BLUE PAPERS

Water & Heritage for Sustainable Development

Edited by Carola Hein, Matteo D'Agostino,
Carlien Donkor & Zuzanna Sliwinska

Leiden-Delft-Erasmus
Universities

2024 (Vol. 3 No. 2)

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Blue Papers: Highlighting the Critical Role of Water and Heritage in Sustainable Development

Water in all its forms is key to human survival and well-being. Humans have created intricate and ingenious solutions to survive and thrive in difficult and complex territories, and adapt to changes in social and environmental conditions. Remnants of past practices, structures and objects are still with us – in the built environment, in our institutions, in our ways of living and in our languages. Sometimes we call these objects and practices heritage, but more often they are so much a part of our everyday lives that we take them for granted.

As emphasized in the *UNESCO Thematic Indicators for Culture in the 2030 Agenda,*[1] culture is an important part of the Goals and Targets of the 2030 United Nations' Agenda for Sustainable Development. Stand-alone technological interventions cannot solve the complexities of the social, cultural and economic implications of climate change in the long term. New solutions require the engagement of local interested parties and local knowledge to address social and cultural dimensions of water and to create a new embedded water awareness in the built environment, in institutions and culture(s), so that we can preserve and protect our heritage, understand and learn from the past, and activate history and heritage for future sustainable and inclusive living.

The biannual peer-reviewed journal *Blue Papers* explores the complex relationship between water, culture and heritage to assess lessons from the past, to protect heritage sites, to make use of water heritage and to contribute to the development of inclusive and sustainable future water systems. The past can help build a new platform for awareness of water and heritage, which involves shared methodologies and terminologies, policies and tools that bridge disparate fields and disciplines. To achieve this, we also need to rethink the role of water in the UN Sustainable Development Goals (SDGs). Water is not fully captured in *Goal 6: Ensure access to water and sanitation for all*; it is also an integral and inseparable key to all SDGs that carry us forward to a more sustainable future.

All issues of the journal will be loosely based on themes that link to water, culture and heritage, including (but not limited to):

- Transcending the nature-culture divide
- Tangible and intangible aspects
- Integrated discourses and practices

1. The UNESCO Thematic Indicators for Culture in the 2030 Agenda (UNESCO Culture|2030 Indicators), https://whc.unesco.org/en/culture2030indicators/.

- Capacity building for holistic systems
- Long-term (living) history perspectives for comprehensive understanding
- Preservation, protection and reuse of water-related (living) heritage
- Human and non-human stakeholders
- New practices and rituals for water awareness and engagement
- Strategies for inclusive sustainable development, including those drawing on heritage.

The launch of the open access, peer-reviewed journal *Blue Papers* has been led by the Chair History of Architecture and Urban Planning, TU Delft; the UNESCO Chair Water, Ports and Historic Cities; and the LDE PortCityFutures Center. It was made possible thanks to financial support from the Ministry of Infrastructure and Water Management, the Netherlands; the Chair History of Architecture and Urban Planning, TU Delft and the LDE PortCityFutures Center. Setup and development of Blue Papers has been supported by ICOMOS NL, ICOMOS Germany, ICOMOS ISC Water, the Initiative for the Future of Great Rivers (IFGR), WAMUNET, Waternet, Witteveen+Bos, and Stichting OpenAccess Platforms (SOAP).

Cover image: Bahasa Indonesia: Persawahan di Nagari Kinari dalam proses tanam. Terletak di Kecamatan Bukit Sundi, Kabupaten Solok, Sumatera Barat, taken by Ian Bagindo Piliang. March 18, 2023. Distributed under the Creative Commons Attribution-Share Alike 4.0 International license. Image available under: https://commons.wikimedia.org/wiki/File:Sawah_Kinari.jpg.

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Content

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Capturing Water, Culture and Heritage through Icons: A First Attempt

Carola Hein, Matteo D'Agostino, Carlien Donkor, Queenie Lin and Hilde Sennema

Humans have engaged with water in multiple ways, creating physical structures – such as buildings, cities, infrastructures and landscapes – and sociocultural manifestations – for example, institutions, laws, artistic practices and rituals. They have transformed natural settings in keeping with climate and energy conditions. To understand the diverse conditions of water spaces and heritage, we have created a set of icons to categorize tangible and intangible objects and practices related to water. The icons help us identify different scales, functions and forms of water management-related heritage objects, as well as generic water-related structures. The categories identified are suggestions and not conclusive or mutually exclusive.

Tangible

Drinking
A key function of water management is the provision of freshwater and access to potable water; infrastructures and techniques to store, pump, redistribute and use drinking water.

Agriculture and Irrigation
Numerous strategies and technologies exist to channel and exploit water resources for food production, including the irrigation of agricultural land and livestock watering.

Drainage and Sewage
The removal of excess water and sewage water – e.g., rainwater and excess surface runoff, and wastewater (black and gray water) – requires extensive infrastructure and cleaning systems.

Food from Water Bodies
Natural and artificial water bodies - including seas, rivers, lakes and ponds - are home to plants and animals and are a source of food, obtained through traditional and industrial fishing techniques as well as aquaculture.

Shelter and Defense
Humans have built shelters to protect themselves from harsh climatic elements (rain, snow, etc.), through architectural and urban forms. They have also made structures to defend themselves from and through water, such as dikes, dams, moats and fortification walls.

Health
Clean water is key to human well-being. Water quality is important for individual and public health. The pollution of water bodies through biological and chemical agents has notably influenced the development of spatial planning.

Energy/Industry
Water is used in industrial processes, e.g., for cooling down machinery, in mining activities and breweries; it is exploited for energy production, such as hydroelectric power. Energy is also key to controlling water and is used to generate energy.

Transport
Water bodies – seas, rivers and canals – are key to transporting people and goods for everyday mobility, tourism and commercial purposes. Specific infrastructures exist to transport people and goods from sea to land and vice versa (e.g., quays, cranes), and for storage (e.g., warehouses).

Places of Leisure
Water bodies, natural or manmade, in cities and landscapes serve leisure practices in multiple ways (e.g., waterfronts, water parks, rivers, swimming pools).

Places of Worship
Humans have created religious spaces for revering water and they may use water to express reverence for or connection with a spirit or deity. Structures such as churches and temples contain elements related to water, or can be part of the management of water resources.

Intangible

Daily Water Practices
Water is part of everyday practices, including drinking, bathing, washing and cooking.

Recreation
Recreational practices use water bodies, natural and artificial. These practices include water sports as well as spending time by the sea.

Rites and Rituals
Water is part of religious and spiritual practices all over the world, including those of major world religions. It is often associated with purification, and in some belief systems, it is revered as a source of all life.

Language/Idioms
Idioms, proverbs and sayings that concern water and water-related societal wisdom and ancestral knowledge.

Laws and Policies
Water management, access, and use have long been regulated through governmental policies and customary laws. Water politics affect and are affected by social, cultural and economic dynamics; they can determine rights and obligations for citizens and community members.

Institutions
Water management laws and policies are often designed and enforced by institutions. These can be political (e.g., a nation-state or a chiefdom), religious or social.

Education
Socialization is key to healthy and sustainable living with water. This can occur through community members, capacity-building programs, schooling, and initiatives to exchange or transmit knowledge and to raise water awareness.

Preservation, Adaptation, Reuse
Diverse traditional and contemporary practices and actions aim at preserving or strategically changing water bodies, related ecosystems and even the social customs connected to them.

Music, Arts and Dance
Ecological knowledge is contained in local songs and other oral traditions, poems, illustrations, paintings and artistic performances that connect life stories to water.

Festivals and Ceremonies
Many special events celebrate, commemorate or inaugurate water-related structures, practices and models. This includes fishing and seasonal festivals, events organized to honor or mourn historic water-related events and ceremonies to establish/launch new water-related objects or structures.

Building a Lasting Water Community

Ismail Widadi
Director of Irrigation and Lowlands, Ministry of Public Works and Housing, Republic of Indonesia

This year's 10th World Water Forum (10WWF), with the theme "Water for Shared Prosperity," highlighted the need to identify and promote the collective values of water, along with heritage structures and practices. I was invited to give an opening speech at the official side event (SE37) of the UNESCO Chair Water, Ports and Historic Cities titled "Promoting the Values of the Subak System for Sustainable Water and Heritage Management."

My office at the ministry has the tasks of formulating and implementing policies on water resource management, drinking water systems, wastewater and solid waste management, environmental drainage, and housing provision and development. Our role is complex in that housing depends on water supply as much as road construction depends on stormwater drainage. At a time when freshwater supplies and quality are diminishing for many reasons, including urbanization pressure, environmental degradation and pollution, we recognize that age-old traditional water infrastructure can offer inspiration for the design of contemporary hydrological systems. It can also be preserved as a model of ancestral ingenuity.

The work on the Balinese Subak water management between my ministry and institutions such as Indonesia's Ministry of Culture and Udayanas University's Subak Laboratorium provides the foundation for long overdue collaboration across sectors, technologies and borders. The Subak is an irrigation system that combines artistry and technical ingenuity. It is also a communal institution for the collective work of rice farmers using a shared irrigation system on land fed by the same water source. This cultural heritage of the Subak, which holds significant local wisdom, has endured for centuries due to its principle of community engagement, even in the technical sector of water supply. Subak transcends mere agricultural management. It embodies a holistic philosophy of harmonious coexistence between God, nature and fellow beings.

The successful preservation of this multiscalar system demonstrates the importance of the communal collaboration required for its development and maintenance. Although problems occur even amid solutions, the joint effort at different levels, from local and regional to national, contributes to the Subak's resilience and adaptability. Also, the spirit of "Gotong Royong" or mutual cooperation, which is imbued in Balinese society, permeates social obligations and religious practices. From agricultural endeavors to communal rituals, cooperation is not merely a virtue, but a way of life, binding communities together in collaboration. The Subak system's sustainability is underpinned by a guarantee of land ownership rights. According to Bali's traditional land laws, those who cultivate untamed lands inherit the rights to steward them for generations, alongside obligations to contribute toward communal resources through financial sharing.

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Preface

By harnessing the wisdom embedded in water heritage, we can chart a course toward a future where water is not merely a commodity, but a source of shared prosperity and harmony. The discussions presented in *Blue Papers* address current challenges by bolstering concepts, strategies, new approaches and methodologies aimed at ensuring the sustainability of water use. The editors have proven their commitment to advancing dialogue, knowledge exchange and dissemination, and interdisciplinary collaboration in the pursuit of bridging the water-culture-heritage nexus, which aims at achieving water security and inclusive prosperity. I endorse the journal and support the team of the UNESCO Chair Water, Ports and Historic Cities in their activities in the coming years. I invite more publications and articles that show the complexity of the Subak's past and its contemporary relevance, both of which have profound implications for water governance, cultural preservation and sustainable development and can serve as a global example.

Editorial Issue 2/2024
Community in Water and Heritage Management

Carola Hein, Zuzanna Sliwinska, Carlien Donkor and Matteo D'Agostino

In recent years, community engagement has become a cornerstone in peace-building, decision-making and sustainable development. It also plays an increasingly significant role in heritage management and the processes involved in heritage listing. The 1972 World Heritage Convention, Article 5, proposed adopting a policy of integrating cultural and natural heritage in the life of communities. In 2007, "Communities" was added as the "Fifth C" to the Strategic Objectives to "enhance the role of communities in the implementation of the World Heritage Convention" (UNESCO 2007). The 2011 UNESCO Historic Urban Landscape (HUL) approach further strengthened commitment to community engagement by emphasizing the importance of community values and the need to learn "from communities about their histories, traditions, values, needs and aspirations, and by facilitating mediation and negotiation between groups with conflicting interests" (UNESCO 2011). This shift reflects a broader recognition that effective heritage preservation requires integrating local knowledge, practices and cultural values.

Sophisticated water management systems, adapted to specific geographical and climatic conditions, often incorporate centuries of accumulated knowledge. The traditional water-sharing system of the Balinese Subak exemplifies the human capacity for environmental stewardship, aligning with values of kinship between people and the natural world. However, rapid industrialization and urbanization have significantly altered many traditional communities' ways of life and their relationships with local environments, including water systems. The advent of "modern water" (Linton 2013), understood as water disconnected from its social context, has disrupted traditional practices. Additionally, new legal frameworks have changed community dynamics.

Climate change exacerbates existing challenges through flooding, storm surges, rising sea levels and prolonged droughts, threatening heritage sites and communities. The combined effects of modernization and climate change – changing cultural priorities, community dispersion and displacement and damage or limited access to sites – impair communities' ability to pass down the knowledge and practices related to water use and management in harmony with local environmental cycles.

Heritage plays an important role in community building, fostering a shared identity, a sense of belonging and collective responsibility. Strengthening communities through active participation in heritage management and adopting a more inclusive approach can help recognize and integrate

diverse knowledge systems, drawing upon collective historical wisdom. Taking inspiration from traditional water systems and practices and preserving them can establish a foundation for collaborative and effective water initiatives that honor diverse cultural perspectives and provide sustainable pathways for the future. An example of this approach is community archaeology, which involves local communities in researching, excavating and interpreting archaeological sites and artifacts. This participatory approach redefines the role of heritage in community life. However, it is important to acknowledge that not all traditional practices are inherently sustainable, as they can be tied to societal roles and functions that perpetuate gender inequalities and forms of discrimination.

The 10th World Water Forum (10WWF), held in May 2024 in Nusa Dua, Bali, highlighted the importance of citizen participation and the development of communities of practice (10th World Water Forum Secretariat 2024; PortCityFutures, n.d.). The forum provided an opportunity to showcase the work of the UNESCO Chair Water Ports and Historic Cities and to exchange ideas with representatives of other international programs and projects aimed at ensuring sustainable and just water futures through interdisciplinary collaboration and innovation (Donkor et al. 2024b). Our team co-organized and coordinated several events, many of which are reported on the PortCityFutures blog entitled "10th World Water Forum: Our Collective Journal and Key Takeaways, Part I" (Donkor et al. 2024a). One of the team's activities was an official special side event, SE37 Promoting the Values of the Subak System for Sustainable Water and Heritage Management, organized in collaboration with colleagues from Udayana University, University of Indonesia, Reservoir, Bale Bengong and Capybara Unit Visual.

The SE37 event aimed to move beyond simply representing local communities by facilitating meaningful exchanges around shared interests and highlighting opportunities for collaboration. A site visit to two Subak locations and an in-situ workshop gave participants firsthand experience of the Subak cultural and physical landscape and its social organization. On-site discussions emphasized the importance of involving local communities in all stages of development, from strategy formulation through to the monitoring phase and beyond, to avoid top-down solutions that may not fit local contexts and challenges.

Blue Papers, Volume 3, Number 2 (2024), brings together 15 articles, several of which discuss community roles in developing or preserving water heritage sites.

In Part I, "Challenges, Concepts and New Approaches," Tino Mager opens the issue with a call to incorporate water management strategies in the management plans of World Heritage properties to address climate change threats. His article underscores the critical importance of historic water management in addressing local challenges across past, present and future contexts. Martine van Lier discusses the examples of six Dutch harbors, highlighting the role of local maritime heritage practices and slow tourism in driving sustainable development and supporting climate adaptation efforts. Li Lu and Haoxiang Zhang focus on the built heritage of the Master of the Nets Garden in China, using spatial, empirical and experimental analysis to examine human-water relationships and offering a methodology that can be applied to other small-scale sites.

Social justice is a key theme in the contribution of Lauriane Verhoog, who employs a cross-dimensional approach rooted in geohistory to advocate for greater recognition of the water-related heritage of coastal communities along the Mozambique Channel. Similarly, Federico Camerin emphasizes the need for inclusive heritage management in Venice, especially in response to recent proposals that threaten local communities. He discusses the potential for repurposing heritage sites to tackle urgent issues such as mass tourism, housing shortages and environmental protection.

Part II features several case studies with a particular focus on water communities in the Indo-Pacific region, along with their struggles and strategies for facing climate change and exclusion from urbanization processes.

Through their interactions with water, communities have shaped unique territories. However, modernization and urbanization have led some water-centric spaces to be neglected. The case study of the Antalaotra people of Madagascar by Lauriane Verhoog explains how ethnic marginalization failed to acknowledge the past trade networks across the Indian Ocean, which brought prosperity to the area; her article makes a case for a more inclusive national narrative. Salma Begum paints a picture of a monsoon-led landscape in Bangladesh, focusing on the liminal spaces known as *ghats*, which represent important cultural and functional interfaces between land and water.

Kelly Shannon and Bruno De Meulder describe the intricate relationship between the sociocultural practices of floating villages and the Tonlé Sap Lake in Cambodia, which is endangered by climate change, calling for coordination between Indigenous knowledge systems and practices and modern development proposals.

Swagata Das, Kelly Shannon and Bruno De Meulder emphasize the significance of Indigenous knowledge systems in navigating environmental challenges and preserving cultural heritage. They focus on *char* dwellers in the Brahmaputra River, exploring how they maintain unique spatial practices amid political marginalization. Di Fang and Kaiyi Zhu examine Malaysia's Sama Dilaut sea nomads, highlighting their struggle to uphold their traditional way of life in the face of urbanization and Western influence.

Traditional knowledge and ancient water management systems are at the heart of the contribution by Pierantonio La Vena and Bhatta Ram, who analyze the efficiency of the *khadeen* system of the Thar Desert in Rajasthan and the threats posed to it by mining activities and urban developments. Vu Linh, Bruno De Meulder and Kelly Shannon focus on Khmer communities and their complex hydrosociology in the Phnom K'to (Cô Tô Mountain) area of Vietnam's Mekong Delta, presenting their water management practices as potentially helpful in the struggle to address climate change threats. Wei Lei, Kelly Shannon and Bruno De Meulder analyze the case of *weitian* (polder) systems in the Yangtze River Delta, revealing both the benefits and shortcomings of their transformations and emphasizing the need for a balanced approach that facilitates development while preserving the region's unique deltaic conditions and water towns. Ouafa Messous focuses on Figuig Oasis

as a model of ecosystemic resilience against water scarcity and climate change, highlighting the potential of integrating ancient water management practices with modern governance.

