

Webinar Report:
Governing the Invisible River: Participatory
Underwater Domain Awareness (UDA)
Framework for the Brahmaputra Basin



Held on: 23rd June 2026

Introduction

The Maritime Research Centre (MRC), Pune, organised a high-level webinar titled "Governing the Invisible River: Participatory Underwater Domain Awareness (UDA) Framework for the Brahmaputra Basin" to advance discussions on integrating underwater processes into river basin governance. Building upon earlier deliberations on Underwater Domain Awareness (UDA) in the Brahmaputra, this webinar shifted the discussion from understanding the invisible river to examining how underwater intelligence can be translated into practical governance, community participation, and regional cooperation.

The webinar convened leading experts from river governance, environmental policy, sociology, diplomacy, and water management to examine how scientific monitoring, traditional ecological knowledge, and institutional coordination can collectively strengthen governance of one of South Asia's most dynamic transboundary river systems. Discussions focused on developing Participatory Underwater Domain Awareness as a governance architecture that combines hydrographic science, sediment intelligence, ecological monitoring, and community knowledge to support anticipatory governance, disaster resilience, navigation safety, infrastructure planning, and transboundary confidence-building.

Background

The Brahmaputra Basin is characterised by rapid sediment transport, shifting channels, extensive erosion, dynamic floodplains, and complex ecological systems. Although these underwater processes fundamentally shape flooding, navigation, infrastructure stability, fisheries, and livelihoods, governance mechanisms largely continue to focus on visible surface phenomena such as flood levels, embankments, and damaged infrastructure. This disconnect creates a structural governance challenge. Many of the processes that eventually produce disasters begin beneath the river surface, developing gradually through changes in sediment transport, bathymetry, riverbed morphology, and underwater habitats before becoming visible at the surface.

The concept of Underwater Domain Awareness (UDA), provides a framework for understanding these hidden processes through integrated scientific observation, technological monitoring, institutional coordination, and community participation. Building upon earlier discussions that introduced UDA for river governance, this webinar explored the concept of Participatory UDA, in which technical monitoring is complemented by the lived knowledge of fishers, ferry operators, char dwellers, and floodplain communities whose daily interactions with the river provide valuable insights into underwater change.

Opening Address by Dr. (Cdr) Arnab Das, Founder and Director, Maritime Research Centre, India

Dr. Arnab Das welcomed the distinguished panel of experts and participants, emphasising that the Maritime Research Centre has progressively expanded its research on the Brahmaputra by integrating engineering, environmental science, public policy, social sciences, and liberal arts.

He highlighted that understanding the Brahmaputra requires far more than hydrological measurements. River governance must account for underwater processes, ecological interactions, technological innovations, and human dimensions simultaneously. He noted that MRC's interdisciplinary research teams, including engineers, anthropologists, policy scholars, geographers, and humanities researchers, are collectively developing an integrated understanding of the basin.

Dr. Das explained that the webinar represented another step in developing a comprehensive governance framework centred on Underwater Domain Awareness, moving beyond conventional surface-level management toward a more holistic understanding of river systems. He expressed hope that the expert interventions would further strengthen the emerging framework and contribute to the forthcoming monograph on the Brahmaputra.

You can watch the full address [here](#).

Keynote Address by Ms Tejaswini Kaktikar, Research Fellow, Maritime Research Centre, India

Ms. Tejaswini Kaktikar delivered the keynote presentation titled "*Governing the Invisible: Participatory Underwater Domain Awareness Framework for the Brahmaputra Basin*." She argued that while governance institutions primarily respond to visible events, such as floods, embankment failures, navigation disruptions, or declining fisheries, the underlying processes producing these outcomes occur beneath the river surface through sediment redistribution, riverbed migration, scour, and ecological transformation.

She distinguished between three forms of invisibility affecting Brahmaputra governance:

- **Physical invisibility**, where underwater processes remain difficult to observe due to turbidity and river dynamics.
- **Institutional invisibility**, where information remains fragmented across multiple agencies and sectors.
- **Political invisibility**, where differences in monitoring standards and transboundary information sharing create uncertainty and mistrust.

The presentation emphasised that underwater observations alone are insufficient unless they are interpreted within governance systems capable of translating evidence into decision-making. She therefore proposed Underwater Domain Awareness not merely as a technological monitoring system but as a governance architecture connecting scientific observation, institutional interpretation, verification, and policy action.

