007, and 2012 and Landsat 8 Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS) images for 2017. Each year, images of different times (March and September) in the Naogaon district have been analysed using the Geographical Information System (GIS) and ERDAS Imagine software. The analysis shows the relation of the flood in the four observation years and the economic loss related to the flood spread, flood height, and the corresponding land uses. The analysis also shows that land use changed from 2002 to 2017, influencing economic loss. The study helps to identify the losses and related relations of floods and, thus, the importance of water management. The study encourages further flood water management studies.

Investigation of the Eutrophication State of "Durga Sagar" Lake in Barisal, Bangladesh by Using Remote Sensing and GIS

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Eutrophication causes excessive growth of plants and algae when a body of water becomes overly enriched with materials and nutrients. The development of phytoplankton biomass causes eutrophication in water bodies, which satellite sensors can easily detect. "Durga Sagar" lake has significant public interest (recreation, water supply, etc.). So, it is undergoing massive environmental changes due to the thriving impact of human activities. As a result, improvement in monitoring changes in water quality is required. This study focused only on three parameters, chlorophyll "a" phosphate, and nitrate, in evaluating the eutrophication state in "Durga Sagar" Lake. The trophic state index (TSI) is also calculated in this work. Satellite data and GIS techniques are used in this study to classify and map the lake's trophic state. The findings indicated that the TSI in the "Durga Sagar" Lake varied from mildly eutrophic in the northern parts of the lake to eutrophic and hyper-eutrophic in the southern parts. The N/P ratio indicated that P is the limiting factor in the eastern part. However, N was the limiting factor in the south of parts close to drains. As this lake contains significant historical importance, this study will help consider the practical implementation of water management plans.

Analysing the Relationship between the Changing Pattern of River System and Sustainable Urban Planning Using GIS and Remote Sensing Techniques: A Study on Dhaka City

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Bristi Chakma
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&
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Over the past 57 years, eclectic studies have revealed that Bangladesh, as a riverine country, has faced the drying up of about 158 rivers. Dhaka, one of the fastest-growing megacities, is surrounded by six rivers - Turag, Balu, Shitalakkhya, Tongi Khal, Dhaleshwari, and Buriganga. This whole river system has been affected adversely due to years of unplanned urbanisation and a fast-growing population. This paper explores the shrinking pattern of the rivers surrounding Dhaka city, relating to the effects of increasing urbanisation. The research results will be based on a quantitative comparison of river coverage areas calculated among the satellite images collected in a 10-year interval period from 1980 to 2020 using Landsat 4-5 TM, Landsat 7 ETM+, and Landsat 8 OLI/TIRS satellite images. These images will be analysed through supervised classification to figure out four classes of land uses – waterbody, built-up area, vegetation coverage, and other land uses, which will be further used to calculate the river coverage area and urban built-up area. The overall accuracy of the land use classification will be calculated using the Kappa coefficient. The extent of the temporal changes in the river area will be linked to the degree of urban expansion to understand Dhaka's vulnerability. As suggested by the study, uncontrolled urbanisation leading to the decline of rivers will pose an imminent threat to the city's sustainability.

Mapping of Land-use/Land-cover Changes and Its Dynamics in the Turag River Basin Using Remote Sensing and GIS

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Understanding the dynamics of land use and land cover change at a basin scale, including its driving causes, is vital for developing and planning appropriate environmental management policies and strategies for any country. This research aimed to analyse and understand the long-term dynamics of land-use/land-cover changes and population growth in the Turag River Basin using remote sensing and Geographic Information System (GIS). Landsat images for 1990, 2000, 2010, and 2020 will be processed, classified, and analysed. We will do the accuracy assessment to ensure that the classification will be relatively acceptable and effective in detecting the long-term land-use changes in the Turag River basin. We will calculate the amount of the decrease in the cropland beside the river basis between 1990, 2000, 2010, and 2020. Similarly, the built-up area beside the river basin will be analysed, while the main reason for the built-up area is sedimentation. Deforestation, population growth, urbanisation, and industrialisation have impacted the area's available water resources and runoff. The findings from this study will help design sustainable environmental management strategies and practices to ensure the sustainability of the ecosystem and natural resources. The results can also be used to address food security issues in the river basin since we see an increasing trend in population growth with a proportional decrease in agricultural land, thereby increasing food security concerns.