Finally, in their interview with Feng Gu, a former director of the China Grand Canal World Heritage Application Joint Office, Kaiyi Zhu and Qingyong Zhu explore how the Grand Canal's inscription has catalyzed collaborative efforts across eight Chinese provinces to enhance the protection of its historic landscape, cultural heritage and surrounding cities while promoting integrated cultural, ecological and economic development.

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Carola Hein is Professor History of Architecture and Urban Planning at Delft University of Technology, Professor at Leiden and Erasmus University and UNESCO Chair Water, Ports and Historic Cities. She has published and lectured widely on topics in contemporary and historical architectural, urban and planning history and has tied historical analysis to contemporary development. Among other major grants, she received a Guggenheim and an Alexander von Humboldt fellowship. Her recent books include: *Port City Atlas* (2023), *Oil Spaces* (2021)*, Urbanisation of the Sea* (2020)*, Adaptive Strategies for Water Heritage* (2020)*, The Routledge Planning History Handbook* (2018)*, Port Cities: Dynamic Landscapes and Global Networks* (2011). Carola is also the leader of the PortCityFutures research group.

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Matteo D'Agostino is a researcher at the Delft University of Technology, a member of the PortCityFutures research group, and currently affiliated with the UNESCO Chair for Water, Ports and Historic Cities. Matteo is a cultural anthropologist experienced in the analysis of perceptions and relational dynamics between public and private actors. His research focuses on understanding multiple structural, spatial and socio-economic factors as the basis for spatial planning and social interventions. Other interests include policy implementation for granting access to basic resources, such as water, and strategic reinterpretation of heritage by institutional and activist organisations.

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Carlien Donkor is Researcher at Delft University of Technology. She is also affiliated with the LDE PortCityFutures research group and the UNESCO Chair for Water, Ports and Historic cities. Carlien is trained as an architect with experience in design, construction, procurement and project management. Her master thesis focused on the subject of integrated urban water design and how factors not only limited to climate change and rapid urbanization pose a risk to the design and planning of historical water cities like Milan. Other interests include confronting issues that affect communities also through volunteer work.

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Zuzanna Sliwinska is an architectural designer and researcher with an MSc (*cum laude*) from Delft University of Technology and a bachelor's degree from Westminster University, London. She has worked on several projects on water-related heritage sites and climate change hazards in Europe and Asia. As co-creator and editor of the open-access journal *Blue Papers: Water & Heritage for Sustainable Development*, which was featured at the 2023 UN Water Conference, she investigates the interplay between water, culture and heritage to inform sustainable water systems. Her personal research focuses on the relationship between human activities and the Deep Bay wetland ecosystem in Hong Kong. She examines how traditional practices like aquaculture have shaped the landscape, supported local wildlife and have been impacted by urban expansion and changing cultural priorities.

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Editorial Team

Kaiyi Zhu is a postdoc researcher at the Chair of History of Architecture and Urban Planning, Delft University of Technology, working at the interface of architectural and urban history and heritage studies. She is also affiliated with the LDE PortCityFutures project and Centre for Global Heritage and Development. Trained as an architect and heritage expert, Kaiyi obtained her PhD at TU Delft with her research titled "In the Name of Conservation." Her research mainly focuses on the transnational exchange of ideas, layered cultural values, interpretation of heritage concepts, and heritage-related legislation in China.

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Foteini Tsigoni is a Research MSc student in the Faculty of Archaeology at Leiden University. Her main topic of interest is the cultural biography of archaeological heritage, in other words how archaeological sites have been received in the past and the present. Within the PortCityFutures team is helping in matters of heritage management and network theory.

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PART I Challenges, Concepts and New Approaches

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Water Management for Sustainable Development of World Heritage properties

Tino Mager
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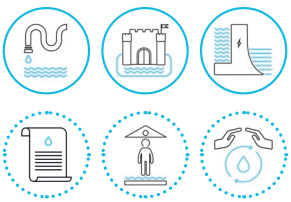
As climate change and water-related threats like floods and droughts intensify, water management must become a key component of World Heritage management plans. Currently, these plans are not required to address water management even though an increasing number of sites are encountering water-related challenges. A lack of comprehensive data and knowledge sharing hampers efforts to collectively address these issues, posing a risk to the preservation of their Outstanding Universal Value. This article examines the significance of water management for World Heritage properties, including sites directly connected to water and those facing water-related threats. It presents three examples from Germany to illustrate these challenges and underscores the need for improved knowledge sharing and integration between World Heritage properties and their surrounding environments.

Keywords: *World Heritage, water management, climate change*

KEY THEMES



< Fig.1 Shushtar historical hydraulic system panorama (Source: Iman Yari, 2014. Wikimedia Commons, CC BY-SA 4.0).

Introduction

Cultural World Heritage properties are inherently connected to water; their construction and preservation have always depended on effective water management. Especially in arid climates and floodplains, communities had to secure a reliable water supply while protecting themselves from water in excessive quantities (UNESCO 2011). Additionally, maintaining these sites for continued use requires a balanced water supply to ensure livable conditions and preserve the functionality and longevity of the properties. However, changing climatic conditions (ECMWF 2024) increasingly threaten cultural sites through water shortages, droughts, floods and damage to foundations.

Addressing these emerging threats demands sustainable adaptations in water management and comprehensive strategies to develop such adaptations. Water management plans have not been included in World Heritage nominations or in the management plans required for inscribed properties since 2005 (UNESCO 2005). However, incorporating these plans could enhance the conservation of World Heritage properties by ensuring adequate water supply and protection from water-related threats. As water problems escalate, appropriate water management can strengthen sites' resilience and long-term sustainability.

The solution to these challenges can often be found within the heritage sites themselves. Many World Heritage properties explicitly relate to water, as they were created to provide or treat water, to utilize water for various purposes or protect against it. Examples include pumping stations, dams, polder areas and historic water management systems. These sites contain valuable information about historical water management practices and strategies that have stood the test of time. Studying these sites can lead to a better understanding of past strategies, as well as inspire contemporary approaches to today's water-related challenges (Dai 2023). Therefore, integrating water management in the conservation of World Heritage properties is crucial. This integration should focus on preserving sites in the face of climate change, while respecting or adapting them in line with historical water management practices. This integration of water and heritage can help develop solutions that inspire water management beyond the World Heritage properties (Chen 2016).

This article seeks to encourage further exploration of this topic by examining the relationship between World Heritage and water. It emphasizes the need for water management planning to be included in World Heritage management, arguing that water serves as a critical link between the local and global dimensions of these sites, as well as between their past, present and future. Using cases from Germany, the article considers a variety of relationships between World Heritage properties and water management, highlights the importance of such management, and outlines current and emerging challenges.

World Heritage and Water: Multi-faceted Relationships

While individual World Heritage properties have unique local relationships with water, climate change is increasingly connecting these relationships to global phenomena within an interconnected system. The water-related challenges for World Heritage properties need to be assessed individually but can be grouped into categories common to many sites. Although the World Heritage List traditionally maintains

^ Fig. 2 An eighteenth-century depiction of the oldest existing waterworks in Germany, the Augsburg waterworks at the Red Gate (Source: Neitram, 2014. Wikimedia Commons, public domain).

a strict division between cultural and natural sites, with separate responsibilities assigned to advisory bodies (the International Council on Monuments and Sites [ICOMOS] and the International Union for Conservation of Nature [IUCN]), recent efforts have aimed to bridge this divide to foster a more integrated approach.

Initiatives such as the Nature-Culture Journey at the 2016 IUCN World Conservation Congress and the establishment of an International Scientific Committee on Water and Heritage by ICOMOS are examples of efforts to close this artificial gap and promote a more comprehensive understanding of cultural heritage sites as part of a complex natural system. Also, there is growing interest from the field of hydraulic engineering in historic aspects of water management, as demonstrated by an increasing number of sessions on water heritage at international conferences.[1]

Water-Related World Heritage

Beyond the institutional level, there are important relationships between water and heritage at individual sites that make any conceptual separation between culture and nature inconsistent. This is particularly evident in World Heritage properties with an explicit connection to water, such as the Water Management System of Augsburg. Listed in 2019, the site comprises 22 elements, including a historic water-powered cooling system, weirs, wells, canals and water-

1. Examples of such sessions took place at Amsterdam International Water Week 2023 and at the UN Water Conference 2023.

^ Fig. 3 The Srah Srang, a tenth-century artificial reservoir close to Angkor Wat (Source: Diego Delso, delso.photo. Wikimedia Commons, CC BY-SA 4.0 DEED).

works (fig. 2). These components connect the city of Augsburg, its inhabitants and local industry with the surrounding natural environment, forming a larger, integrated system.

Augsburg's ingenious management of water resources has helped the city prosper for centuries, highlighting the interdependence of culture and nature. Inscribed on the World Heritage List specifically because of its water management system, Augsburg naturally plays a key role in emphasizing the importance of water management in World Heritage properties. The City of Augsburg has published numerous resources on their website (https://wassersystem-augsburg.de/de/mediathek), detailing individual elements of the system and their functions.

Other World Heritage properties represent different types of water-related heritage. These include sites associated with distribution and drainage (such as the Persian Qanat and the Mill Network at Kinderdijk-Elshout), the use of water for industrial purposes (Mines of Rammelsberg, Historic Town of Goslar and Upper Harz Water Management System), military purposes (Dutch Water Defence Lines), trade and exchange (Venice and its Lagoon, Canal du Midi), agriculture (Rice Terraces of the Philippine Cordilleras) and leisure and health (the Great Spa Towns of Europe). So far, their common challenges have not been addressed as a unifying and compelling issue for World Heritage properties and their managers. Research, exchange and education in the field of water

management at World Heritage properties are urgently needed and will only become more important in the future.[2]

The sites mentioned above are prime examples of sustainable water management. They illustrate its specific forms and show what has worked well in particular places and contexts. Research on these sites can illuminate which solutions have worked over a long period of time and under certain circumstances and how past approaches may be relevant today. Even examples that tell of the failure of long-term water management can be instructive, such as Angkor Wat, an extensive twelfth-century temple complex in the historical Khmer kingdom (fig. 3). The empire perished when the water supply system failed in the fourteenth century, and the site now offers insights into the complexity of the relationship between culture and nature (Prasad 2020). Historical examples can aid the development of new water management strategies. Today's changing climatic conditions make it necessary to adapt historical systems so that they continue to function effectively and meet current and future needs.

Water Challenges at World Heritage properties

In addition to World Heritage properties related to water and water management designated as having Outstanding Universal Value, there are a number of sites that are facing water-related problems. These include the Palaces and Parks of Potsdam and Berlin. Located in Germany's most water-rich federal state and surrounded by lakes, the existence of the historical parks is increasingly threatened by dry periods and declining water tables. As a result, almost 80 per cent of the trees in the Sanssouci World Heritage Site have suffered damage and every year 160–300 trees must be cut down (UNESCO-Welterbestätten 2024). Changing precipitation patterns have made tree damage a widespread problem across Europe and call for effective solutions. If sufficient water cannot be provided through adapted management, significant changes, such as the introduction of more resistant tree species, may alter the character of historic parks.

While many World Heritage properties are affected by drought, an excess of water also poses a serious challenge, with over 20 per cent of World Heritage properties worldwide affected by river flooding (Arrighi 2021). These problems extend beyond the physical boundaries of heritage sites, as water cannot be managed in isolation. Issues like drought and flooding are influenced by climate but also by large-scale infrastructure planning and often require solutions at the regional or even international level – if they can be addressed at all. When increasing flooding can no longer be controlled by flood defenses, site managers must implement structural measures to protect the properties. Where drought is a problem, they must develop mitigation strategies.

Water-related hazards not only can damage or alter the sites but can jeopardize World Heritage status if adequate protection is not provided (Gerard-Sharp 2017). A look at the 56 properties on the World Heritage in Danger list reveals that, after armed conflict, water issues are a major factor threatening the survival of the sites. Threats include the loss of aquatic life, siltation, flooding and the construction of reservoirs. Two of the three delisted World Heritage properties – Dresden and Liverpool – were water-related and insensitive changes to

2. The upcoming conference "WORLD.HERITAGE.WATER - Water Management as a Potential and Challenge in World Heritage properties," on November 7, 2024, in Leipzig will explicitly address this topic for the German-speaking world.

their attributes led to the loss of their Outstanding Universal Value. In the case of Dresden, the construction of a bridge over the Elbe destroyed a cultural landscape that had been designated a special treasure of humanity.

Water Management for (the) Future (of) World Heritage properties

More than ever, site managers are required to incorporate water considerations into their preservation and operational strategies. This need aligns with a broader understanding of World Heritage as "a process influenced by social, environmental and economic dynamics" (Gioia 2022) and calls for a deeper understanding of the systemic integration of cultural heritage sites. UNESCO's support for education in sustainable development, such as the e-learning curriculum series on water management at World Heritage properties, reflects increased awareness of water issues in heritage preservation (UNESCO 2024). Exchange and education on this topic are crucial for implementing effective water management measures.

A comprehensive consideration of water management is not only important for current sites but also enables better assessment of the values and vulnerabilities of potential World Heritage properties, guiding the designation of attributes that convey these values. A better understanding of water relationships and challenges at World Heritage properties can aid the integration of water management in required site management plans, which will become increasingly important as water-related climate variability grows. However, UNESCO's *Policy Document on Climate Action for World Heritage* (2023) does not fully recognize this need; while it emphasizes researching and documenting water management techniques to support climate science, it omits any reference to water management plans for individual sites.

In many cases, water management was historically integral to these sites but was not recognized as essential to their heritage. For example, could better research into the now-defunct historic water supply system at Sanssouci and its recognition as a vital part of the estate help improve the park's ecological situation? Sound water management can certainly support the preservation of World Heritage properties and inspire broader strategies to address increasing water challenges.

Conclusion

The risk assessment of World Heritage properties and changing weather patterns demonstrate that integrating water management is crucial for the sustainable conservation of many cultural heritage sites, including cultural landscapes. This article confirms the need for water management plans and encourages further research and communication on this topic. It serves as a call for ongoing international exchange to develop guidelines for integrating water management and preservation. Such efforts may play a key role in incorporating water management into the management plans of World Heritage properties, which currently do not adequately address climate and water-related threats. In order to ensure the sustainable preservation and development of heritage sites, it is essential to challenge the arbitrary and misleading separation of culture and nature. Instead, built heritage should be conceptualized as a synthesis of both cultural and natural elements. Monument preservation and climate protection are intertwined, and water management plans represent a valuable step toward an integrated sustainability strategy.

Policy Recommendations

- Water management must become an integral part of the management plans of World Heritage properties. This includes comprehensive research into each site's water management needs and the exchange of knowledge among site managers. A systemic understanding of heritage sites, viewing them not merely as cultural artifacts but as entities embedded in natural systems, will help promote innovative approaches to conservation.

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The Promise of Maritime Heritage for Port Cities: Challenges, Concepts and New Approaches

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Maritime heritage – an ensemble of ships, ports, waterways, buildings and maritime skills – is one of the oldest and most vital forms of heritage. It has been key to the growth of port cities around the world. Maritime skills, which include the techniques and materials used to build and use watercraft, from dugout canoes to container vessels, have made it possible to transport goods, animals and people, bringing wealth to deltas and coastal areas. This article argues that maritime heritage holds cultural, historical and environmental value and can drive sustainable spatial and economic development. In the heritage sector, maritime heritage is a relative newcomer compared to built and natural monuments. However, especially in the context of climate change, it offers valuable lessons on adaptation and sustainability. Six examples from the Netherlands demonstrate how preserving maritime heritage can be compatible with climate adaptation and energy transition, including, for example, using wooden fishing vessels and tugboats in cities, towing vessels for slow tourism, and sailing vessels for combined passenger and goods transport. The article calls for additional studies of how the conservation of maritime heritage can encourage sustainable development.

Keywords: *development, sustainability, lifestyle, circularity, clean transport*

< Fig.1 Sleepvaart museum Maassluis, with visible sea-steam tug Furie (Source: kees torn, 2015. Wikimedia Commons, CC BY 2.0).

The Layered Meanings of Maritime Heritage

The Netherlands, situated in a delta of major European rivers and along the North Sea, has long been renowned for its trade, transport and maritime heritage. Historically, shipping played a crucial role in the country's spatial development and prosperity. Villages and cities have flourished because of their strategic locations along waterways. Ports, shipping and towing canals formed a waterway network in the Netherlands that remains vital to national and international economies.

The unique historic ships of the "Brown Fleet" – traditional sailing vessels now used for passengers and groups – and harbors that have been turned into museums enhance the Dutch cultural landscape, maintaining the maritime character of harbor villages and port cities. These heritage sites preserve the past and present new functions and innovative solutions for the future. Maritime heritage offers many social, ecological and economic benefits for boat owners, citizens, urban and spatial developers and government authorities. This requires that the potential of maritime heritage is recognized and utilized.