A central contribution of the presentation was the concept of Participatory UDA, which recognises that local communities possess extensive experiential knowledge of underwater conditions. Fishers, ferry operators, and char dwellers continuously observe changing channels, submerged hazards, fish behaviour, erosion patterns, and navigation routes. Rather than replacing scientific monitoring, such knowledge complements technical observations by providing local context and operational significance. Within this framework, scientific evidence and community knowledge jointly support credible, actionable intelligence capable of informing navigation, fisheries management, infrastructure maintenance, disaster preparedness, and environmental protection.

Ms. Kaktikar concluded that governing the Brahmaputra requires recognising uncertainty as an inherent characteristic of dynamic river systems and developing governance institutions capable of acting before visible damage occurs.

Watch the full presentation [here](#).

Intervention by Dr. Sumit Vij, Assistant Professor, Wageningen University

Dr. Sumit Vij welcomed the keynote's conceptualisation of the "invisible river" while questioning whether the Brahmaputra can truly be considered a well-understood system. He argued that although significant scientific work exists, basin-wide interdisciplinary research and governance remain limited, leaving important ecological, institutional, and political dimensions insufficiently explored. He also suggested that invisibility extends beyond underwater processes to include the marginalisation of river-dependent communities whose knowledge and experiences often remain absent from decision-making.

Dr. Vij further emphasised that underwater processes should be understood alongside surface and atmospheric interactions, advocating a more integrated systems perspective. He also highlighted the importance of recognising political dimensions of river governance, noting that effective participation depends not only on scientific knowledge but also on addressing questions of power, institutional willingness, and community agency.

Watch the full intervention [here](#).

Intervention by Dr. Mirza Zulfikur Rahman, Heinrich Böll Foundation

Dr. Mirza Zulfikur Rahman commended the presentation for bringing attention to an under explored dimension of Brahmaputra governance. He observed that research and policy have historically prioritised structural interventions such as embankments and hydropower development over systematic understanding of river dynamics, creating significant knowledge gaps. He argued that future governance should integrate scientific approaches with traditional ecological knowledge while recognising the historical and political contexts shaping river management.

He further emphasised that the Brahmaputra should be understood as a shared ecological system rather than a collection of political jurisdictions. Greater regional cooperation, stronger community engagement, and improved access to scientific information, he suggested, are essential for translating innovative governance concepts such as Participatory UDA into practical outcomes.

Watch the full intervention [here](#).

Intervention by Ambassador Riva Ganguly Das (Retd.), Former Secretary (East), Ministry of External Affairs, Government of India

Ambassador Riva Ganguly Das welcomed Participatory UDA as a valuable framework for examining the unknown and less visible dimensions of transboundary rivers. She noted that considerable research and practical testing would still be required before the framework could be applied at scale.

She emphasised that implementation should begin at the local and community levels, supported by stronger public awareness of UDA and its non-military applications. Ambassador Das argued that the framework could eventually contribute to constructive dialogue among upper, middle, and lower riparian countries by improving their shared understanding of underwater processes and strengthening cooperation around transboundary waters.

Watch the full intervention [here](#).

Intervention by Shri Ashwin Pandya, Former Chairman, Central Water Commission

Shri Ashwin Pandya highlighted the exceptional physical, climatic, and social complexity of the Brahmaputra Basin. He stressed that governance must balance the interests of local communities with broader environmental, developmental, and national considerations.

He emphasised the need for a common platform through which credible and comprehensive information could be exchanged. He noted that the challenge was not only the availability of data, but also whether existing information products were appropriate for the purposes and institutions using them. Shri Pandya further argued that the Brahmaputra should be understood as an interconnected basin rather than only as a river channel. Effective governance, he suggested, requires wider stakeholder participation, stronger institutional coordination, and greater understanding of the mutual interests connecting communities across the basin

Watch the full intervention [here](#).

Concluding Remarks by Ambassador Tariq Karim (Retd.), Director, Centre for Bay of Bengal Studies, Bangladesh

In his concluding remarks, Ambassador Tariq Karim emphasised that the Brahmaputra must be understood as an interconnected and indivisible basin rather than through fragmented national or administrative boundaries. He observed that rivers naturally transcend political borders and therefore require cooperative and basin-wide governance approaches.