Digital Change Detection of Water Body and Its Impact on Urban Planning Using Satellite Imagery: A Case Study on Pabna District

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Bangladesh has a glorious past of many rivers because of its unique geographical location. Haphazard development activities across the country are destroying most natural resources, including water bodies, wetlands, and greenery. The present study pursues the application of remote sensing to identify land use and land cover change from 2000 to 2020. Multiple methods, including unsupervised classification, supervised classification, inter-spectrum relation method, and water index method (normalised difference water index, modified normalised difference water index, and new water index), have been analysed using the maximum likelihood classification technique in ERDAS. The images of the study area were categorised into four different classes: water bodies, bare land, shrubs (light vegetation), and healthy vegetation. The result indicates that the water body declined gradually from 2000 to 2015, whereas 2020 indicates a sharp change of decline in the Water threshold index, revealing this argument. The paper highlights the importance of digital change detection in finding the most effective water extraction method with different usages at different times. Here, Pabna City is selected as the study area.

Climate Finance and Community Resilience: A Study of Water Infrastructure Needs in Pratapnagar Union

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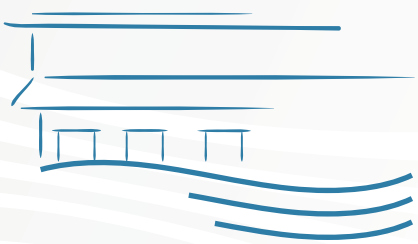
Bangladesh, which is one of the most climate change-sensitive countries in the world, is exposed to various kinds of natural disasters such as cyclones, floods, saline intrusion, storm surges, erosion, and droughts. Laying out a case of Pratapnagar Union of Assasuni Upazila, Satkhira Districts, this study assesses the need for climate finance to enhance water infrastructure resilience in cyclone-affected regions of Bangladesh. Remote sensing data offered precise spatial and temporal insights into the extent of flood damages, while qualitative evaluations improved this understanding by capturing the lived experiences and socioeconomic challenges encountered by affected individuals. The region's coastline is frequently hit by cyclones, some of which have had catastrophic effects. The risks of the local population are highlighted throughout the study, combined with the deterioration of the necessary infrastructure, particularly after the Cyclones Amphan and Yaas in 2020 and 2021, respectively. Due to an embankment failure that caused tidal water to flow back and forth and disrupted daily activities, the communities in Pratapnagar Union suffered greatly for 18 months. Saltwater intrusion caused by the river embankment failures and non-functional sluice gates severely endangered the livelihoods of the people of that area. This study demonstrates the indispensable need for long-term and sustainable infrastructure financing solutions. As demonstrated by the Pratapnagar case, the availability of climate change finance to invest in building, strengthening, and maintaining disaster mitigation infrastructures is imperative to ensure the protection and resilience of vulnerable coastal communities from frequent and recurring disasters and its long-term impacts on their lives and livelihoods.