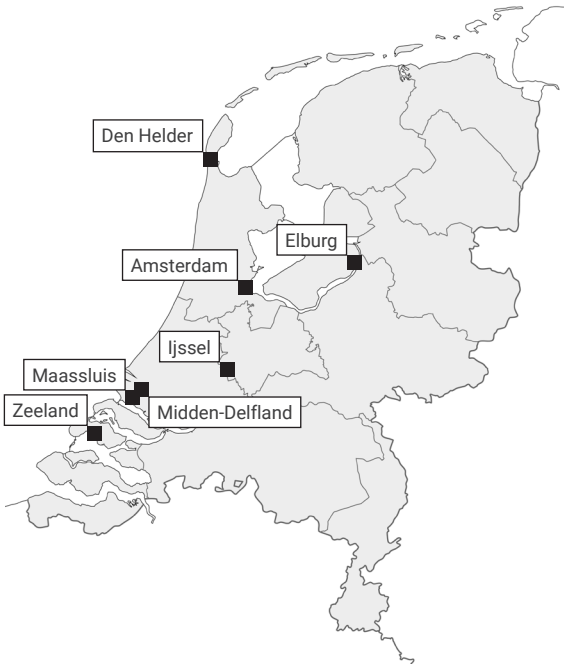
Historic ships are most often privately owned or safeguarded by museums, but they rely on public facilities like moorings, harbors, waterways, bridges and locks. Provinces and municipalities can support this rich maritime heritage by providing these essential facilities. Additionally, they can leverage the layered meanings of historic ships and maritime ensembles – both in content and relational aspects – to develop their environmental visions and spatial plans.

Methods like Urban Genesis (Stadsgenese) (Grond et al. 2021), the Sector-Factor-Vector-Approach (Janssen et al. 2017) and the Transformation Framework (Meurs et al. 2022) can help integrate maritime heritage in spatial visions and make development plans more comprehensive and well-founded. Through provincial or municipal regulations, authorities can protect and secure sailing monuments and maritime ensembles, enabling them to contribute to urban and spatial development.

A. The Urban Genesis is a method that uses a place's history of culture and natural systems to guide climate adaptation and urban development.
B. The Sector-Factor-Vector-Approach to heritage is a dynamic framework that frames three approaches to heritage. It argues that heritage is more than a monument-based sector and should also be a factor and a vector for dynamic engagement reflecting different times and cultures.
C. The Transformation Framework refers to the Dutch Heritage Department's guidelines for transforming cultural heritage into integrated spatial designs with high spatial quality. The method aspires to embrace change while preserving the genius loci, or local character. The goal is a value-driven spatial plan (D'Agostino and Hein 2024).

Conserving maritime heritage is important from spatial, cultural and historical perspectives. It offers opportunities to create a meaningful living environment while addressing current challenges related to mobility, leisure, energy and climate. This is important not only for shipowners but also for all residents of port cities and harbor villages and municipal and regional authorities.

Let's consider six innovative maritime heritage examples located in the Netherlands (fig. 2), using the methods mentioned above: *botters* in Elburg (A), tugboats in Maassluis (B and C), houseboats in Amsterdam (B), towing vessels



^ Fig. 2 The Netherlands with six harbors described (Source: Adapted from "Location Map of the Netherlands." Wikimedia Commons, CC BY-SA 3.0,).

in the Hollandsche IJssel (A), the "Beurtvaart" in Zeeland (A and B) and sailing cargo vessels in Den Helder (B).

Maritime Heritage as a Flywheel for Sustainable Development

The municipal and regional authorities of Elburg have been pursuing sustainable urban growth by incorporating in their municipal and regional policy the maritime ensemble of the harbor – which includes wooden vessels called *botters* that were once used for fishing, harbor buildings and the *botter* wharf (fig. 3). The municipality of Elburg has officially recognized historic vessels as "municipal sailing monuments." Both the municipality and the province financially support the *botters* and the *botter* wharf, making it possible to maintain them and restore or recover old and neglected *botters*. This aligns with Method A, Urban Genesis: the local fishing culture and the maritime landscape have been the starting point for harbor redevelopment. There were hardly any *botters* left in Elburg after the construction of the Afsluitdijk, which turned the salty Zuiderzee into a freshwater lake, IJsselmeer. This maritime ensemble can thus serve as a flywheel for the urban and economic development of the local harbor area and help make this old fishing village attractive to tourists (https://botterselburg.nl/pagina/11/museum-en-werf/).

Maritime Heritage and the Future of Maassluis

Maassluis has a famous maritime towage and salvage history. This heritage remains visible in the city and offers an outstanding opportunity for a long-term plan to bring the city center up to date and help it remain attractive to residents, entrepreneurs and visitors.

The center of Maassluis is a nationally protected cityscape (Rijksdienst voor het Cultureel Erfgoed n.d.), which means that the cultural and historical values of the buildings, harbors, quays, bridges and locks in this area must be preserved. Yet the area looks worn. City authorities have become concerned about the increasing vacancy of retail premises. The rich maritime heritage is in decay: there is little activity, the traditional vessels are not accessible and maintenance has been neglected. The three museums are only open for limited hours and there is no coordination of activities. The quays need to be refurbished. The city can use an economic boost: tourism is minimal, and the city has few employment opportunities.

Yet, Maassluis has much to offer. It derives its character from its maritime past, which can still

^ Fig. 3 *Botters* in the Elburg harbor (Source: Martine van Lier, 2021).

be recognized in its picturesque harbor, with its museum vessels, traditional tugboats, and salvage boats, the National Towage Museum and Museum Maassluis. The city wants to strengthen the historic harbor and city center with an area-oriented approach. The local council, therefore, has accepted a 10-year plan, "Maritime Historic Maassluis," developed by the Erfgoedkwartiermakers Coöperatie (Heritage Pioneers Cooperative). The plan aims to boost the center and the harbor by using the towage and salvage history and making the maritime heritage technically and organizationally sustainable. The goal is a sustainable and dynamic historic harbor and center with a flourishing Living Lab called Loods M – a knowledge center where the sustainability of the maritime heritage will be realized and where the museums will be located. At Loods M, maritime heritage will involve opportunities to experience, learn and innovate. The plan is based on Method B, the Sector-Factor-Vector-Approach, protecting the heritage vessels as municipal sailing monuments, using the maritime heritage for social as well as economic values and taking the vessels as the starting point of inspiring sustainable innovations. The plan is also based on Method C, the Transformation Framework, using the harbor with tugboats and salvage vessels as part of the genius loci to develop a broader multi-value-driven spatial plan.

The project involves four key areas of action: cooperation between the engaged professionals and volunteers, the development of a community sailing program, the establishment of Loods M and the establishment of an area cooperative that will anchor the collaboration between ships, museums, education and technical and retail businesses. Loods M (https://loodsm.nl/) aims to connect the area's history to an innova-

tive future. The bidbook for realizing the design for Loods M will be ready in September 2024.

Modeling Sustainability: Using Alternatives to Fossil Fuel

Living on the water without carbon-based fuels is possible on modern houseboats and historic vessels.[1] By using water, air and sun as primary energy sources, boats and other vessels can be heated in winter and cooled in summer. This system requires sufficient insulation, a water-to-water heat pump and thermal solar panels. The solar panels supply electricity, while the thermal tubes underneath supply hot water, and the water-to-water heat pump keeps the vessel at the desired temperature. However, the initial investment cost is still rather high. The collective acquisition can be a solution for residential collectives like museum harbors. By making vessels and houseboats more sustainable, collectives can point the way to the development of climate-adaptive floating villages, which offer future possibilities to live on water in delta landscapes (see the web page of *VLOT* Magazine for examples, https://www.vlotwaterwonen.nl/). These developments use maritime heritage as a vector, as proposed in Method B, the Sector-Factor-Vector-Approach: using these alternatives to fossil fuels inspires not only boat owners but also urban planners.

Lifestyle Changes: Slow Tourism

Towing canals formed a popular public transport system in Golden Age Holland. For over 250 years, towing vessels have been a reliable and comfortable means of transport for long distances. Along the canals were towpaths, where horses would walk while towing the vessels. A network containing 600 km of towpaths connected the cities in western and northern parts of the Netherlands and hundreds of towing vessels formed what is known as the "Intercity of the Golden Age" (Wellenberg et al. 2021). In the nineteenth century, the introduction of railways and trains marked the end of the towing system.

Recently, the municipal authorities of Midden-Delfland and a few shipping companies have embraced the Slow City Movement (www.cittaslow.org), which provides an international quality designation to municipalities committed to their landscape, regional products, hospitality, environment and heritage. A related phenomenon is known as "slow tourism." Shipping companies have succeeded in encouraging interest in once again using the old towing canals again: the canals are made accessible, towing vessels are restored or newly built and horses are trained. Traveling on towing vessels, passengers can experience the landscape more fully than when whizzing by in a car or train. In this way, sustainable recreation contributes to the heritage-inclusive development of rural areas. Regional recreation offers an alternative to mass tourism and tourism that requires polluting transport to faraway destinations. Also, in this example, in line with Method A, the Urban Genesis, the history of the towing culture, the maritime landscape of towing canals and the embrace of the Slow City Movement have been used to encourage climate adaptation through sustainable tourism.

1. In the Netherlands there are about 12,000 houseboats, including 2,500 historic vessels and 40 museum harbours. The use of water-to-water heat pumps and thermal solar panels is a recent development but can be found in a few mooring places and museum harbours, e.g., in Amsterdam, Rotterdam and Groningen.

Circular Economy: The Beurtvaart Rediscovered

The Zeeuwse Groene Compagnie (Zeeuwse Groene Compagnie) was started by two ship owners who have equipped their historic sailing vessel to carry freight and passengers once again. Inspired by the old system of the *beurtvaart* – freight and passenger transport sailing along a certain route according to a scheduled timetable – they developed an innovative concept: to transport regional products and passengers on fixed routes. The sailing vessel "Vrijbuiter," the first of five (https://www.vrijbuiterzeilen.nl), will use the wind as often as possible, but for maneuvering, they installed an electric engine with a salt battery as the energy source. In the harbors along their planned routes, solar panels placed on the roofs of harbor buildings supply electric energy to charging stations for the salt batteries. This initiative should stimulate area development in historic harbor villages and port cities by providing them with a new sustainable function, namely the transshipment of regional products. The crew is assisted voluntarily by the passengers. In the region of Zeeland, the maritime culture and the natural system of waterways are well suited to transport by sailing vessels and turns to Method A, the Urban Genesis. According to Method B, the Sector-Factor-Vector-Approach, the co-creation vector will sustain the maintenance of historic vessels, combining historical and economic values. Ultimately, this project is envisioned to boost the local economy and counteract the shrinking of rural communities.

Clean Shipping: Wind in the Sails at Sea

In 2007, three young ship captains, Jorne Langelaan, Arjen van der Veen and Andreas Lackner, in the maritime hub of Den Helder, in the province of North Holland, became inspired to find alternative means of transport for merchant shipping. They started the clean transport movement Fair Transport and to demonstrate their project's feasibility, they bought an old cargo vessel, took out the engine, put it under sails and began to offer climate-friendly cargo shipping. Today, this vessel, "Tres Hombres," has several sustainable sailing sister ships worldwide, forming a growing movement of cargo ships powered by wind. Using historical knowledge of using the wind as power, these ships have the potential to encourage the modern seafaring industry to use wind power and diminish the enormous greenhouse gas emissions of seafaring engines that use fossil fuels. The first contracts with shipbuilders to convert or build seagoing ships with sails, like the Ecoliner and the Trade Wings 2500, have recently been signed. If such efforts seem successful, this solution could help diminish air pollution in port cities. It could make the combination of housing facilities in port areas and moorings for converted freight and cruise ships more feasible. As indicated in Method B, the Sector-Factor-Vector-Approach, this use of maritime heritage to revitalize the seafaring industry, using the narrative and intangible heritage of sailing seamanship, is an example of the value of heritage in a changing physical and social context.

Conclusion: Maritime Knowledge and Craft as Motors of Sustainable Development

The examples above show how maritime heritage can be applied to the crucial transitions we now face. They demonstrate that historic ships can encourage sustainable tourism, circular economy practices, green shipping, and sustainable living on board and water. The three methods – Method A, which uses heritage for climate adaptation and urban development; Method B, which uses heritage for the protec-

tion of collections, re-using heritage for historical and economic values and co-creating with the sociocultural meanings of tangible and intangible heritage; the Transformation Framework, which embraces change while preserving local character – are suitable for developing sustainable plans with maritime heritage where maritime knowledge and craft drive sustainable development. Shipping and port cities have long been important agents of innovation, and their historical practices can inspire green futures. This is one reason it is important to preserve historic ships in their maritime context and not let maritime knowledge and craft be lost.

Policy Recommendations

- Shipping and port cities are, as they have been for centuries, important agents of innovation. Maritime heritage buildings, vessels, knowledge and craft should be considered living sources of inspiration for today's crucial transitions. Let's be receptive to the innovative power of maritime heritage.

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Cultivating Water-Human Intimacy within the Built Environment: Insights from the Master of the Nets Garden

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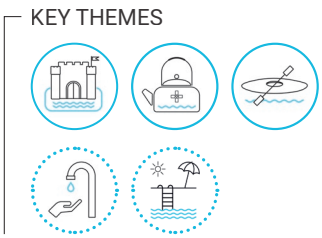
Water plays a fundamental role in human survival and well-being. Despite extensive research highlighting the importance of water-human relationships, how to cultivate intimacy between them at the architectural scale remains largely underexplored. This article explores this dynamic through a case study of the Master of the Nets Garden in China. Using spatial, empirical and experiential analyses, it introduces a three-stage framework that integrates both quantitative and qualitative methods and examines various conditions within the garden that foster intimacy between visitors and water. It concludes that spatial conditions within the perceptual sphere of water, enabling diverse experiential modes, are crucial for fostering a sense of intimacy between visitors and water at the architectural level. The article highlights water-human intimacy as a core value of water-centric built heritage. This value remains significant for researchers, spatial practitioners and policymakers, offering important insights for heritage preservation and sustainable development.

Keywords: *water-human relationship, Chinese built heritage, perceptual sphere, spatial-visual stimulus analysis, spatial conditions analysis*



< Fig.1 The central landscape area of the Master of the Nets Garden (Source: Li Lu, 2018).

Introduction

Water plays a fundamental role in human survival and well-being (Hein et al. 2022). Research suggests that an intimate water-human relationship – one that fosters enjoyable interactions in everyday life, such as recreation, relaxation and aesthetic appreciation – significantly enhances physical, mental and social health (Ampatzidis and Kershaw 2020; Boers et al. 2018; Hein 2023; Huang et al. 2022; Nutsford et al. 2016; Zhang, Nijhuis and Newton 2023a). While factors and indicators leading to such a beneficial water-human relationship have been widely discussed (Boers et al. 2018; Nutsford et al. 2016; Zhang, Nijhuis and Newton 2023a; Chen and Yuan 2020), these studies are often constrained by their quantitative focus. Consequently, they primarily address statistical manifestations of the water-human relationship at the city or regional scale, overlooking its nuanced manifestations in individual experiences at the architectural scale. Understanding the water-human relationship at this micro level is crucial, as it is through day-to-day interactions that a meaningful and beneficial connection forms.

This article explores how water-human intimacy can be fostered at the architectural scale through embedded spatial-experiential conditions. Here, spatial-experiential conditions refer to formal or physical elements integrated into the built environment that facilitate specific spatial experiences. This article focuses on the Chinese literati garden, a classical built form of landscape architecture in ancient China. These gardens are significant for their historical, cultural and aesthetic value and are renowned for the sophisticated garden-making techniques used to foster harmony between humans and nature, with a particular emphasis on the water connection (Keswick, Jencks and Hardie 2003; Lu 2022). We use the Master of the Nets Garden in Suzhou as a case study. Celebrated for its water-centric design, this garden exemplifies how built environments at the architectural scale cultivate intimacy between water and humans through various spatial conditions.

Our methodology integrates spatial, empirical and experiential analyses. The spatial analysis examines the embedded conditions that facilitate a sense of intimacy, while the empirical and experiential analyses reveal how this sense of intimacy emerges from these conditions. Our inquiry begins with the most fundamental aspect of the water-human relationship – the human perception of water – as a starting point, providing a solid foundation for further examination. In this research, we focus predominantly on the spatial-visual dimension of water perception, as research in cognitive psychology indicates that visual perception accounts for 80–85 per cent of our interactions with the environment (Nijhuis, Lammeren and Antrop 2011). Specifically, we first analyze the spatial-visual sphere of water – a visually defined spatial framework that enables human perception of water – within the garden, where visitors directly engage with both water and the space it frames. We then identify the water-related experiential modes associated with this framework, followed by a detailed examination of the spatial conditions that facilitate these modes of experience.

This article concludes that the density and diversity of spatial-experiential conditions within the garden's perceptual sphere of water are critical in shaping and enhancing intimacy between water and visitors at the architectural scale. Furthermore, it highlights water-human intimacy as a core value of water-centric built heritage. This understanding provides researchers, spatial practitioners and policymakers with es-

sential insights for incorporating this value into spatial interventions, ultimately enhancing the water-human relationship in the contemporary world.

Case Selection and a Three-Stage Analytical Framework

The Master of the Nets Garden is one of the smallest "literati gardens" in Suzhou, with an area of just 5,400 m², significantly smaller than the Lion Grove Garden (11,000 m²), the Lingering Garden (23,300 m²) and the Humble Administrator's Garden (52,000 m²). Despite its compact size, the garden's cultural, historical and aesthetic values have garnered global acclaim. The garden stands as a prime example of ancient Chinese built heritage sites (UNESCO 2004). Its delicate spatial design, finely balanced layout, picturesque views and poetic atmosphere all contribute to its exceptional ability to generate rich, multi-dimensional and infinitely flowing spatial experiences within a confined area.