He cautioned against resource nationalism and argued that riparian countries must recognise the river as a living system whose ecological and hydrological processes cannot be divided. Ambassador Karim encouraged continued engagement among experts and stakeholders from across the basin, noting that UDA could strengthen collective understanding, support anticipatory governance, and provide a constructive basis for regional cooperation.

Watch the full remarks [here](#).

Conclusion

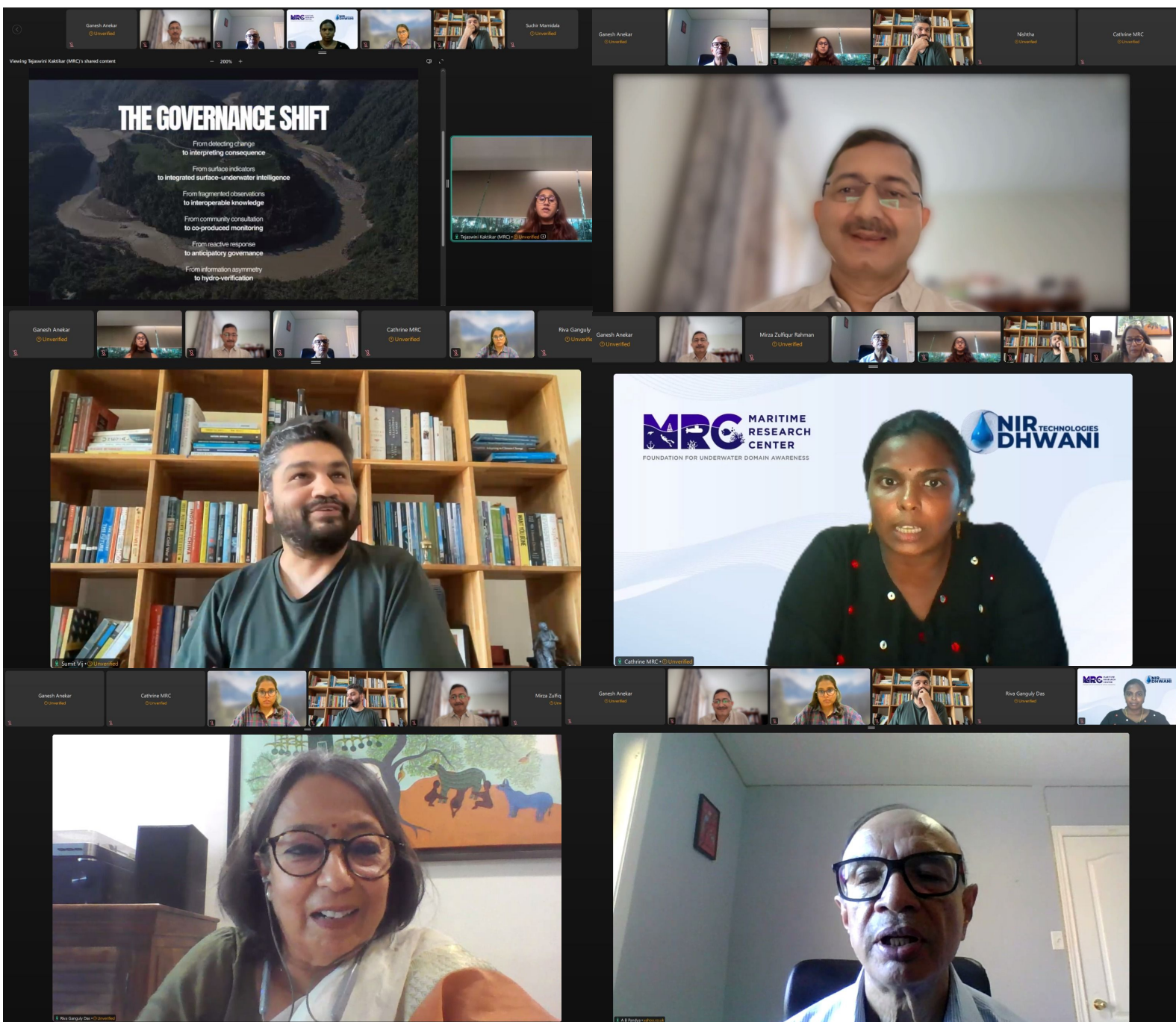
The webinar demonstrated that governing the Brahmaputra requires moving beyond surface-oriented and reactive approaches towards a more integrated understanding of the processes occurring beneath the river. Participatory Underwater Domain Awareness emerged as a valuable framework for connecting scientific monitoring, ecological intelligence, community knowledge, and institutional decision-making. By integrating bathymetric change, sediment dynamics, underwater habitats, and locally observed river behaviour, UDA can support more anticipatory approaches to navigation safety, infrastructure planning, fisheries management, erosion response, and community resilience.