Water scarcity in certain regions of Bangladesh has led to frequent changes in land cover over time, causing drought in some areas (for example, the northwestern region)

Water-related disasters (floods, cyclones, etc.) are leaving cascading impacts on people's lives, especially in coastal communities

Technology and Innovations



Waste Water Treatment Technologies for Bangladesh

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Waste water treatment is winding up perpetually because of lessening water resources, expanding wastewater transfer costs, and stricter release directions that have brought down reasonable contaminant levels in water flow. The primary reason for the wastewater treatment process is to expel the different constituents of the polluting load: solids, natural carbon, supplements, inorganic salts, metals, pathogens, and so on. Compelling wastewater gathering and treatment are of incredible significance from the ecological and general well-being viewpoint. Sewage/wastewater treatment operations are done by different strategies, keeping in mind the end goal to lessen its water and natural substance, and a definitive objective of wastewater administration is the insurance of the earth in a way equivalent to general well-being and financial concerns. This paper exhibits the wastewater treatment technologies present in Bangladesh to expel contaminants from squandered water, for example, halogenated hydrocarbon mixes, overwhelming metals, colours, pesticides, and herbicides, which speak to the fundamental toxins in the wastewater.

Innovative Combined Fresh Water Capture and Purification System

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NA, BEng(Mech), Peng (Canada), RBYNA Ltd.(President)
&
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Environmental Researchers BD (ERBD)

The importance of availability and proximity of freshwater has always been a significant concern to everyone worldwide. With the rapid changes in climate and its ever-increasing damage to infrastructure, especially the contamination of freshwater sources such as wells and freshwater reservoirs, there needs to be a more resilient, stable, and secure system for freshwater supply to people. Freshwater mitigation and risk reduction to create safer sources are paramount for climate-resilient arrangements. These solutions must be adaptive, allowing families to incorporate freshwater sources into the infrastructure upon which they reside. This significant decision will help solve the potentially increasingly prevalent contaminated freshwater risk. The method of solving this problem must allow for the availability of fresh water on demand under all circumstances, from regular to extreme weather events. Such solutions must be designed to enable simple and easily maintained service by the inhabitants of the infrastructure. The proposed solution must be scalable to facilitate small family scenarios for more extensive public services. The project encompasses three-dimensional spherical freshwater sourcing to create resilience and adaptive mitigation for securing safe freshwater sourcing. The methodology involves two hemispheres; one captures potential freshwater sources from the ground and surrounding or supporting water mix during regular storms or flooding, and the other filters and stores the captured rainwater. The combined capture of these water sources is accomplished using a marine hull design called the Marine Hull Underbody (MHU(D)RSBROOKE). The form is such that it will attain a floating condition when required on land or water.

The complete (MHU(D)RSBROOKE) design includes storage and conversion systems that capture and refine fresh water on board. The result is a haven with a reliable freshwater production system and other innovative support systems that create a complete climate-resilient infrastructure solution. The roof of the marine hull is used as the catchment for collecting rainwater. Gutters are set up on the roof's edges, maintaining a suitable slope for directing the rainwater towards a filtration tank through collection pipes. A first flash is also used here to separate and

discharge dirt mixed with rainwater before entering the filtration tank. The filtration tank uses multiple-layer effective materials to remove the suspended and organic pollutants from the collected rainwater. After filtration, the rainwater is stored in the storage tank for future use after further refining.

Devising a Smart Floating Garden for the Haor Areas of the Sylhet Region in Bangladesh

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Floating gardening is a climate change adaptation strategy using water hyacinths *(Eichhornia crassipes)* as a growth medium in the haor areas of Bangladesh. It is a traditional method of growing crops using aquatic plants to ensure food security during the monsoon period in the haor area. Because of floods and intense waterlogging, there is no alternative option for crops to be produced during the monsoon season in the haor areas. Though traditional floating gardening is a successful method to grow crops in the haor area during the waterlogged period, the unavailability of water hyacinths, high water depth, and wave action make traditional floating garden practice difficult in some haor areas. Regarding the primary survey in the study area, the study is conducted to develop an economically feasible and locally acceptable innovative floating garden model. Five different floating garden models have been developed based on local feasibility and materials availability, where three models are suited to the study area because these three models need a minimum construction cost, and materials, e.g., water bottles, bamboo, and cork-sheet, are highly available in the study area. These models provide two to three times (assumed) greater output than its construction and input cost at the 2nd and 3rd year cropping cycle based on the first-year cropping cycle analysed in this study. The other two models need a higher construction cost than the first three. Still, the durability of the other two models is relatively higher than the first three models, increasing the PNW value by the cropping cycle. This study might provide a solution that enables landless local people in a suitable area to grow vegetables during the monsoon season, which reduces the high transportation cost of buying vegetables from a long distance.