We selected the Master of the Nets Garden for our case study for two primary reasons. First, as a key example of water-centric built heritage in ancient China, the garden vividly demonstrates the crucial role of water in shaping both spatial and experiential frameworks within the built environment, encouraging awareness and appreciation of water (Lu 2022; UNESCO 2004; Liu 1979; Zhou 1999). Second, despite its small size, the garden features complex, rich and densely embedded spatial-experiential conditions, illustrating how high-quality water-human intimacy can be cultivated in confined spaces through carefully organized spatial configurations (Keswick, Jencks and Hardie 2003; fig. 1). To analyze these aspects, this study introduces a three-stage analytical framework, offering a systematic approach to understanding the interplay between water, space and human experience.

We first examine where visitors have direct sensory engagement with water in the garden, referred to as the "perceptual sphere of water." In this research, we focus on one dimension of the perceptual sphere shaped by water – the spatial-visual sphere – as visual perception predominantly influences one's experience within the garden. Using digital models and analytical tools, we quantitatively represent the spatial-visual sphere of water within the garden. Next, we delve deeper to examine the types of experiences that this spatial-visual connection with water creates. These water-related experiences naturally follow specific patterns, which we call "modes of experience." To identify these patterns, we use on-site participatory observation and reflexive introspection (Xue and Desmet 2019). Finally, we investigate how these modes of experiences occur within the spatial-visual sphere of water and identify specific spatial conditions embedded to enable their occurrence.

Stage 1: Mapping the Spatial-Visual Sphere of Water Within the Master of the Nets Garden

In the context of this article, the spatial-visual sphere of water refers to the territory where a visitor can see any portion of a water feature. This concept is crucial for understanding the water-human relationship within a built environment, as it represents the fundamental condition through which the visual perception of water occurs. In Chinese literati gardens, visual perception plays a dominant role. As Lu (2011) notes, "seeing has a psychological value that drives the visitor's exploration." Therefore, while the spatial-visual sphere is only one dimension

of water-human intimacy – among others, such as auditory and olfactory – mapping it within the garden provides a foundation for further analysis of the conditions that facilitate this intimacy.

Data Processing

We use 3D isovist analysis within a Rhino-Grasshopper environment to objectively capture visual perceptions of water bodies in the Master of the Nets Garden. This method is particularly suited to complex environments at the architectural scale due to its ability to incorporate detailed three-dimensional digital models and viewer traits (Zhang, Nijhuis and Newton, 2023c). The data processing includes several key steps:

1. Model reconstruction – Based on field observations and the 1960s garden map (Liu 1979), we reconstruct a detailed 3D garden model, maintaining its traditional layout and minimizing later distortions.
2. Spatial division – We segment the garden's central water body and accessible areas into small cells measuring 0.5 by 0.5 meters.
3. Establishing viewing points – We establish a viewing point at the center of each cell, excluding those submerged in water, to perform 3D isovist analysis. We consider individual viewing features and potential obstructions like vegetation and buildings.
4. Visibility calculation – We analyze the visibility of the central water surface from each designated viewing point by calculating the number of visible water cells. This metric quantifies the extent of visual access to water from various locations within the garden.
5. Proportional analysis and visualization – We determine and visually display the proportion of water bodies visible from each area unit.
6. Examination and correction – Due to technical constraints, some inconsistencies arose between the stimulus analysis results and our site observations. To ensure accuracy, we reviewed and manually corrected these inaccuracies based on on-site experiential observations.

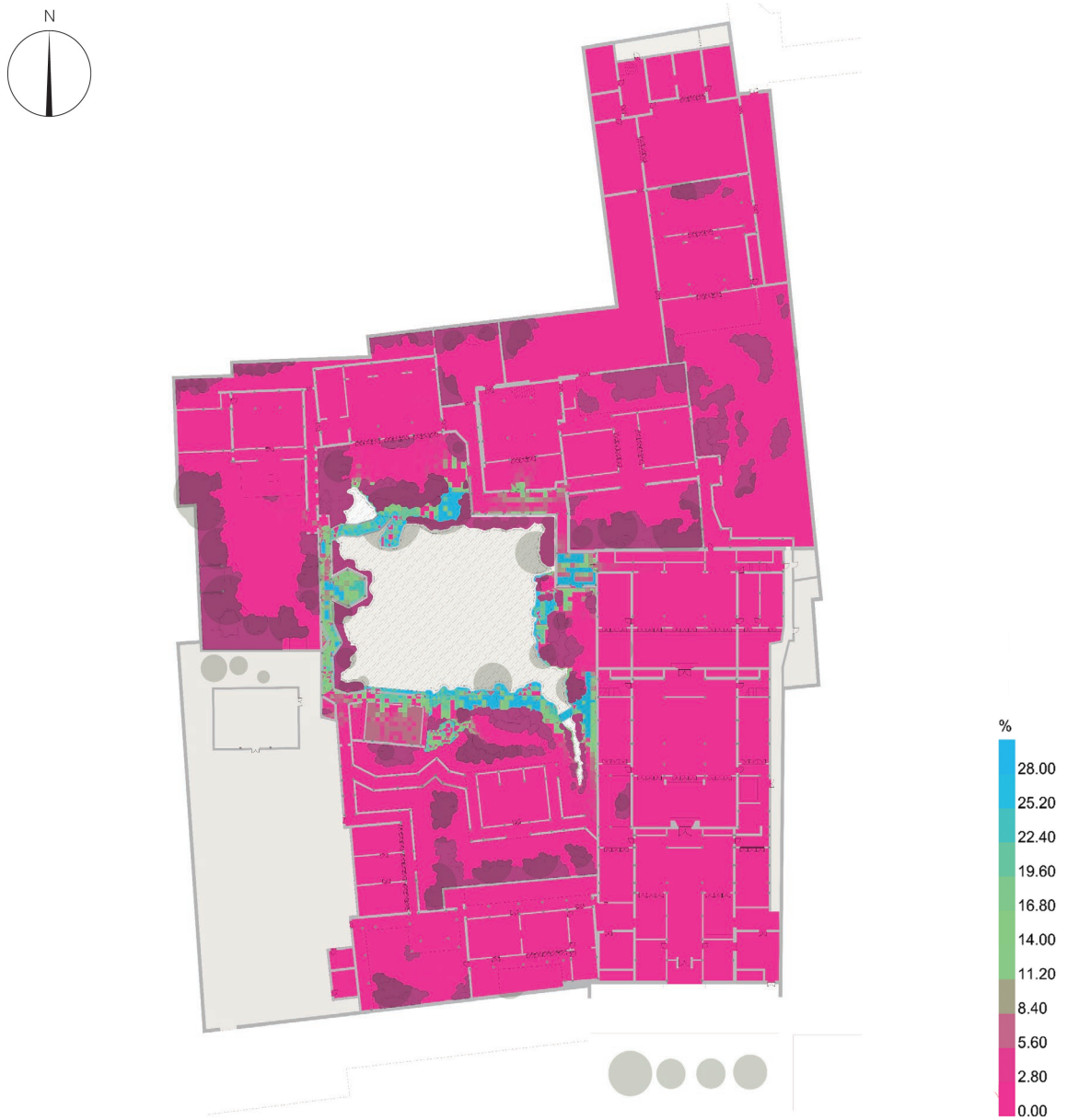
This approach offers a quantitative representation of the perceptual sphere of water within the garden, serving as the first step toward understanding how water-human intimacy is cultivated.

Analysis Results

Our analysis quantifies the visibility of the water body from various locations within the garden, expressed as percentages (fig. 2). The diagram uses different colors to represent this visibility: areas where more than 28 per cent of the water is visible are shown in sky blue (indicating good visibility), while areas where the water is entirely obscured are marked in deep purple (indicating poor visibility). The visibility range between these extremes is divided into 10 levels, each represented by a gradually shifting color gradient.

The diagram shows that visual engagement with water in the Master of the Nets Garden is predominantly concentrated around the central water area (fig. 1). Most of the footpath surrounding this water area exhibits high visibility, with more than 19.6 per cent of the water body visible on average, indicating that visitors can see a significant portion of the water from most parts of this path. In areas adjacent to the footpath, visibility per centages range from 11.2 per cent to 19.6 per cent. Further away or in obstructed areas, less than 11.2 per cent of the water is visible. Additionally, visitors in nearby courtyards occasionally have visual access to the water, suggesting that visual engagement with the water extends beyond the physical boundaries of the central area.

This mapping method offers dual advantages over purely experiential descriptions or quantitative analyses: It delivers a precise quantitative analysis of visitors' water exposure while enabling a nuanced qualitative interpretation of the relationship between humans and water. The results reveal intricate spatial dynamics not only around the water body but also throughout the garden, extending into many interior and exterior areas far from the water. This approach demonstrates how the spatial-visual framework formed by water influences human-water interactions across different parts of the garden.

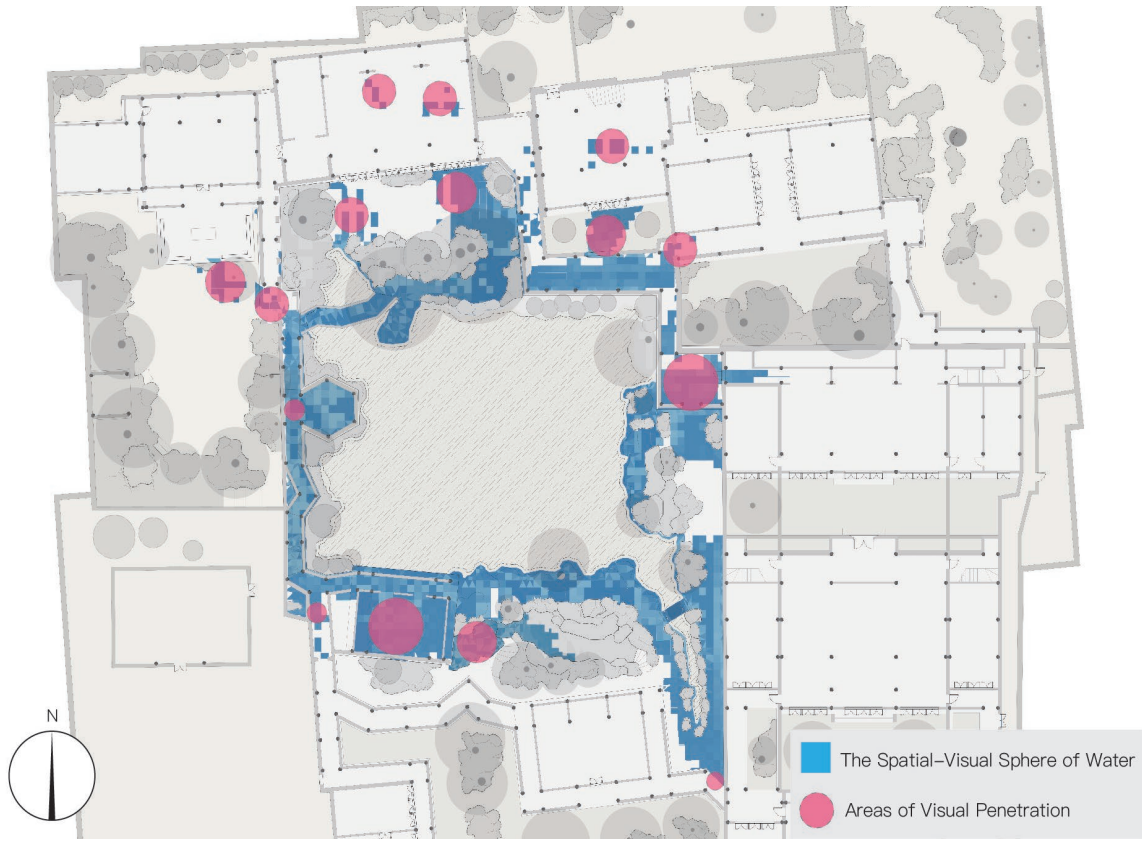


^ Fig. 2 An analysis of water visibility within the Master of the Nets Garden (Source: Li Lu and Haoxiang Zhang, 2024).

Interpretations

The results provide a solid foundation for further exploration of how water-human intimacy is generated and manipulated within the spatial-visual framework centered around the central water feature. First, the results highlight significant visual exposure to water in areas surrounding the central water body. Visitors in these locations frequently enjoy expansive water views, experiencing a high level of water-human intimacy. Additionally, the findings reveal that visual perceptions often extend beyond these immediate areas into more enclosed architectural spaces, such as halls, corridors and courtyards near the water (fig. 3). This visual penetration is facilitated by spatial elements such as doors, openings and lattice windows in the walls. These features help visitors maintain a visual connection with the water as they navigate various interior and exterior spaces beyond the central landscape.

Second, the results suggest deliberately manipulating water visibility within the garden. By controlling the view of the water from different vantage points, the garden has allowed visitors to perceive only portions of the water – sometimes small, sometimes large – while they move through the central landscape. This creates the impression that the water extends beyond what is immediately seen, giving the illusion that the water body is larger than it is (fig. 4). This technique, often referred to as "seeing the large in the small" [小中见大], is widely employed in traditional Chinese landscape and architectur-



^ Fig. 3 An analysis of the visual penetration of water within the Master of the Nets Garden (Source: Li Lu and Haoxiang Zhang, 2024).

^ Fig. 4 A corner of the central water body. Although only a narrow, elongated corner of the water can be seen from this perspective, it creates the impression that the water extends far beyond what is immediately seen (Source: Li Lu, 2018).

al design (Keswick, Jencks and Hardie 2003; Dong 2016; Gu 2010; Guo and Zhang 1963; Wang 2017). It enhances visitors' perception of water by creating an illusion, leaving a vivid and expansive water image in visitors' minds.

Third, the results reveal a dynamic spatial-visual mechanism related to the central water feature. As visitors navigate around the water, their attention continually shifts among various focal points: a bridge at the water's edge, a rockery beside the water, or a veranda hanging above the water (fig. 5). As these elements are strategically designed and positioned in formal and spatial relation to the water, while visitors' focus shifts from one point to another, they often gain a stronger impression of the central water feature. While capturing and releasing these focal points, objects transform into symbols, with meanings generated in visitors' minds at each instance of focus. For example, focusing on (and then shifting attention away from) the space formed by the Pavilion for the Advent of Moon and Wind immediately suggests the possibility of lingering there and enjoying the surrounding water view, which subsequently evokes feelings of relaxation and pleasure. Visitors develop a strong and meaningful connection with the space by dynamically engaging with various landscape and architectural elements related to the water.

Building on these findings, we can now identify the various modes of experience related to the perceptual sphere of water. These modes, facilitated by various conditions embedded within these perceptual spheres, play a crucial role in shaping water-human intimacy.

Stage 2: Identifying Water-Related Modes of Experience within the Garden

A mode of experience, as we use the term here, refers to a recurring pattern of experiences. Psychological, behavioral and philosophical studies suggest that when sufficient and appropriate conditions are carefully embedded within a built environment, its experiences tend to follow distinct patterns (Lu 2022). These experiential patterns are often encouraged by a series of spatial conditions. When the triggering spatial conditions of a pattern are related to a perceptual sphere of water, the pattern becomes water-related. Many water-related experiential patterns are observable within a built environment, manifesting human-water intimacy.

Through extensive participatory observation and reflexive introspection during our site in-

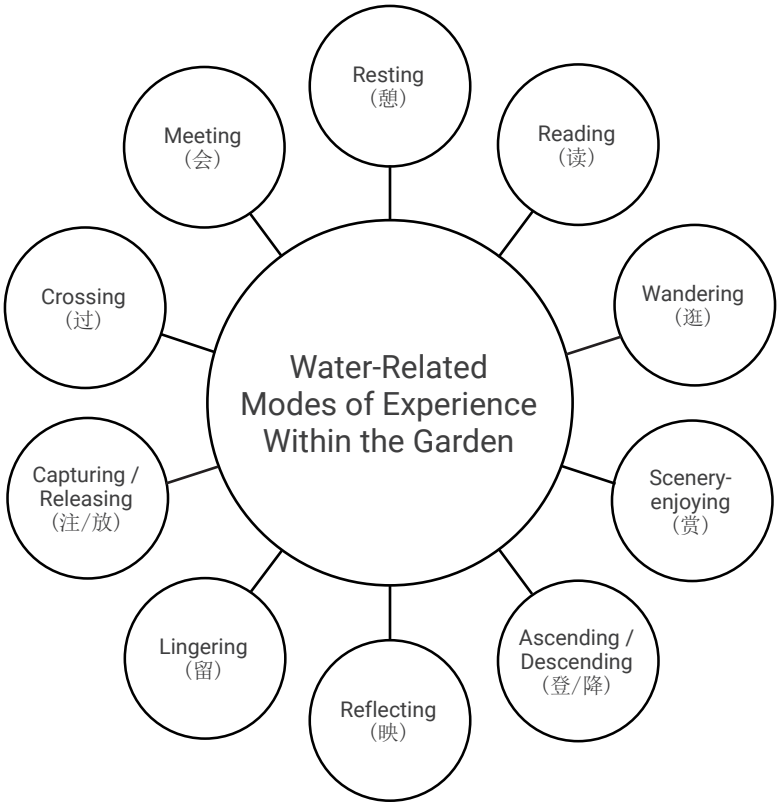
vestigation, we have identified 10 modes of experience within the Master of the Nets Garden: wandering, lingering, resting, reflecting, reading, meeting, crossing, ascending/descending, capturing/releasing and scenery enjoying (Lu 2022). Table 1 provides a detailed description of these modes of experience and illustrates the typical circumstances under which they occur. It is important to note that the images in this table do not always depict the experiences themselves but rather the conditions that enable them. Each circumstance typically involves a set of conditions, which will be explored in the following section.

Stage 3: Examining the Spatial Conditions Contributing to Water-Human Intimacy

After identifying the modes of experiences within the visual sphere of water, we further examine the spatial conditions related to them. As illustrated in Table 1, all 10 modes of experience frequently occur under conditions closely tied to the visual sphere of water within the garden. By examining how these spatial-experiential conditions are embedded and organized around the water body, we can gain insight into how intimacy between water and humans is cultivated within the garden. Table 2 lists the identified spatial conditions and the corresponding modes of experience contributing to water-human intimacy. Additionally, we mark the location of some typical conditions on the map (fig. 7).