Participants also emphasised that technological capability alone cannot produce effective river governance. Meaningful progress requires credible data exchange, institutional coordination, genuine community participation, political commitment, and a basin-wide perspective that recognises the Brahmaputra as an interconnected system spanning national

boundaries. In this context, Participatory UDA offers not only a means of making underwater change more visible, but also a platform for strengthening trust, improving cooperation, and enabling more adaptive and inclusive governance across the basin.

You can watch the full webinar [here](#).

Image Gallery



Enclosure 1

Underwater Domain Awareness Framework

Dr (Cdr) Arnab Das

The concept of Underwater Domain Awareness (UDA), in a more specific sense, will translate to our eagerness to know what is happening in the underwater realm of our maritime areas and the freshwater systems. This keenness for underwater awareness from the security perspective means defending our Sea Lines of Communication (SLOC), coastal waters, and varied maritime assets against the proliferation of submarines and mine capabilities intended to limit access to the seas and littoral waters. The freshwater systems, particularly the transboundary Rivers, are not defended by the Navy & the Coast Guard, but these waters are equally vulnerable and more complex to manage. However, military requirements may not be the only motivation for generating underwater domain awareness. The earth's underwater geophysical activities have a lot of relevance to the well-being of humankind, and monitoring them could provide vital clues to minimize the impact of devastating natural calamities. The commercial activities in the underwater realm need precise inputs on the availability of resources to effectively and efficiently explore and exploit them for economic gains. Underwater resources include fisheries, aquaculture, seaweeds, pharma ingredients, minerals, and others with significant market value. The regulators, on the other hand, need to know the pattern of exploitation to manage a sustainable plan. The connectivity through the water bodies has been recognized as the most effective and efficient mode of transportation, however, ensuring navigability in these water bodies requires a massive amount of UDA. With so many commercial and military activities, there is a significant impact on the environment. Any conservation initiative needs to precisely estimate the habitat degradation and species vulnerability caused by these activities and assess the ecosystem status and climate change risk. The scientific and research community needs to engage and continuously update our knowledge and access of the multiple aspects of the underwater domain. The global community is looking at the Indo-Pacific strategic space for their geopolitical and geostrategic engagements. The Indo-Pacific region, by definition, is the tropical waters of the Indian and Pacific Oceans. The tropical waters present unique challenges and opportunities regarding rich biodiversity and resource availability. However, the sub-optimal sonar performance is the biggest issue, limiting the UDA in these regions. The sonars that were designed for the temperate & polar waters of the Greenland, Iceland, United Kingdom (GIUK) gap during the Cold War era suffered 60% degradation when deployed in tropical waters. The developing nations in tropical waters need to customize these technologies to suit their conditions. The Western nations that are pushing this hardware do not have the manpower to deploy it. In contrast, the tropical nations, have the manpower but lack the appreciation of the technology and the know-how. The proposed UDA Framework, presented in the figure below, can optimize resource deployment and provide nuanced policy and technology intervention, along with acoustic capacity & capability building to manage the tropical challenges and opportunities. There is significant fragmentation among all four stakeholders, namely Strategic Security, Blue Economy, Sustainability & Climate Change Risk Management, and Science & Technology (Digital Transformation), and the UDA framework provides a comprehensive way forward for the stakeholders to engage and interact

On a comprehensive scale, the UDA Framework needs to be understood in terms of its horizontal and vertical construct. The horizontal construct would be the resource availability in terms of technology, infrastructure, capability, and capacity specific to the stakeholders or otherwise. The stakeholders represented by the four faces of the cube will have their specific requirements, however, the core will remain the acoustic capacity and capability. The vertical construct is the hierarchy of establishing a comprehensive UDA. The first level, or the ground level, would be the sensing of the underwater domain for threats, resources, and activities. The second level would be making sense of the data generated to plan security,

conservation, and resource utilization strategies. The next level would be to formulate and monitor regulatory framework at the local, national, and global levels. The individual cubes represent specific aspects that need to