Flood Water Harvesting and Treatment

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Bangladesh is one of the most flood-prone countries in the world. It faces floods of different magnitudes and types every year. At least eight extreme flood events occurred during the last half-century, affecting almost half of the countryside. Bangladesh has 230 nearby rivers, including significant rivers (Ganges, Brahmaputra, Meghna, etc.), with a flow range of 300 to 120000 cumec. The semi-major rivers (Surma, Garai, Arial khan, etc.) have a flow range of 100 to 15000 cumec, and the minor rivers have 1 to 1000 cumec. Floods generally occur due to the overflow of these rivers as the capacity of rivers is decreasing day by day. Typically, 20-25% of the country is inundated during every monsoon from June to September. It can be 40-50% in extreme flood events.

However, due to floods, river water becomes polluted and contaminated by many dissolved and suspended matter, pathogenic bacteria, microorganisms, etc. These make water aesthetically unpleasant, tasteless, turbid, and unpalatable. Again, the chemical parameters (pH, alkalinity, hardness, etc.) are also disturbed in flood water. During the dry season, a colossal water scarcity occurs, resulting in drought. So, to overcome this problem, we must preserve water for later use. Flood water can also be maintained as a considerable amount of water becomes waste, which occurs in disaster only for people. The water from the flood is polluted and unpleasant, so we cannot use it without treatment.

There is a process based on the mechanism of sand filtering and solar distillation to treat the flood water. A treatment plant is necessary for this process, containing an underground water tank with a top cover and a sand filter fabricated with one sand layer and one coarse aggregate. The water tank and the filter were located one by one, and the separation between the tank and the filter was a screen whose gratings were at least 100 mm. Water preserved in the tank was first treated by solar distillation, and the micro-organisms died and were deposited in the bottom. Then water passed through the screen to the filter. Then, the water was treated slowly for at least 10 days, which was then preserved in the previous water tank and washed neatly. After this treatment, about 92-97% of bacteria is removed, 20-25% of colour is removed, and turbidity to about 50 ppm is removed. This water can be used in irrigation systems. After measuring the pH, BOD, COD, amount of iron, and arsenic, if these are within the standard value of WHO, this water can be distributed for use in household purposes. In Bangladesh, especially in rural areas, water scarcity for domestic and irrigation systems can be overcome economically and efficiently.

Studies on the Use of Locally Available Renewable Seaweed Wastes from Cox's Bazar and Saint Martin as Compost Organic Fertiliser Resources