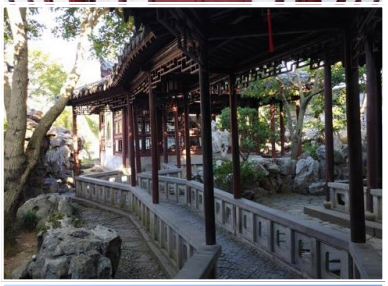
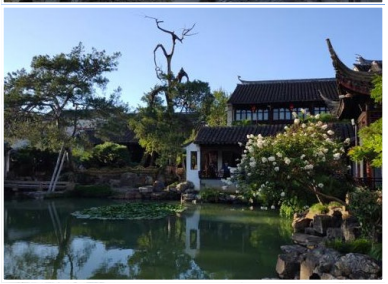
This detailed examination helps illustrate how specific spatial elements and their arrangements foster intimate interactions between visitors and the water, enhancing the overall water-related experience within the garden. As these modes of experience all occur within the visual sphere of water, they are naturally either water-related (with water as the content of the experience) or water-inspired (with water as the trigger of the experience). The results reveal 10 distinct categories of water-human intimacy, each corresponding to specific modes of experience: resting near water, reading beside water, crossing above water, wandering alongwater, reflecting within water, meeting near water, enjoying the scenery of water, descending/

^ Fig. 5 A panorama of key elements around water. As visitors navigate around the central water feature, their gaze dynamically shifts between focal points (Source: Li Lu, 2018).

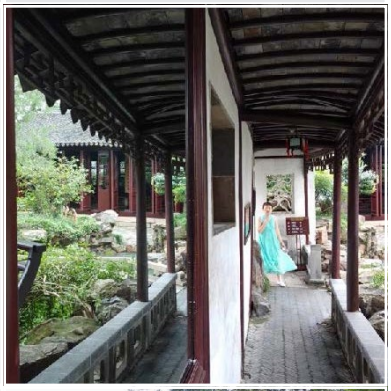


^ Fig. 6 Modes of experience that occur within the spatial-visual sphere of water in the Master of the Nets Garden (Source: Li Lu, 2024).

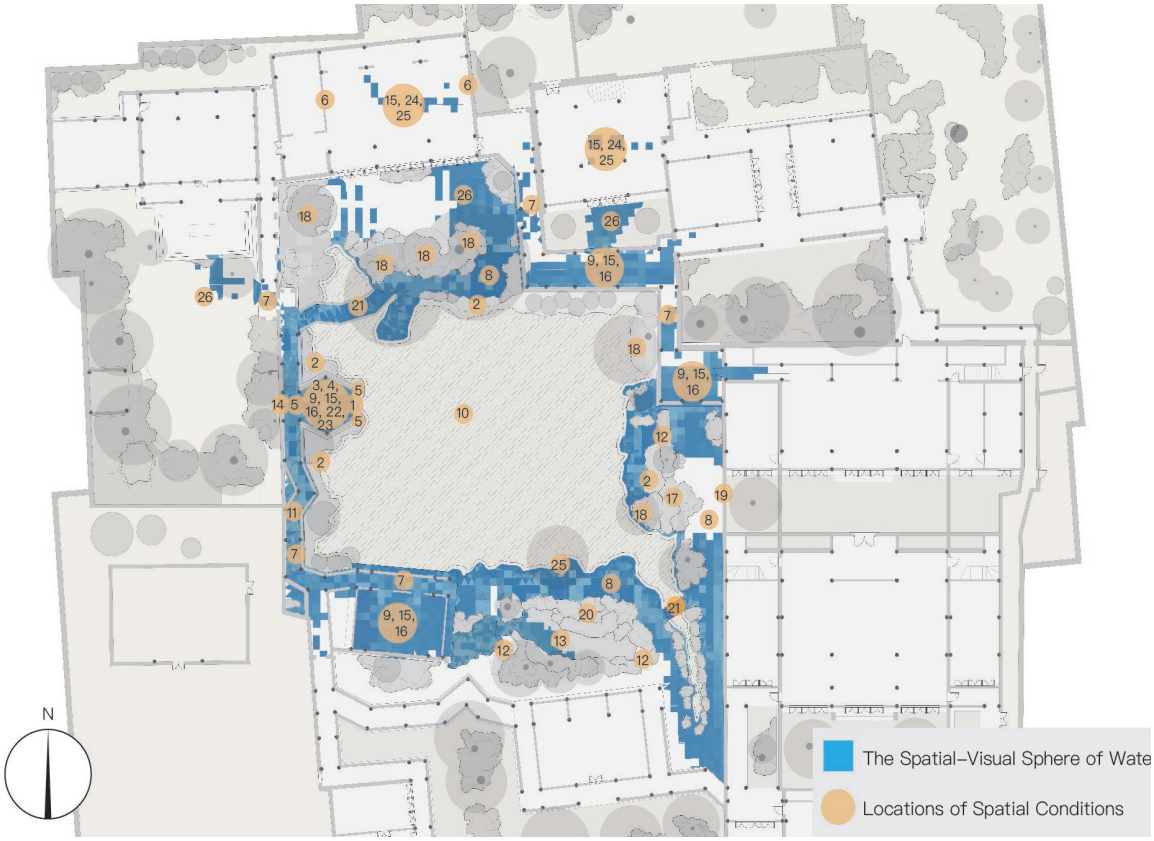
ascending to appreciate water, lingering around water and capturing/releasing the view of water (Table 2). As demonstrated, various intricate spatial conditions are embedded in the visual sphere of water, facilitating the dynamic occurrence of these modes of experience. Consequently, a rich and profound water-human intimacy is established. This understanding provides researchers, spatial practitioners and policymakers with essential insights for incorporating this value into spatial interventions, ultimately enhancing the water-human relationship in the contemporary world.

Mode of Experience	Description	Typical Circumstances
Resting	Resting is the act of relaxing to relieve fatigue or stress. It occurs when one achieves a state of physical, mental and emotional calm.	
Reading	Reading is a "complex cognitive process of decoding symbols to derive meaning" (Hans and Hans 2013). It occurs when this process of decoding is engaged.	
Wandering	Wandering is characterized by aimless or unsystematic movement across various spaces within a garden. It occurs as a dynamic, continual physical flow without a predetermined purpose or destination.	
Enjoying scenery	Scenery-enjoying refers to the appreciation of aesthetically arranged landscapes within one's surroundings. It occurs when visitors engage visually and emotionally with the carefully composed elements of the landscape.	
Ascending/descending	Ascending/Descending encompasses a cluster of experiences associated with vertical movement within a space. It occurs when an individual physically moves upward or downward, navigating different elevations.	

^ Table 1 Description of 10 modes of experiences and typical circumstances identified within the visual sphere of water (Source: Li Lu and Haoxiang Zhang, 2024).

Mode of Experience	Description	Typical Circumstances
Reflecting	Reflecting involves becoming aware of one's environmental surroundings through a reflective surface within a space. It occurs when these reflective elements highlight or alter the perception of the surrounding environment.	
Lingering	Lingering refers to an extended stay within a particular space, dominating both spatial and temporal aspects of one's experience. It occurs when one halts their continuous movement to remain in a location, allowing time to appreciate and engage with the surrounding entities. Intriguingly, lingering can serve both as a cause and consequence of many other experiential modes.	
Capturing/releasing	Capturing/Releasing involves a group of experiences directly tied to the shifts in a visitor's conscious awareness. Capturing occurs when an entity enters the visitor's consciousness, marking the moment of engagement. Conversely, releasing happens as the entity departs from the visitor's conscious attention, signaling disengagement. This dynamic process reflects the visitor's mental engagement and disengagement with the environment, impacting their overall experiential journey.	
Crossing	Crossing refers to the act of physically moving across a space. It occurs when an individual travels from one area to another, facilitating transitions within the environment.	

Mode of Experience	Description	Typical Circumstances
Meeting	Meeting refers to the act of visitors coming together to share a moment of interaction. It occurs when individuals gather and enjoy each other's company, engaging in social exchanges within a shared space.	



^ Fig. 7 Locations of typical corresponding conditions within the visual sphere of water (Source: Li Lu and Haoxiang Zhang, 2024).

Mode of Experience (related to water)	Corresponding conditions within the spatial-visual sphere of water
Resting (near water)	A wall to lean against, a rock to sit on (2)
	Beauty's Arm Bench, suitable for one to comfortably sit on (1)
	A roof that offers shelter from inclement weather (3)

^ Table 2 Identifying conditions in the spatial-visual sphere of water corresponding to the 10 modes of experiences (Source: Li Lu and Haoxiang Zhang, 2024).

Mode of Experience (related to water)	Corresponding conditions within the spatial-visual sphere of water
Reading (besides water)	An area where inscribed characters are easy to read (4)
	Calligraphy inscribed in plaques or stelae (5)
	A painting displayed on a wall (6)
Wandering (along water)	A continuous, covered corridor that allows for enjoyable views while walking in a relaxed, pleasant and comfortable mood (7)
	A walkway alongside rocks, trees, shrubs, flowers and grass that facilitates strolls in a relaxed, pleasant and comfortable mood (8)
Enjoying scenery (of water)	A place designed and built to allow one to enjoy the surrounding landscapes (9)
	A water-centered area, harmoniously integrated with various landscape and architectural elements, creating a picturesque scene (10)
Ascending/Descending (for appreciating water)	An ascending or descending path to follow (11)
	Stairs inviting visitors to ascend or descend (12)
	A rocky, mountain-like segment standing by the south of the pond (13)
Reflecting (through/of water)	A mirror on the wall of the corridor beside the Pavilion for the Advent of Moon and Wind (14)
	An area where reflections in the mirror can be consciously perceived
Lingering (around water)	A sheltered place that protects visitors from natural disruption, allowing them to remain for an extended period (15)
Capturing/Releasing (of water view)	An elegantly shaped architectural feature designed to capture visitors' interest (16)
	A carefully arranged rock formation intended to draw visitors' attention (17)
	An eye-catching tree (18)
	A long wall that divides the garden into sections, strategically guiding and manipulating attention (19)
	A rocky, mountain-like area that interrupts and redirects visitors' sightlines (20)
	A picturesque composition visible through an opening in the wall
Crossing (above the water)	A tiny, curved stone bridge spanning the narrow end of the water pond (21)
	A courtyard that invites visitors to walk across it (26)
Meeting (near water)	A round stone table surrounded by four stone chairs in the center of the pavilion (22)
	A hexagonal pavilion floor that generates a centripetal trend (23)
	A symmetrical, well-lit hall (24)
	Two south-facing chairs positioned on a central axis in the hall, with an elaborately painted screen behind them and a table between them (25)

Conclusion

This article has delved into the rich and profound water-human intimacy cultivated within the built environment at the architectural level, using the Master of the Nets Garden as a case study. By integrating spatial, empirical and experiential analyses, the study has revealed how water features within built environments frame spaces and shape spatial experiences, fostering a pervasive intimacy between water and visitors through a series of spatial-experiential conditions. Our findings highlight several critical insights.

The role of the spatial-visual sphere of water: Our analysis demonstrates that perceptual spheres play a fundamental role in establishing water-human intimacy within the built environment. These spheres form the spatial-experiential framework under which water-human intimacy occurs. Although this article focuses on the spatial-visual dimension, it is worth noting that this framework has a multi-dimensional structure.

Diverse modes of experience: Our identification of 10 water-related modes of experience indicates that water-human intimacy is shaped by how individuals interact with water through various experiential patterns. Therefore, stimulating diverse modes of experience is essential for cultivating a rich and profound water-human intimacy.

Impact of spatial-experiential conditions: Our examination reveals that the density and diversity of spatial-experiential conditions within the perceptual sphere of water are crucial in shaping the quality of water-human intimacy. As demonstrated by the case study, higher density and greater diversity enhance visitors' sensory engagement with water, thereby strengthening their connection to it.

Overall, this study highlights water-human intimacy as a core value of water-centric built heritage and analyzes how this intimacy can be fostered through carefully designed and integrated spatial-experiential conditions within a built environment. The method we used does have some limitations, particularly in the precision of the digital model and the matrix size for calculation. These limitations restrict our ability to capture visitors' visual perceptions fully. In the future, incorporating point cloud techniques and advanced computing capabilities could improve the detail and accuracy of representations of individual visual experiences.

Despite these challenges, the method holds considerable promise and can be applied in many areas. It offers a valuable framework for researchers, spatial practitioners and policymakers to better understand and evaluate the water-human relationship in water-centric built environments, providing detailed, precise and nuanced insights to foster a beneficial water-human relationship in the contemporary world.

Policy Recommendations

- **Go beyond the statistical approach:** The experiential quality of the water-human relationship deserves equal (if not greater) attention compared to its statistical manifestations. Combining spatial, experiential and empirical analysis provides a deeper understanding of this relationship and can help develop more beneficial and sustainable water-centric environments.
- **Maintain the water-human relationship as a core value:** Appreciating the intrinsic relationship between humans and water within the water-centric built heritage and maintaining it as a core value in conservation can promote both heritage preservation and sustainable development.

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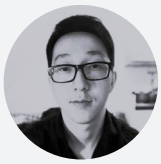

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Space, Time and Scale: When Geohistory Reveals a Territorial Heritage Based on Water

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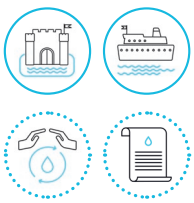
The Mozambique Channel separates the island of Madagascar from Mozambique on the African continent, creating a total of 6200 km of coastline. Yet, in inscriptions of national heritage, water is not a focus of discussion nor is it considered. This lack of attention to water-related heritage is surprising given that the cities and heritage sites along the Mozambique Channel emerged from a maritime trade network that existed until the nineteenth century and formed the foundation for the evolution of the two countries. A water-based approach to heritage can help address contemporary challenges involved in the regional expression of heritage as well as the building of a national identity. Focusing on territorial dynamics, this article helps to rethink the role of heritage in creating a water-aware approach to heritage along the Mozambique Channel. It uses a multiscalar and spatio-temporal methodology called geohistory to analyze the development of the two coasts, their development over time and the resulting questions for heritage.

Keywords: *geohistory, urban network, maritime territory, geographical partitioning, Mozambique Channel*

KEY THEMES



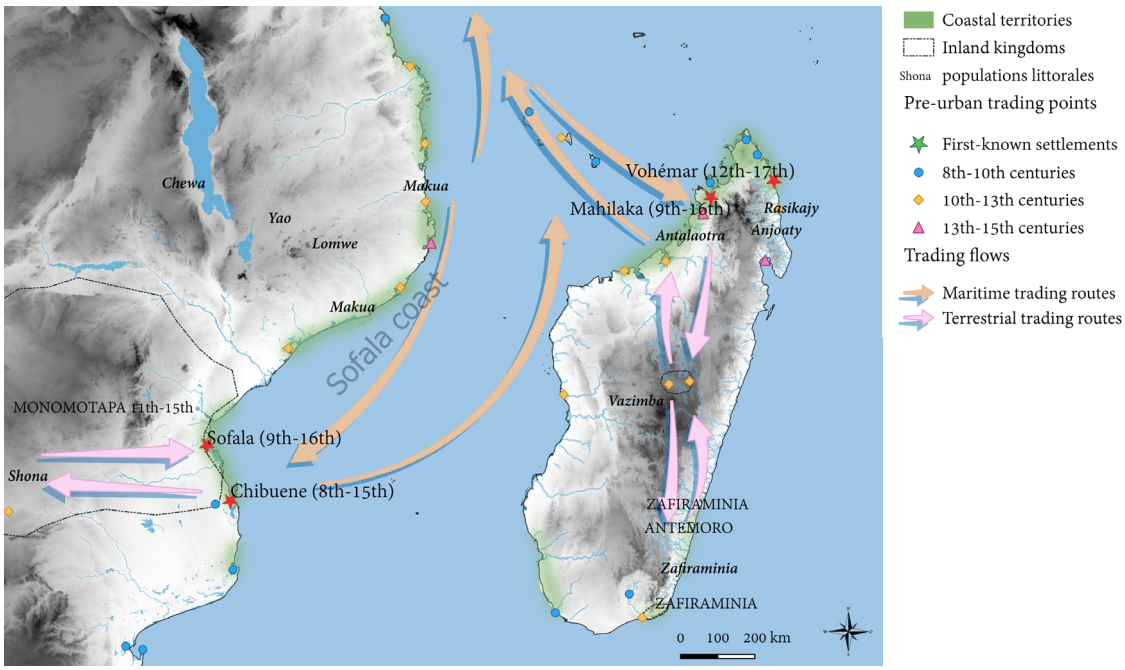
< Fig. 1 Dhow, a traditional means of transportation between regions in Vilanculos, Mozambique (Source: Lauriane Verhoog, 2023).

Introduction

The Mozambique Channel is a segment of the Indian Ocean that lies between the countries of Mozambique and Madagascar. For centuries, it has served as a vital route for transportation and trade, facilitating the movement of goods and people. Trading along the channel's coasts gave rise to a network of settlements and cities. Despite the presence of numerous historical and heritage sites along this coastline, there is currently no comprehensive national policy for the recognition and preservation of this coastal heritage.