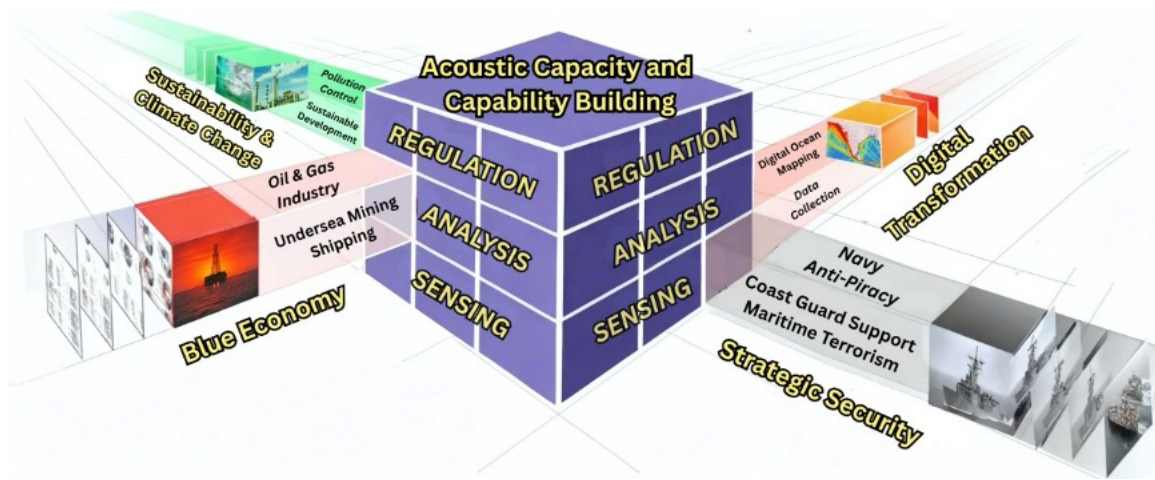


Figure 1: UDA Framework (Source: <https://udafoundation.in/>)

be addressed. The ‘User-Academia-Industry’ partnership can be seamlessly formulated based on the user requirement, academic inputs, and the industry interface represented by the specific cube. It will enable a more focused approach and a well-defined interactive framework. Given the appropriate impetus, the UDA Framework can address multiple challenges being faced by the global community today. Meaningful engagement of the young and aspirational population is probably the most critical aspect that deserves attention. Multi-disciplinary and multi-functional entities can interact and contribute to synergize their efforts towards a larger goal seamlessly. The UDA Framework is a structured, comprehensive, and inclusive framework to drive the underwater domain effectively and efficiently. The structured approach will minimize the fragmentation among the stakeholders, regional players, national authorities, and local bodies. The multiple entities will have divergent interests and priorities, thus, converging them into one single and focused governance mechanism will be a challenge. The governance mechanism must be comprehensive and recognize all dimensions of the stakeholder requirement. The 3 dimensions include varied layers that are instrumental in building a strong governance mechanism. The first layer would be five pillars: research, skilling, academia, innovation, and policy. The second layer is its translation into policy & technology intervention, along with acoustic capacity & capability building. The inclusive aspects include varied socio-economic, socio-political, and socio-cultural native groups in the larger governance framework. The varied socio-economic strata of the society, particularly the coastal & riverine communities, get excluded in the conventional development models. The students need to prepare for real-world challenges and get very late before they get exposed to the nuances of real-world issues. The political spectrum is always driven by the social structure, based on left or right leanings. The governance mechanism has to address the concerns and aspirations of both sides. The cultural divide translates to the traditional practices and beliefs that drive their livelihoods and social structure. The governance mechanism has to address these divides and integrate everyone into one national, regional, or global framework. The global community is also professing the triad of people, economy, and nature for enhanced governance mechanisms. The people component includes the livelihood, well-being of the native communities, social dynamics, and more. The economic component is the growth and prosperity associated with the activities. The nature component addresses sustainability and climate change risk management. This is also measured in terms of the Environmental, Social, and Governance (ESG) formulation. The UDA Framework is consciously addressing all these varied measures of global good parameters.

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