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This study evaluates the potential of Hypnea species, a red seaweed prevalent along the coasts of Cox's Bazar and Saint Martin, Bangladesh, as a sustainable source of organic compost fertiliser. Hypnea's nutrient profile includes high levels of potassium (K), nitrogen (N), and phosphorus (P), alongside micronutrients such as iron (Fe), zinc (Zn), and manganese (Mn), as well as bioactive compounds like carrageenan, auxins, and cytokinins. These characteristics make it beneficial for enhancing soil health, promoting plant growth, and increasing crop yield. The composting process for Hypnea is efficient, marked by rapid biodegradation and active microbial involvement, resulting in nutrient-rich humus that enhances soil structure, moisture retention, and pH balance, while improving plant resistance to stressors like drought and salinity. A six-month field experiment conducted in the Khasia farming community of Sreemangal assessed three treatments: T1 (control with standard farming practices), T2 (25g of seaweed-based compost per support tree), and T3 (50g of seaweed-based compost per support tree). The highest yield was observed in T3, with an average of 2880 betel leaves plucked per day, significantly surpassing T1 and T2, which both recorded 2780 leaves. ANOVA analysis confirmed the statistical significance of these results (F-statistic: 14822.79; p-value ≈ 8.84 × 10^-42). The findings underscore that applying 50g of seaweed-based compost per tree significantly boosts betel leaf yield, demonstrating the practice's economic viability by reducing reliance on chemical fertilisers and cutting agricultural costs, aligning with sustainable development goals and the blue economy framework. Utilising seaweed waste minimises environmental pollution, recycles natural resources, and benefits coastal economies by transforming waste into valuable fertilisers. Climate change disrupts water cycles, causing irregular rainfall, droughts, and floods. Melting glaciers and rising sea levels impact freshwater availability, while warmer temperatures reduce water quality. Water-centric ecosystems, like wetlands and mangroves, face habitat loss, altered biodiversity, and increased salinity, threatening species and the ecosystem services they provide to humanity. Ecosystems and seaweed waste are interconnected as seaweed waste when managed sustainably, supports nutrient cycling, soil enrichment, and biodiversity. Decomposed seaweed enhances marine and terrestrial ecosystems by providing organic matter and essential nutrients.

Sharing Innovative Water Solution Implementation for Climate Change Adaptation - Experience from Coastal Urban Towns: A Case of Kerala State, India

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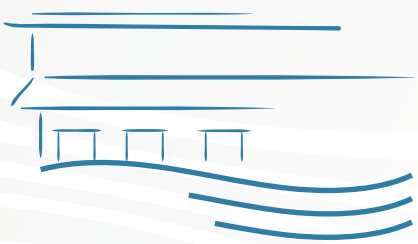
This paper shares the experience of implementing an innovative climate change adaptation solution in the coastal urban-rural continuums in Kerala State, a coastal state in southwest India for the past 15 years. Kerala receives an average annual monsoon rainfall of 3000 mm and approximately 200 homestead well density per square kilometre on average. The majority of these wells go dry during summer or water quality is affected due to saline ingress in the coastal belt mainly due to climate change impact. To combat this situation, in 2008 the Thrissur District Administration, Kerala initiated participatory groundwater well aquifer recharging. The technique directs roof rainwater and homestead stormwater into the wells or closer to the well using roof rain harvesting installations. This process desalinates and dilutes the saline ingress well water while improving the groundwater table and reducing water scarcity in summer. The technique is underpinned by the Gyben-Herzberg Relation and is designed in the format of a local government scheme called "Mazhapolima" Well Recharging. Implemented by the District Rainwater Harvesting Mission, an NGO in Thrissur District, the scheme is supported by local people, households, local governments, and the Kerala government in a participatory approach. The unit cost of a single well recharging unit is about US$150-190 depending upon the roof type and beneficiary local situations. So far the agency is directly involved with implementing more than 36,000 government-subsidised household rooftop well recharging units. Learning the usefulness of the programme, households started installing it at their homesteads with their own funds. No longer Kerala state is drought affected unlike in the past. The Centre for Water Resources Development Management, Kozhikode, of the Kerala state government conducted the Impact Assessment for one hydro-geological year. Their report confirms that it improves the groundwater table in the midlands and upper lands and reduces the saline ingress in the coastal wells. It is a nature-based climate change adaptation technique. Indeed, this method can be replicable in Bangladesh at the field level since Kerala and Bangladesh have similar geography and rainfall availability. The water quality of tube wells/filter points at the coastal / lowlands also can be improved using roof rainwater harvesting.