An analysis of the area's geographical partitioning and evolution reveals how water, once a central element of society, became a neglected space. Water-based practices have played a significant role in shaping the coastal territory on both sides of the Mozambique Channel, resulting in a shared expression of evolving regional territoriality with the channel at its core. This article identifies three spatio-temporal phases in the logic of territorial evolution in this region. At the regional scale, there has been a strong consolidation of local identities that are specific to this coastal territoriality. The expression of these identities has been affected by colonization as well as the sense of belonging associated with them. As a result, the coasts have evolved in distinct ways, maintaining a certain distance from the new national scale and safeguarding their original coastal characteristics. In recent times, national interests have increasingly sought to incorporate these coastal territories in their territorial dynamics. However, despite this growing attention, they struggle to be acknowledged and legitimized as an important part of the national heritage.

Geohistory can illuminate the territorial and societal dynamics of the region. This methodology allows for the examination of specific territorial dynamics over time, using temporality, space and scale as analytical tools (Jacob-Rousseau 2009). Using this method, I identify three dis-



^ Fig. 2 The emergence of a coastal territory starting in the eighteenth century (Source: Lauriane Verhoog, 2024).

tinct time periods and show how the territories on both sides of the channel were part of larger trends beyond the present-day national scale.

In this article, I ask how Mozambique and Madagascar have handled their shared channel heritage throughout these three phases, leading to their marginalization in the present day. Using a multiscalar approach, I explore the role of water as a source of connection and division on both sides of the channel over a period of eight centuries. I also highlight contemporary elements that reaffirm the importance of geohistorical analysis in understanding a regional identity focused on water and its role in cross-channel heritage discussions.

Water as the Center of a Territory: Maritime Routes and Port Cities Networks

In the Mozambique Channel, regional organization originated from a maritime trade system as early as the fifth century (Beaujard 2009). Maritime routes served as the foundation for the growth of a complex network of coastal settlements. Within a hierarchical network, each trading outlet played a specific role depending on the natural resources of various inland areas and on its connection to various ports in the Indian Ocean. By examining these coastal networks we can grasp the regional articulation of the territory as both water and land. Indeed, the coastline permitted the emergence of a specific territory that was not subject to any political domination.

In the tenth century, the coastline became connected to inland kingdoms (Sinclair 1982) but the coastal settlements acted independently with regard to trade. As a result, coastal cities emerged and declined throughout the centuries, depending on the intensity of maritime trade routes. During the golden age of the Great Zimbabwe Empire (from the eleventh to fifteenth centuries), important trading points emerged on the coast of Mozambique, such as Chibuene and Sofala. However, as the empire started to decline, other routes took over, leaving the former cities in despair. In Madagascar, the first settlements were located along the northern coast, first in Vohémar and later in Mahilaka. These cities played a key role in shaping the channel's coastal dynamics (fig. 2).

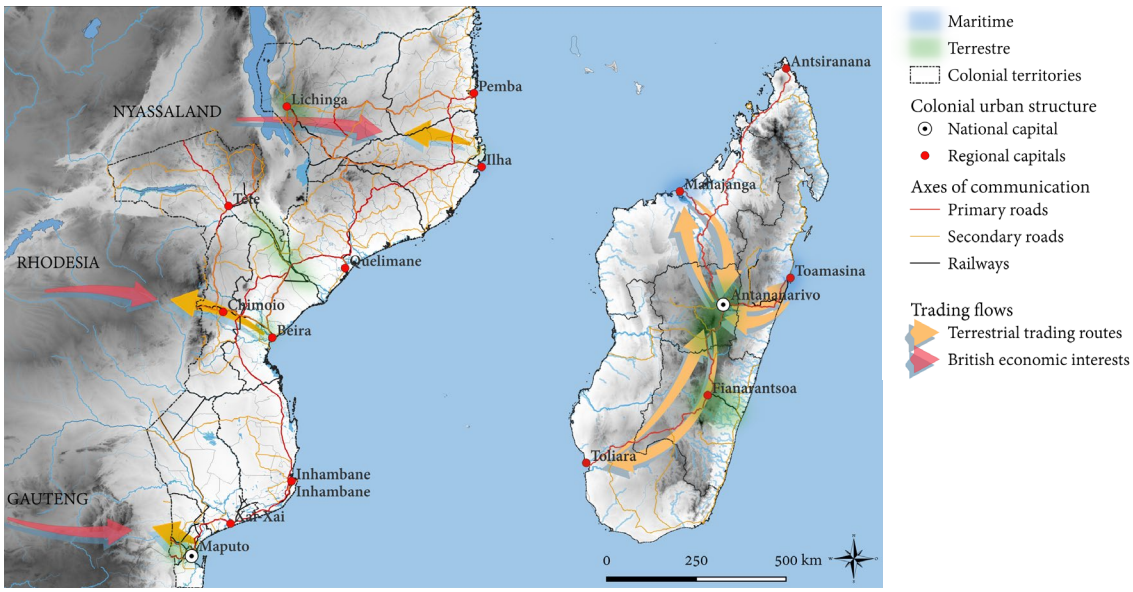
Taking islands and archipelagos in the southeastern Indian Ocean region as an example, Ottino (1974) argues that the emergence of a coastal territory is strengthened by the development of "coastal fringe cultures." This also applies to the Mozambique Channel. In fact, the coast served as a focal point for many different populations. As a result, organized communities emerged, creating specialized roles in trade activities (Ottino 1974; Beaujard 2009) that connected both sides of the channel as early as the ninth century (Sinclair 1982). These included the Antalaotra people, known as the "People from the Sea" in the Malagasy language, who lived on the northwest coast of Madagascar, as well as the Rasikajy and the Anjoaty people. These coastal populations were the result of mixed cultures that shared cultural and religious characteristics. Furthermore, this led to a similar spatial organization in which water served as the connector, as socio-spatial dynamics relied on maritime routes. The slightest change in regional geopolitics had enormous consequences for regional socio-spatial dynamics.

Water as a Border: Changing Territorial Partitioning and Colonialism

By the nineteenth century, the Imerina kingdom's expansion and subsequent colonial conquests

introduced the concept of national territories. As a result, an urban network developed with a focus on the new political center (Coquery-Vidrovitch 1988). On the East African coast, the territorial vision underwent a drastic change when Portugal and France created new land-based colonial territories, dividing Mozambique and Madagascar into two distinct territories. Each territory had its own capital, serving as a new political center. This change had a significant impact on the role of the urban network within the emerging society. Coastal cities now served the newly formed national territories, which turned their attention toward the capital. Maritime routes were replaced by new terrestrial routes, leading to a reduction in trade contacts between the coasts and the eventual closure of the Mozambique Channel.

Each country developed its own terrestrial focus leading to the independent evolution of coastal territories. In Mozambique, the national communication network was organized along two axes: a north–south axis that replaced the former maritime cabotage system along the coast, and a second axis crossing from west to east to connect the English inland territories with a harbor (Fair 1989). As Mozambique served as a territorial outlet for the nearby English colonies, three main port cities emerged: the newly named national capital Lourenço Marques (now Maputo) serving the Gauteng region, Beira for Rhodesia and Nacala for Nyasaland. The establishment of these cities disrupted the former regional organization and relegated the historical port cities to a secondary level of importance. In Madagascar, the former coastal organization remained largely unchanged. The three former coastal cities on the west coast – Antsiranana, Mahajanga and Toliara – were designated provincial capitals. The communication network was designed to converge toward the capital Antananarivo, located in the territory's central highlands. However, the secondary network connecting the provincial capitals did not seem necessary to the colonial administration (fig. 3), allowing communities – like the Vezo and the Sakalava – to continue their traditional activities that were closely tied to water.



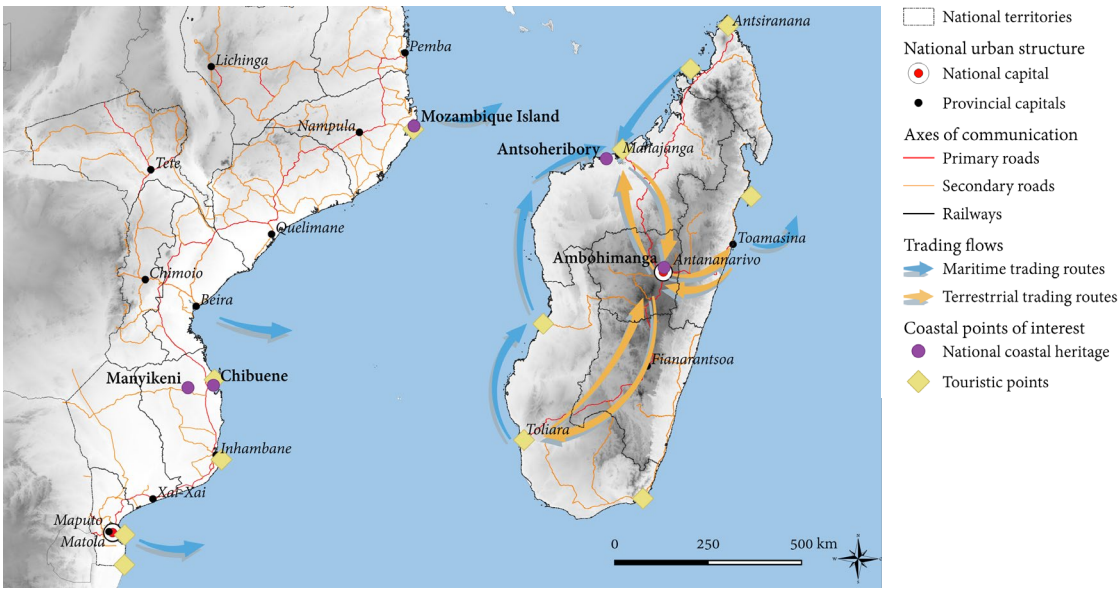
^ Fig. 3 The coast as colonial outlets (Source: Lauriane Verhoog, 2024).

The new national capitals always kept their distance from the coastal settlements, sometimes forging a national vision in opposition to the latter in pursuit of political goals (which included maintaining their dominance). The territorial conquest was reinforced during colonization with the gap between inland and coastal communities growing deeper and stronger. In Mozambique, even though the coast was still an area of economic interest, the new cities were created ex nihilo, ignoring the importance of regional trade in the past. The coastal territories never disappeared completely during this geographical partitioning but continued to exist in a marginalized way, shadowed by national hegemony (fig. 1). Later, independence brought new possibilities for the coastal territories to claim their legitimacy.

Water as Heritage: Reconnecting the Dots of a Common Water-Based Territory of the Past

Postcolonial independence reinforced the inclination toward a national vision. Since the geographical centers were located in the national capitals, national unity mainly emerged through those centers, which empowered the countries' territorial structures. However, once the two countries disconnected from the former colonial powers, this situation offered better national visibility to the local scale. In fact, empowering regional urban centers became a priority on the national agenda. Given the predominant coastline in both Madagascar and Mozambique, coastal cities were ideal candidates.

Consequently, coastal communities have appeared more prominently on the national stage. For example, the maritime cabotage system is a preferred alternative to the national roads, the conditions of which are worsening every year. In addition, tourism is attracting more people to the coast, highlighting the region's distinctive historical and cultural aspects. Tourism perhaps is the strongest factor of this coastal highlight. It allows reconnection with the history of the coast itself, bringing regional trade history, which is unique to coastal areas, from the past into the spotlight. The shared territorial



^ Fig. 4 The coastal area as a predominant point of interest (Source: Lauriane Verhoog, 2024).

foundation is reemerging in the expression of the various coastal heritages (fig. 4).

However, coastal heritage struggles to be accepted as national heritage. Recently, progress has been made by the central governments and communities to highlight regional heritage. To name a few examples, in 1991 the Island of Mozambique became a UNESCO World Heritage Site, the only national historical site to be listed. The former trade route linking the Great Zimbabwe to the Mozambican coast was highlighted recently by the restoration and development of two archaeological sites in Chibuene and Manyikeni. In Madagascar, the islet of Antsoheribory, a former capital of the Antalaotra merchants, is being listed by the Malagasy government in its inventory of the national heritage. Although only a few places have achieved this kind of recognition, they offer important examples of how it is possible to reconnect the national scale to its regional past, with water as a shared inheritance.

Conclusion

Reshaping territories inevitably transforms the approach of their features. In the Mozambique Channel, water heritage is one of these features, since water provided a foundation for the territory's original construction. Geohistory highlights this common territorial foundation that continues to exist and on which a variety of water heritages have evolved. The region has shifted from water-based territories to land-based territories without totally erasing the former connection with water. In fact, local communi-

^ Fig. 5 The Garden of Memory, remembering the slave trade routes in the Indian Ocean, Island of Mozambique (Source: Lauriane Verhoog, 2023).

ties shifted their ways of expressing their heritage. With a common contemporary process of seeking the former regional territorial heritage and reasserting their own local heritage, the latter is then still forged on the past water-based territory. Designating the Island of Mozambique as a UNESCO World Heritage Site not only highlights the island's historical past as part of national history but also reconnects its regional past within the southwest Indian Ocean (fig. 5). Not lost but only hidden, a shared water-based territory evolved and became fragmented, but reemerged in a way that allowed local heritage to be expressed.

Policy Recommendations

- National heritage should include every part of the national territory as a legitimate part of its heritage. Although it might not be obvious from a contemporary perspective, so-called territorial opposition may have common roots.

Acknowledgment
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The Venetian Arsenal: Water, Culture and Heritage

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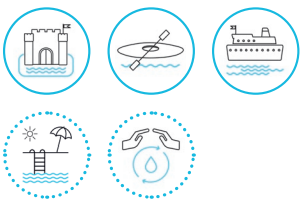
The Venetian Arsenal, one of Europe's oldest shipyards, played a crucial role in the development of Venice. Although it now hosts events for the renowned Biennale, since the partial departure of the military, the site has offered little value to the communities in its vicinity in part because citizens have not been included in heritage management decisions. A recent draft agreement signed in 2022 to expand La Biennale's activities threatens to further exacerbate livability problems faced by local communities. However, the agreement's early stage presents an opportunity to repurpose the Arsenal in response to Venice's many problems, including mass tourism, the need for more housing, the ecosystemic loss in the Venetian Lagoon and the ongoing privatization of public spaces.

Keywords: *urban regeneration, sustainable development, commodification, public asset*

KEY THEMES



< Fig. 1 A view from the Gaggiandre, the aquatic canopies built between 1568 and 1573 in the Darsena Novissima and used to shelter rowing galleys that did not require masting (Source: Camila Burgos Vargas, 2023).

Introduction

The Venetian Arsenal (Arsenale di Venezia) has become renowned for its architecture and for the art displayed there. Yet, it is also a place where water management, heritage preservation and urban justice issues converge. One of Europe's oldest shipyards, the Arsenal played a crucial role in the development of the city. Between 1660 and 1797, it saw the construction of 115 warships (Nani Mocenigo 1995, 105–18). The site consists of 478,000 m^2 of buildings (136,380 m^2), open spaces (224,620 m^2), and water surface (117,000 m^2), covering approximately 20 per cent of Venice's Castello district (without counting water surface). Until the end of World War II, the Arsenal was a mass-production shipyard and armory with a workforce of varying size (at the peak of its efficiency in the early sixteenth century, the Arsenal employed some 16,000 people) (Menichelli 2022). Because Venetian navy and merchant ships were built and repaired at the site, it became a symbol of the city's economic, political and military power. Since its gradual abandonment by the military, the water system surrounding the Arsenal has been recognized as an area where both current and future challenges to Venice's survival are concentrated.

The combined effects of past industrialization, the widening of shipping channels across the lagoon and unmonitored groundwater extraction have caused the city to sink, increasing the risk of flooding, especially as sea levels rise. The Venetian Lagoon also faces threats from mass tourism and cultural globalization, which have turned Venice into a "dying city" (Settis 2014; figs. 2 and 3). In light of these complex challenges, this article argues that the Arsenal, recognized as a site of Outstanding Universal Value by UNESCO, should be managed in a way that prioritizes the well-being of local citizens and ecosystems.

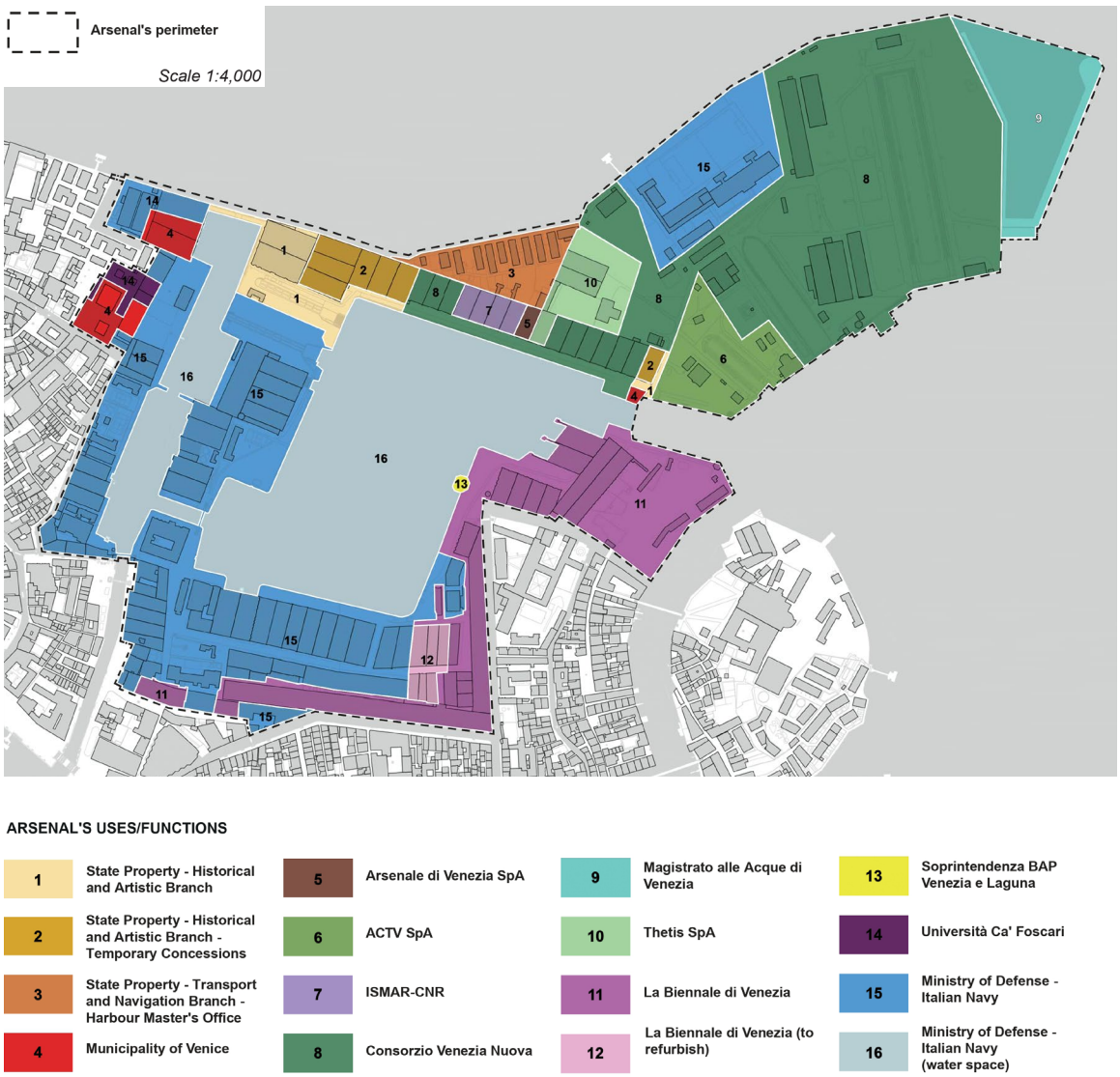
^ Fig. 2 A sector of Venice covered by high water (Source: Federico Camerin, 2019).

^ Fig. 3 A cruise passing through Venice's Grand Canal (Source: Federico Camerin, 2019).

Recent Approaches to Preserving and Managing Water Heritage

In the 1980s, a long process began that would turn the Arsenal into an art hub. There were many complexities and challenges. Repurposing former port sites often presents difficulties, as observed in similar cases around the world (e.g., Orchowska-Smolińska 2019; Van Valkenburgh Associates 2024). The challenges are apt to be even more pronounced in a city as historic as Venice, where attracting tourists and commodifying public assets competes with the need to maintain or enhance livability.

The initial phases of the Arsenal's transformation followed the dominant concepts of waterfront regeneration, prioritizing public-private partnerships and private ventures, with limited citizen involvement in heritage management (Zan 2022).



^ Fig. 4 Planimetry of the Arsenal, color coded with current uses and functions (Source: Federico Camerin, 2024).

^ Fig. 5 The interior spaces of a restored building that today hosts activities of La Biennale (Source: Gerardo Semprebon, 2023).

^ Fig. 6 Exterior open spaces of the Arsenal devoted to La Biennale at the edge of the area still owned by the military (Source: Gerardo Semprebon, 2023).

To date, five main civil functions have been established at the Arsenal, with the aim of combining restoration and innovation (fig. 4). The first function is connected to the Arsenal's military history; the Italian military still owns 77,000 m^2 of the site, which houses, among other things, the Italian Navy Staff College and a library.

The second function dates to 1980 – before the Venetian Lagoon's 1987 designation by UNESCO as a World Heritage Site – when the Arsenal became an exhibition site for La Biennale, one of Italy's most influential cultural foundations and known especially for its semiannual international exhibitions. Since then, La Biennale has played a significant role in the restoration of the Arsenal, redeveloping several areas to host foundation activities (Somma 2021, 146; figs. 5 and 6).

In the early 2000s, a third function was introduced when the Institute of Marine Sciences (ISMR), part of the National Research Council (CNR), relocated its headquarters to the Arsenal. This state-led institution conducts research in Mediterranean, oceanic and polar regions, focusing on climate change and its socioeconomic impacts on coastal systems (Menichelli 2022).

The fourth function began in 2006 when the Consorzio Venezia Nuova, a concessionaire of the Italian Ministry of Infrastructure and Transport, was granted a significant portion of the northern part of the Arsenal for the storage of industrial materials and debris. The consortium is responsible for the planning, maintenance, management and control of the ecosystem associated with the functioning of MoSE (Experimental Electromechanical Module), a large-scale engineering project designed to prevent flooding, which became operational in 2020 (Menichelli 2022).

Finally, since 2019 public authorities have sought to revive the boating and shipbuilding

^ Fig. 7 Interior spaces of the Arsenal hosting the annual international Venice Boat Show (Source: VELA S.p.A., 2024).

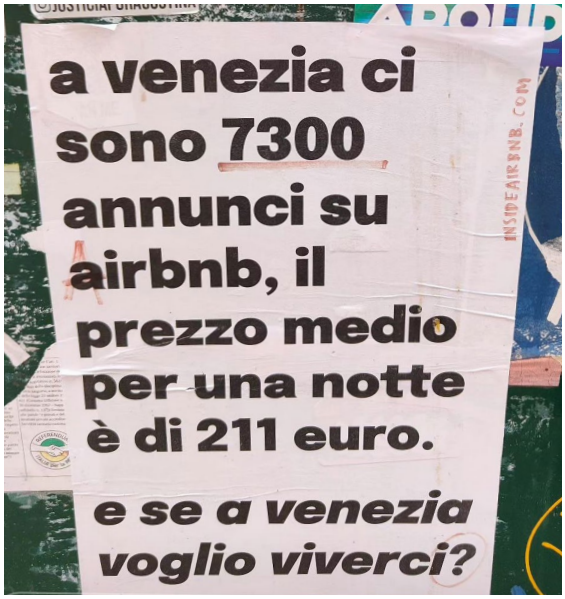
industry through the annual Venice Boat Show. This event has focused on both traditional and innovative shipbuilding, linking heritage craftsmanship with modern concerns such as sustainability and innovative technologies including electric, hybrid and hydrogen propulsion systems. Additionally, the event has promoted educational and sporting activities in and around the sea and the lagoon, emphasizing Venice's enduring connection to these waters (Città di Venezia 2024; fig. 7).

The restoration and rehabilitation of the Arsenal has created space for scientific research, heritage preservation, cultural activities and military functions. However, this transition has failed to provide facilities or spaces freely accessible to citizens or addressed their most pressing concerns: excessive tourism and the shortage of housing (Zan 2022; figs. 8 and 9). From the outset, the regeneration of the Arsenal has been disconnected from the needs of local communities, prioritizing the commodification of the cultural activities promoted by La Biennale.

Current and Future Challenges in the Management of the Arsenal

The Arsenal faces two distinct sets of challenges, both stemming from the top-down approaches to water management, urban planning and heritage protection taken by the national and local governments. On the one hand there are ecological challenges associated with the MoSE system of movable barriers designed to block high waters and prevent flooding in the city (fig. 10). However, the frequent use of MoSE, which is likely due to climate change, is reported to damage the ecosystem of Venice and its lagoon (Viviano 2022). Specifically, the system threatens the halophytic vegetation of salt-tolerant plants that serve as a biodiversity hotspot. The MoSE prevents the vegetation from

^ Fig. 8 Written on a shop shutter: "Too many tourists" (Source: Federico Camerin, 2024).



^ Fig. 9 A poster on the street in July 2023 states "Venice has 7,300 listings on Airbnb, with an average price of 211 euros per night. What if I want to live in Venice?" (Source: Federico Camerin, 2023).

being regularly submerged by tidal sediment, disrupting the intake of essential nutrients for local flora and fauna (Alberti et al. 2023).

On the other hand, since the early 2000s intellectuals, academics and citizens have advocated for portions of the Arsenal to be dedicated to boatbuilding, rowing groups and the display of traditional watercraft, which could generate jobs while preserving traditional Venetian ways of life. However, much of the Arsenal remains largely inaccessible to the public.

In 2002 the conference Arsenale e/è Museo (Arsenal and/is Museum) proposed converting the Arsenal into a "civilizing center of water" – a public complex that would include a national museum of archaeology, history and ethnography, along with a research center focused on the Venetian Lagoon as a resource (Castelli 2002). Although this idea was supported by the local district council and the navy, it was not endorsed by the City Council, and no further action was taken.

Twenty years later, in 2022, the Ministry of Defense, Ministry of Culture, and the City Council signed a draft agreement (Ministero della Difesa-Mibact-Comune di Venezia 2022) that appears to reinforce La Biennale's focus on private-oriented cultural and leisure activities, backed by €170 million of public national funding (with 107 million coming from Italy's recovery and resilience plan). This agreement, which was not publicly discussed, outlines three main actions: the creation of an International Center for Research on the Contemporary Arts, managed by La Biennale in a navy area; the restoration of the Arsenal's old docks and Galeazze canal as a dock and safe harbor for emergency public boats; and the requirement to host two events per year, each lasting at least 15 days.

These initiatives seem to overlook the relationship between citizens, the Arsenal and the sea, focusing instead on La Biennale's artistic and cultural activities and the associated economic gains. The 2022 draft agreement, which grants more public space to La Biennale, highlights the absence of an integrated heritage management strategy. The Arsenal now risks being transformed from a unique symbol of Venice's maritime history to merely a venue for La Biennale events. Residents and organizations have opposed the agreement due to the lack of public consultation and the continued commodification of public assets for private interests.

Future Possibilities for the Arsenal

Amid increasing water-related and environmental challenges, changing socioeconomic dynamics and the pressures of privatization,

^ Fig. 10 Aerial view of the MoSE project in Venice, Porto di Lido (channel north of Lido) in mid-2009 (Source: Chris 73, 2009. Wikimedia Commons, CC BY 3.0).

Venetian citizens have mobilized to demand more people-centered approaches for the Arsenal. Reflecting this activism, the grassroots association Forum Futuro Arsenale (2018) has proposed an inclusive heritage management plan and the creation of a maritime museum. However, these proposals have not yet seriously been considered by public authorities, who prioritize more profitable private-oriented reuse of the site. One potential solution to reconcile the interests of public authorities and citizens is the establishment of an autonomous public entity that could integrate the diverse needs of public authorities, private stakeholders and the community. The concept of Public-Private-People Participation ("P4") has emerged to address the shortcomings of traditional public-private partnerships by including the general public alongside public and private actors (Boniotti 2023). Ideally, the City Council would coordinate this initiative, but citizens continue to argue that the local administration has failed to fully assume this responsibility.

The local political and socioeconomic landscape must foster a more sustainable relationship between water and heritage. What the Arsenal lacks is a democratic dialogue involving all stakeholders and the development of short-, medium- and long-term strategies to address diverse needs. Several solutions could unlock the Arsenal's potential to tackle the challenges faced by Venice and its residents:

1. The Bacino Grande of the Arsenal could be repurposed for permanent shipbuilding activities focused on sustainable and traditional practices, such as building oar-powered boats that generate less wave action than motorized vessels, thus reducing the erosion of stilt foundations and preserving both the craftsmanship and the Venetian urban fabric.
2. Underused areas of the Arsenal could be allocated to fulfill citizens' requests for a maritime museum, more accessible public space and housing.
3. Some of the space currently dedicated to the management of the MoSE project, ISMR-CNR and the Italian military could be used for research on safeguarding the Venetian Lagoon, including the restoration of salt marshes that have protected and nourished Venice for 18 centuries.
4. The public-private collaboration with the Biennale could adopt a more community-centered approach, for example, by earmarking a portion of the international event revenues for the renovation of the Arsenal sections dedicated to the public, providing annual access to Venetian residents and creating programming within the Biennale that celebrates and preserves Venetian heritage.

Conclusion

The renovation of the Arsenal has the potential to pursue SDG 11, "Sustainable Cities and Communities," by transforming what was once the cornerstone of Venice's maritime power into a catalyst for the "right to the city" and addressing the social, economic and environmental challenges Venice faces today. Governance partnerships have successfully restored and repurposed sections of the Arsenal for exhibitions, research and educational purposes. However, institutional efforts must become more transparent and aligned with the public interest. While La Biennale and its activities significantly boost the local economy, the solutions proposed by public entities have not sufficiently addressed the hardships experienced by residents and the lagoon ecosystem. Embracing the P4 model – including the components of participation and open planning – offers an opportunity to enhance stakeholders' involvement in heritage management and to foster new public-private partnerships and initiatives capable of addressing multiple challenges.

Policy Recommendations

- Dialogue with citizens should be initiated to overcome the shortcomings of the multi-decade process of repurposing the Arsenal. The sustainable development of the city should be pursued along with protection of the city's water, culture, natural surroundings and heritage. Following negotiations, P4 approaches should be formalized with binding contracts involving civil society organizations, academia, professional organizations and media.

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PART II Methodologies and Case Studies

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The Antalaotra People of Madagascar: Made and Unmade by the Sea

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The territory of Madagascar emerged from the unification of formerly independent kingdoms. These kingdoms were geographically distinct, with one main inland kingdom and several coastal ones. The "Kingdom of Madagascar" emerged in the nineteenth century from political conquests made possible by the trade effervescence taking place along the nearby Mozambique Channel, creating an island-based unity. The Antalaotra people, or "People from the Sea," who lived in the Comoros archipelago and the northwest coast of Madagascar, acted as a bridge between the different territories. Over a period of five centuries, they laid a common cultural foundation for a Malagasy society. Their regional trading culture allowed them to penetrate the inland kingdom through economic and cultural exchange. However, their contribution to an emerging national heritage was quickly suppressed and by the nineteenth century the Antalaotra had disappeared in Madagascar as a community. Today, Madagascar's national identity continues to emphasize the former inland Merina Kingdom, land of the Merina people, making national disparities significant in every aspect, especially culturally. Successive national governments have ignored the role of coastal heritage in the forging of national identity. This article dives into the past and inheritance of the Antalaotra people to argue for the inclusion and acknowledgment of their coastal heritage as part of the national identity.

Keywords: *Antalaotra people, maritime trade networks, national unity, lost heritage, Madagascar*

KEY THEMES

CLIMATE

Aw : Tropical Savanna Climate

< Fig. 1 The economic maritime landscape in Mahajanga (Source: Lauriane Verhoog, 2018).

Introduction

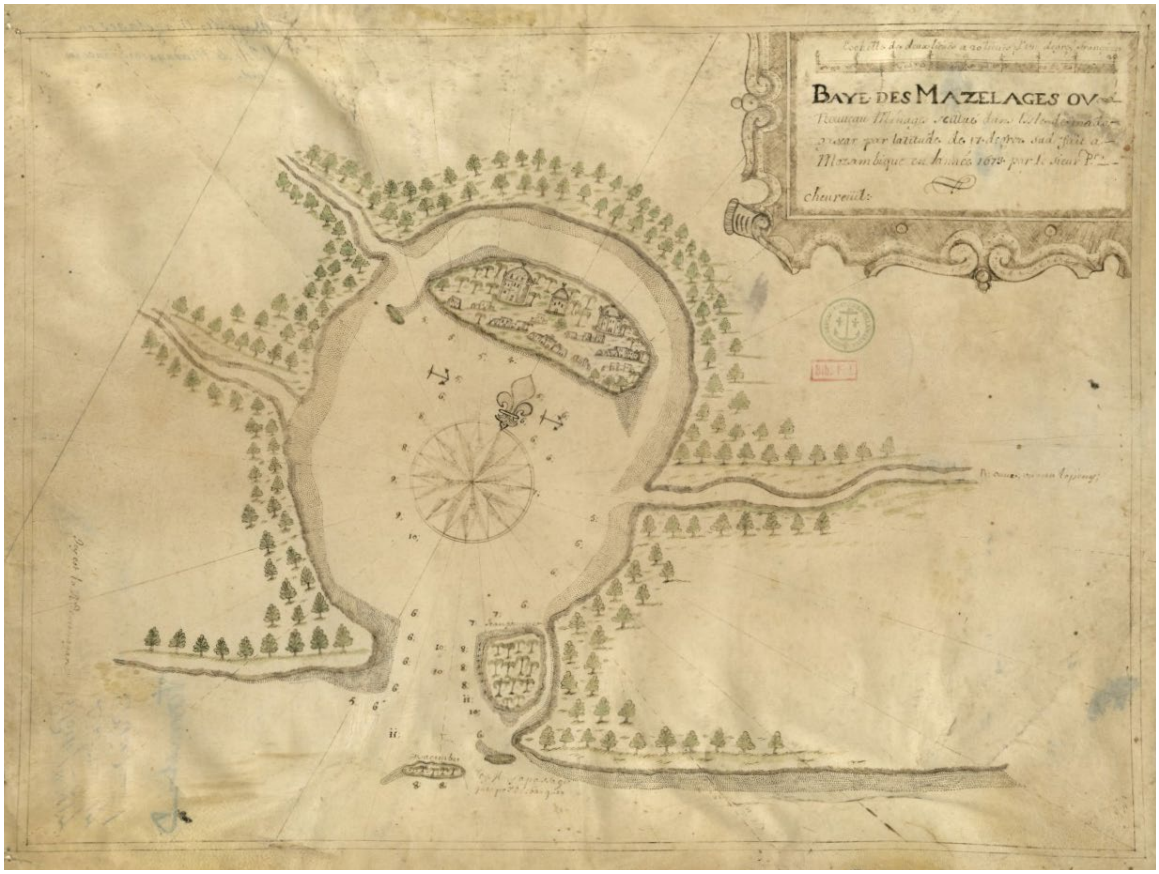
The Channel of Mozambique, along with the rest of the Indian Ocean, was once home to important maritime trading routes that connected inland kingdoms to coastal cities. The coasts served as convergence points for people, goods, religions and cultures, which led to the emergence of new political entities. By the eighteenth century, the northwest coast of Madagascar had become one of the most powerful kingdoms on the island, thanks to wealth derived from maritime trade. Trade routes through the northwest coast connected the Indian Ocean to the Merina Kingdom in the central highlands of Madagascar, leading to a concentration of cultural vitality in the coastal settlements (fig. 2).