Environment and Urban Planning



Causes and Impact of Water-logging Problem for Urban Dwellers in Rajshahi City Corporation (RCC) Area, Bangladesh

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Increased urban population and rapid urbanisation cause serious problems. In recent years, water logging has been a burning issue as it has harassed people's daily lives, especially the urban dwellers, who suffer more due to high population density. Heavy rainfall in the city unavoidably leads to waterlogging, significantly threatening livelihood and property security. In recent years, Rajshahi City has been facing the problem of waterlogging in urban areas. The frequency of waterlogging in urban areas is increasing for natural and human reasons. The research attempts to analyse and summarise the reasons for the formation of urban waterlogging and introduces the concept of preventing waterlogging in Rajshahi City Corporation (RCC) areas. One hundred random household surveys were conducted in the study area for the questionnaire survey. To examine the causes and impacts of water-logging in urban areas, some tools (i.e., Cause-Effect Diagram and PairWise Ranking Matrix) of Participatory Rural Appraisal (PRA) are used. The result indicates that the main reason for waterlogging is the need for a planned and adequate drainage network system, and infrastructural problems in the city lead to an unhealthy environment for urban dwellers. Geographic information system (GIS) is used to identify the most vulnerable areas for waterlogging of the study area based on water logging depth (5-20 cm) and waterlogging duration (1, 2, 3, more than 3 days). The results show that waterlogging prevention can be achieved by applying some parameters, and the research describes these parameters consequently.

An Analysis of Water Demand and Availability in Different Housing Conditions: A Case Study on Rajshahi City

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Rajshahi is the fourth largest city in Bangladesh and the administrative seat of Rajshahi Division and Rajshahi District; therefore, it attracts people from nearby northern areas of Bangladesh. A good water supply is a pre-condition to providing a well-facilitated living place. However, the surface water (both ponds and river water) of Rajshahi City is not suitable for drinking and cooking purposes, and Rajshahi WASA can supply only 67% of the city dwellers. The rest, 33% of people, are using groundwater. The study's main objective is to know the groundwater sources and their availability and safety in using that water, as well as the water demands of the respondents. A questionnaire survey was conducted with 200 random samples from different wards of Rajshahi city to collect information on their water use and whether they need help with what facilities they want. The data were analysed using statistical methods, and in this case, the people were categorised according to their housing conditions. The housing material and number of people living per room were considered to define housing conditions. Statistical Package for the Social Sciences (SPSS; version 21) software is used for data analysis. The analysis of the survey data shows that more than 60% of the poor households do not have any tube well or pipeline connection, and almost 40% collect water from more than 70m away. Nearly 50% family use different water for drinking and cooking than other daily uses. According to the respondents, the major possible remedies for their suffering are to supply water from Rajshahi WASA, install deep tube wells by the government, supply water by grouping the houses, use rainwater, etc. With the help of many secondary sources, the concentrations of arsenic, iron, manganese, total hardness, and total coliform and fecal coliform bacteria were found above the permissible limits for potable water in their daily use water. This causes health damage to the people. Therefore, this study helps to find out the sufferings of people for water (especially the poor people) and ways to mitigate their sufferings. Furthermore, the study argues a national problem statistically, which will make a framework from where the concerned authority should stare, and also, the analysed data will be a resource for further planning and strategy-making policy.

Potentiality of Water Transport as Future Mode of Transportation; Designing a Probable Network to Create a Place of Recreation: Case Study, Rajshahi City Corporation

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Rajshahi, being placed at an advantageous location by the river Padma, offers a spectacular view to the passerby. However, the rapid urbanisation of the city is destroying most of its natural assets, specifically water bodies, wetlands, and greenery. The city also needs more adequate provision of outdoor recreation facilities. Rajshahi still can set an example as a green and fluid landscape paradise. There is an immense scope for planning as well as urban design. If the city is developed with the assets it still has, many scenic places can be created. This research focuses on enhancing the recreational aspects of the Circular Waterways (CW) and reducing traffic flow from the road. With the help of waterways around Rajshahi, the potential scope of developing a water-based transportation system and outdoor recreation for the city dwellers can be explored. This research was conducted in two parts, each involving a distinctive approach. Part one involved a macroscopic approach where traffic volume, traffic growth rate, allocated road, and existing water body data were collected. GIS and remote sensing tools were used to determine the scope of waterway transport around Rajshahi City. In contrast, part two involved a design approach where station points from origin and destination surveys were designed. This design approach followed the preservation, conservation, and restoration rules presented in the sketch. All the maps were presented with the help of ArcGIS. Data

was primarily collected from secondary sources. The data analysis was based on several statistical methods, including regression analysis. The results identified the proper location, network, and approach to introduce a waterway transport system. The result also identified the limiting factors that may impact the study's goal. The study recommends that these results should be applied to introduce a waterway transport system, which will help to overcome the limiting factors of this study. The study also suggests creating a recreation place and minimising the overburden on the road.

Development of a Recreational Zone in the Padma Riverbank Using a Compatible Design Approach: A Case Study in Rajshahi City

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The river Padma creates enormous social, recreational, and commercial opportunities and is a blessing for Rajshahi City. Around 70% of the people of Rajshahi City visit the riverbank to enjoy its beauty and spend their leisure time. Lack of proper management of the riverside and ignorance of local authority destroy its natural beauty, and subsequently, the river loses its attraction. Effective initiatives and increased facilities will make this place an attractive recreational zone in Rajshahi City. The selected area is Fultola to T-Badh, which is almost 81.38 acres and is located in the southern part of Rajshahi City. The study aims to develop a comprehensive and compatible design approach that ensures the proper utilisation of the resources of the Padma Riverbank with appropriate management as well. For this study, primary data was collected through quantitative and qualitative surveys, and the respondents made the recommendations. While responding to the survey questions, visitors mentioned some problems, such as insufficient security, poor waste management system, and insufficient lighting and shading system. Unfortunately, one-third of the total bank area is still unutilised, creating a negative impression among visitors. That is why, at present, people visit the place less frequently than before. Establishing a food court, a large waterfall, a playground for children, a 7.01 km walkway with a bicycling zone, a boating and fishing station, a community park, a museum, and several lampposts have been proposed every 10 metres. Establishing Police booths

has been proposed every 100 metres to ensure the security of the visitors. The study suggested a comprehensive design solution to make the Padma riverbank attractive and functional. Moreover, the study can be a framework for the concerned authority for further decision-making processes.

An Analysis of the Adverse Effects of the Water Blockage Problem During the Rainy Season in Dhaka

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Rain always brings blessings to human lives, but in the last rainy season, further cloudbursts became a curse upon city dwellers. As a result, showers created water blockage in the trunk roads of the primary cities in Bangladesh. Presently, Dhaka, the capital city of Bangladesh, experiences the worst acute water blockage problem almost every time it rains. According to Prof. Mustafizur Rahman Tarafdar (water specialist), the causes behind the water blockage problem vary in different zones (areas) of the city depending on topography (elevation, high, low), lack of proper drainage system, uncontrolled canal filling, etc. The rambling drainage system is mainly responsible for the water blockage problem in Dhaka city. It has become a common scenario in Dhaka that an hour of heavy rain can bring the city to a near-collapse situation, and people suffer for hours, resulting in long tailbacks caused by severe traffic jams in the heavily inundated streets. The study aims to find out the causes and effects of water blockage in various sectors (transportation, economy, livelihood, environment, and road safety) with different statistical analyses. The study was carried out in Banani, Mirpur, and Pallabi areas, where water blockages had been created for a temporary barrage and a canal which should be 60 ft. in width and 2-3 ft. in depth according to the Detail Area Plan (DAP) but it's 15 ft. in width and only 2-3 ft. in depth. For this reason, instead of being left, water has frozen out in the area, creating water blockage. To solve this problem, experts proposed eastern bypass construction, canal reclaiming, open area drainage, a dam in the southern part, and the DND Project for drainage in the Master Plan of Dhaka City. Following the effects of water blockage analysis, this obtainment has concluded with the anticipation that Dhaka WASA should consider them in preparing an ongoing “Stormwater Drainage Master Plan" for better stormwater management and making the city more livable.

Importance of Water Body Conservation in Khulna City: An Environmental Concern

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Khulna is the third largest city in Bangladesh, having a population of 1.5 million people. The city is going through a high industrialisation and urbanisation process. It is an industrial city, and its economy is characterised by the rapid growth of shrimp cultivation and processing and the establishment of two universities. To fulfil housing demand, agricultural lands are demolished, and water bodies like ponds are filling up. As a result, it becomes a headache to conserve water bodies for sustainable urban facilities, including well-managed drainage systems, removing water logging problems within the city, maintaining fire demand, controlling the city's temperature, and considering city aesthetics. Surface and rainwater management and Conservation should be the prime approach and source of the country's water needs. The objectives of our study are to assess the water body (pond) change in Khulna City and then find out the impacts of change to describe the importance of the water body in Khulna City. GIS analysis and Image analysis were done to calculate the change in water bodies over the years. Statistical analysis and a field investigation were conducted to ensure that the expected results met the objectives. In Khulna City, the rate of water body (pond) destruction and filling has significantly increased over the years. This trend is primarily driven by the demand for land for residential and commercial development, with ponds being filled to construct houses or establish businesses. However, if this practice persists unchecked, the city is likely to face severe challenges in the long term. Water bodies play a crucial role in stream water discharge, meeting fire safety demands, and ensuring the effective management of drainage systems. The loss of these vital resources could lead to significant environmental and infrastructural issues, underscoring the urgent need for sustainable urban planning and conservation efforts. Following water acts and properly monitoring water body conservation rules and regulations can solve the problem. The government should take more necessary steps to make people aware.

Acronyms

AAB: ActionAid Bangladesh

AI: Artificial Intelligence

BWDB: Bangladesh Water Development Board

CGAPP: Centre for Global Affairs & Public Policy

COP: Conference of the Parties

CSIR: Council of Scientific & Industrial Research

CSD: Center for Sustainable Development

CSO: Civil Society Organization

CSR: Corporate Social Responsibility

DRR: Disaster Risk Reduction

DWASA: Dhaka Water Supply and Sewerage Authority

EIA: Environmental Impact Assessment

EWCE: Environmental, Water Resources and Coastal Engineering

GIS: Geographic Information System

GRCC: Ganga River Conservation Committee

HRPB: Human Rights and Peace for Bangladesh

ICMIAM: International Conference on Maintenance and Intelligent Asset Management

IISER: Indian Institute of Science Education and Research

IMMT: Institute of Minerals and Materials Technology

IRMA: Institute of Rural Management Anand

IWC: International Water Conference

JRC: Joint River Commission

ML: Machine Learning

MSS: Multispectral Scanner

NWMP: National Water Management Plan

NWWRCB: National Women's Water Resources Council of Bangladesh

NRCC: National River Conservation Commission

OLI: Operational Land Imager

RCC: Rajshahi City Corporation

RO: Reverse Osmosis

RWH: Rain Water Harvesting

SAARC: South Asian Association for Regional Cooperation

SDG: Sustainable Development Goals

SIWI: Stockholm International Water Institute

SRM-IST: Sri Ramaswamy Memorial Institute of Science and Technology

STEM: Science, Technology, Engineering, and Mathematics

STEAM: Science, Technology, Engineering, Arts, and Mathematics

TDS: Total Dissolved Solids

TIRS: Thermal Infrared Sensor

TM: Thematic Mapper

TWRM: Transboundary Water Resource Management

UN: United Nations

UNDP: United Nations Development Programme

WASH: Water, Sanitation, and Hygiene

WASA: Water Supply and Sewerage Authority

WEBS: Water, Energy, Biodiversity, and Sediment

WEF: Women Economic Forum

WHO: World Health Organization

WICCI: Women's Indian Chamber of Commerce & Industry

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