For over five centuries, from the fourteenth to the eighteenth century, the Antalaotra people, a merchant sea community of "*extra-marine*" origins – or beyond the sea (Rantoandro 1984), lived at the heart of the northwest coast of Madagascar. In the eighteenth century, their trading role contributed significantly to the prosperity of an emerging Malagasy society. However, in the nineteenth century, their heritage was suppressed when a drive for national unity emphasized a land-focused identity. There are several reasons that can explain this isolation, but the Antalaotra people made significant economic, political and linguistic contributions to Malagasy society. However, even today, the national Malagasy identity struggles to combine these two strong and divergent cultural identities, resulting in a lack of a strong sense of national unity (Lecompte and Raberinja 1994). Could Antalaotra heritage be seen as one of the first common features of Malagasy identity? Using the Antalaotra people as a representative example, I discuss the ambivalence of Malagasy identity construction.

The Organization of Trade: "Trading Scale" Connecting the Inlands

In the fifteenth century, the northwest coast of Madagascar was home to an important trading system, what Pierre Vérin (1975) refers to as "trading scales." Major trading routes coming from the main port cities of the Indian Ocean converged at a few Malagasy port cities, from which smaller routes reached smaller coastal trading ports. Beginning in the seventeenth century, the Antalaotra people developed strong trade and cultural connections with East Africa and the Comoros archipelago, leading the coast of Madagascar to become a place of cultural interactions. But more important was the trading connection with the inland and its consequences. Although peoples of the coast and the inland retained their distinctive characteristics, the emerging role of the coast allowed common features to be shared between the territories. These included rice culture, *zebu* rites and even a Malagasy language that emerged in the inland area and was also spoken by the Antalaotra. Along the Malagasy coast, the role and importance of the Antalaotra was similar to that of the Swahili along the East African coast (Sanchez 2007); both peoples forged an urban merchant coastal identity that combined the identities of sea merchants with those of local cultures. Indeed, the early prosperity of the Malagasy coast is concomitant with the main migration phase from the African coast and India toward the northwest of the island (Urfer 2020). But it went further.

Emerging in the mid-eighteenth century from an alliance between the Antalaotra and the local population named the Sakalava, Mahajanga was the last port city of the region to be established, where Arab and Indian merchants with large *dhows* (traditional sailboats) were trave-



^ Fig. 2 Map of the islet of Antsoheribory, former capital of the Antalaotra, from Pierre Chevreuil, 1673 (Source: gallica.bnf.fr /BnF).

ling to and from the main port cities of the Indian Ocean. The Antalaotra were in charge of the secondary trading routes along the Malagasy coast, using a cabotage system that was used to reach secondary trade centers with smaller *dhows*. The Antalaotra were not only maritime navigators but were also developing inland routes, connecting the emerging Merina Kingdom with the rest of the Indian Ocean (Blanchy 1995). Although the Antalaotra tended to refrain from politics, they allowed cultural penetration throughout the eighteenth century, when they acted as intermediaries between the Indian Ocean and the Merina Kingdom (Blanchy 1995). More than just economic actors, the Antalaotra people allowed cultural and linguistic penetration of the island, consolidating a territorial connection (Urfer 2020). Indeed, the west coast was essential to the initial prosperity of the Merina Kingdom. However, the inevitable expansion of the latter left no room for a shared cultural heritage in what would become known as the Kingdom of Madagascar.

From Sea to Land: The End of the Antalaotra

Before the eighteenth century, the territorial organization of Madagascar involved no clear separation between the highlands and the coast, although the two areas were culturally and politically distinct. The northwest coast was a major

^ Fig. 3 A rice field in Antsirabe, in Madagascar's Central Highlands (Source: Lauriane Verhoog, 2017).

region of hegemony with its trading port cities and its regional connection with the rest of the Indian Ocean. The inland kingdom of the Merina people remained a small political entity. However, the Merina king, Andrianampoinimerina, began to pursue unification and domination. Perceiving the trading connections as points of territorial penetration; he promoted the consolidation of a single Malagasy territory within the Mahajanga–Antananarivo axis. This led the Merina Kingdom to achieve political domination of the northwest coast, including the city of Mahajanga, which was conquered by the Merina armies in 1824.

As early as the eighteenth century, the Antalaotra and the Sakalava made political and economic alliances for trade purposes and used Mahajanga as a capital of both communities. But when the Merina Kingdom took over the port city, the regional trade organization changed drastically. First, the Merina Kingdom prohibited Antalaotra and Arab merchants from building *dhows* for regional trade, disrupting the trading system and lifeways of the coast (Blanchy 1995). Then, between the 1820s and 1830s, Indian merchants quickly replaced the Antalaotra, who, although they did not seek to acquire political dominance, always protected their cultural distinctiveness and represented a threat to the Merina political hegemony because of their alliances with the Sakalava (Rantoandro 1984). Consequently, in the 1830s the majority of the Antalaotra fled to the Comoros archipelago in the Indian Ocean, off the northwest coast of Madagascar, leaving a minority in the Boeny Region in the northwest (Blanchy 1995).

^ Fig. 4 Avaratra, a neighborhood of fishing people in Mahajanga (Source: Lauriane Verhoog, 2023).

In a prolonged quest to build a united "Kingdom of Madagascar," rice played an important role.

Indeed, at that time, rice culture was an important part of Merina culture, even becoming the kingdom's trademark (fig. 3). During his conquest, Andrianampoinimerina swore on his political testament that "the sea will be the limit of my rice field" (Deschamps 1960) revealing his intent to establish cultural, as well as political, domination. From this point on, a cultural opposition emerged, putting a past common coastal inheritance to the side. In contrast, the coastal societies continued to affirm water as the center of their organization: the monsoon winds were followed for trading with the rest of the Indian Ocean and water was at the center of every traditional ceremony.

A Suppressed Heritage at the Expense of Contemporary Society

During the nineteenth century, and even more so in the twentieth, national unity in Madagascar depended on the dominance of the Merina highlands. Today, the inland and the coastal regions maintain their distinctiveness. Still, the nation-state of Madagascar is predominantly Merina (Raison-Jourde 1991; Fournet-Guérin 2009), and the national identity is fragile and complex. The political control exerted by the Merina people has marginalized water-based cultures and territories, introducing a certain ambiguity to the nation's territorial integrity. Although Madagascar is an island, the national identity was developed in opposition to water. This calls into question the role adopted by the Merina of na-

^ Fig. 5 The implantation of Sakalava traditions on an urban beach (Source: Lauriane Verhoog, 2022).

tional representation. Is the land-sea opposition compatible with the country's cultural plurality? The change from sea-based to land-based territory remains visible today as the infrastructure is still not connected. Economic development has been greatly impeded as a result. The national capital in the highlands is only connected to the coast to benefit from the main national port of Toamasina. More than half the country is not connected to any major transportation axis. This impedes regional integration and the development of strong and sustainable provincial capitals (Lecompte and Raberinja 1994).

Throughout the national process of territorial unification, as the connection with the sea has drifted further from the national vision, the Antalaotra heritage has begun to disappear from social memory. Support for Antalaotra identity has been limited to the northwest coast. Today, the Antalaotra people have disappeared as a communal entity but some individuals remain in the Boeny Region. They claim to be of Antalaotra descent and carry with them the water heritage that still plays a central part of life on the west coast (fig. 1). Although the cabotage system is not used in urban areas, smaller communities still rely on it and on water as a means of subsistence (fig. 4) and as a place of worship on the outskirts of cities.

Mahajanga was the last capital of the Antalaotra and the Sakalava people. It is now the capital of the Boeny Region. It was conquered by the Merina Kingdom and illustrates the ambiguity of Madagascar's water heritage. As a

point of heritage convergence, it is the country's most cosmopolitan city. Thus, within the city of Mahajanga, the inhabitants have opposing relationships with its water heritage although the latter was at the heart of the city's prosperity. During the Merina conquest of 1824, sacred places of the Sakalava were moved outside the city. New worship places are now coming back to the urban landscape. One of those places, called a *doany*, was recently erected on the Village Touristique beach in Mahajanga (fig. 5). However, the *doany* is still associated with superstition, and there is no common acceptance of this water heritage among the population of Mahajanga. This *doany* can be interpreted as a territorial mark struggling for legitimacy and representative of the tension related to heritage in the urban landscape. Water in general is still feared by some Malagasy islanders and is not yet accepted as part of a shared urban identity.

Conclusion

The formation of Malagasy society was a delicate process marked by considerable regional inequalities and a sharp cultural divide. National identity was built on an opposition between the coasts and the central highlands. Rice is to the Merina people what water is to the coastal communities. This division between land-based and water-based activities persists. However, the comprehension of a shared inheritance of water heritage could help transcend the divide and reduce inequality between regions. After all, rice needs water to grow. In the eighteenth century, the Antalaotra served as the first connection between the highlands and the west coast, fostering economic and cultural exchange. However, the process of establishing a heritage based on this shared history has been fraught with cultural and political complexities that could not withstand colonial disruptions. Although this coastal heritage was instrumental in building the nation in the eighteenth and nineteenth centuries, water has not assumed its rightful place as national heritage and is instead relegated to the local level.

Policy Recommendations

- Acknowledging the lost community of Madagascar's national heritage could help reduce inequalities and cultural disparities between coastal and highland regions. Exploring the lost inheritance of local communities facilitates the building of bridges between regions and can encourage national unity.

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The *Ghats* in Dhaka's Monsoon-Fed Landscape

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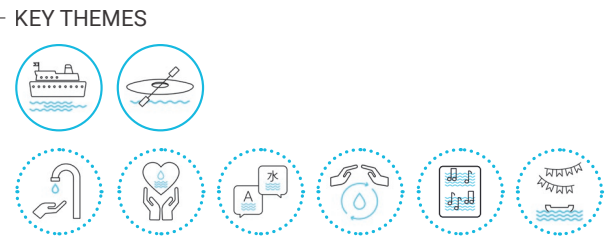
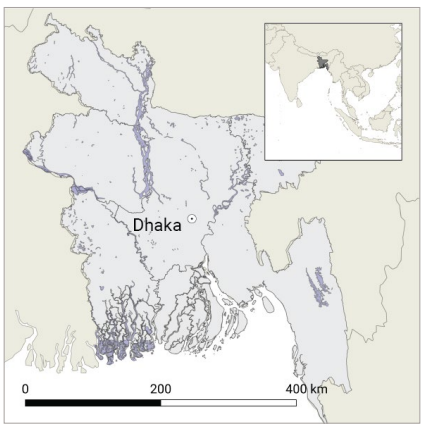
Addressing Dhaka's severe lack of public space in a deltaic landscape, this article considers fluctuating pocket spaces overlooked in planning and policy. It focuses on ghats, liminal zones between land and water, and a common Asian cultural landscape element. It explores their role as vital yet undefined and informal hubs of community life. The article documents social practices in these small, flexible areas carved out within a larger context. Examining specific pockets along the Turag-Buriganga and Balu Rivers, and the Banani-Gulshan-Hatirjheel Lake area in Bangladesh, it reveals how local communities adapt to changing water levels and urban dynamics. Each of these areas represents different degrees of urbanization, showcasing unique responses to environmental challenges. Emphasizing festivals like mela taking place in the ghats and hydrological movements, the inquiry considers the cultural significance of the ghat water landscape. The article takes the innovative strategy of providing an atlas created for this project that presents a place's intricate story in a synoptic composition.

Keywords: *Dhaka, ghat, atlas, liminal space, public space, festival*





< Fig. 1 The traditional way of living with water in the "in-between," which flows and floods, is practiced by fishermen during the monsoon season on the eastern fringe of Dhaka, between the Balu River and Meradia Canal (Source: Salma Begum, 2021).

Introduction

In the Balu and Turag-Buriganga River deltas and the Banani-Gulshan-Hatirjheel Lake area – three north-south oriented water bodies that structure the city of Dhaka, Bangladesh – hyper-speculative urban development has consumed nearly all available land, leaving undeveloped only narrow flood-prone strips along river channels. These strips of shifting ground are liminal spaces, neglected due to fluctuating water levels and location, and dismissed by planners as non-places. Yet, they constitute the only remaining refuge for ecological diversity and a variety of social practices. Unchecked growth in the metropole has occurred without adequate creation of public spaces or preservation of ecological structures. Nested in patches of vegetation, thresholds between water and land such as *maidans* emerge, in which many lively, spontaneous social practices take place. These in-between spaces are an Asian cultural landscape element known as *ghat*.

Ghats bridge the gap between water and land. They come in many forms, sizes and materials. Culturally, they embody important values such as plurality, and in the delta they are associated with distinct cultural practices, religious symbolism and rituals. They also fulfill climate-specific needs (Begum 2023), such as providing access to houses via bamboo bridges, locally known as *baser sako*, which adapt to changing water levels.

This article departs from conventional notions of public space by highlighting the emerging "in-between" space of land and water through everyday social practices. It explores public space in a monsoon-fed landscape in the context of broader hydrological changes and human occupation. It takes the innovative strategy of providing an atlas created for this project that presents a place's intricate story in a synoptic composition, integrating various scales, text blocks, drawings and graphical techniques. The drawings in Figures 1 to 5 are part of the atlas. The resulting maps reveal pocket spaces and urban voids at three water systems in Dhaka, which interact with the monsoon and redefine these areas as integral to the urban fabric. Taking a multi-disciplinary approach to depicting the city's spatial and cultural dynamics, the article builds on the concept of "operative mapping" to observe seasonal changes and how people engage with these spaces, highlighting the diversity of *ghats*, their morphological changes due to fluctuating water levels, and the daily life adaptations informed by local ecological knowledge (LEK). The material presented is based on GIS data, archival and secondary material research, and fieldwork involving on-the-ground investigation focusing on interaction between Dhaka's rivers, other waterways, and the urban environment.

Water Culture and Public Space in Dhaka: Exploring the Varied Sociocultural Contexts of a River and a Lake

In environmental science, the movement of people, culture, ideas and communication is often described in terms of social connectivity, which can be understood through longitudinal, lateral and vertical frameworks (Kondolf and Pinto 2017). The Buriganag-Turag and Balu Rivers are crucial for longitudinal connectivity, serving as major transport routes for Dhaka and linking nearby small villages. These rivers feature numerous *ghats* that serve as landing stations, including the central water terminal of Sadarghat, the busiest passenger port developed during the colonial era, on the south bank of the Buriganga River. While Sadarghat has long been a key port of entry and activity, the smaller, in-

formal *ghats* along the Balu River maintain a traditional layout and are laterally connected with social events, everyday activities and seasonal fairs. People can regularly be seen washing and drying clothes, fishing, swimming and boating. There is a boat fair, where boats are dragged along the muddy slope of these informal *ghats*. During the monsoon season, bamboo bridges are extended in certain areas, illustrating the crucial role of *ghats* in vertical connectivity (Kondolf and Pinto 2017). These *ghats* provide informal access routes, forming culturally significant liminal spaces that are integral to Dhaka's urban reality. Informal *ghats* blur the boundaries between the landscape and Dhaka's dynamic sociocultural fabric.

In Varanasi, India, *ghats* function as a stepped interface between water and land, offering spaces for religious gatherings and the performance of ritual. In contrast, Dhaka's *ghats* are situated within dense urban environments. For example, the Banani T&T (Telegraph and Telephone) Ghat along Banani Lake offers a venue for social rituals and, due to the narrowness of the lake, fosters a sense of intimacy, creating a vibrant public space.

Ghats are associated with purification in both Muslim and Hindu religions. Muslims use *ghats* for ablution before each prayer. In the case of Hindu worshippers, bathing is the most common ritual and is still practiced throughout the country as part of *puja* (veneration) or a *mela* (festival), such as Ras Mela at Dublar Char, an offshore fishing island (Zakaria 2013), where thousands of devotees arrive in boats of all sizes for a two-day festival that includes Jatra play and devotional songs. Another significant festival site is Langalbandh, which takes place in Chaitra (a month in the Bengali calendar) every year in a 2 km stretch along the bank of the old Brahmaputra River, southeast of Dhaka (Siddiquix Haque and Haque 2006). These festivals combine a holy bath and a three-day long *mela*. Due to the massive crowds and the significance of the holy places, many bathing *ghats* have been built. In addition to Hindu rituals, the Bishwa Ijtema, the second biggest Islamic congregation after the Hajj, attracts millions of Muslims annually from over 60 countries (Hossain 2017) to the Turag-Buriganag River. So, considering the boat races (Anisuzzaman, Khan, and Islam 2013; Hossain 2017), small-scale *melas* at Banani T&T Ghat, the seasonal boat fair at Balu River, annual religious celebrations of Eid and Durga Puja Mela in Jheel Park, Beraid Ghat at Balu River, the deity immersion in the Buriganag River and the weekly *haat* (open-air market), the *ghat* might be the most dynamic public place in deltaic Dhaka.

Framing Public Space in a Monsoon Terrain

Dhaka's hydrological landscape is a palimpsest, with rivers integral to the city's identity, "woven from water" (Cullen 2022). The city is cradled within the intricate delta of the Ganges-Brahmaputra-Meghna (GBM) basin, surrounded by river networks like the Turag, Buriganga, Balu, Shitalakshya and Dhaleshwary — tributaries and distributaries of the GBM system — interspersed with ponds, canals, lakes, ditches, natural depressions and irrigated canals forming an enmeshed net. Continual shifts in river courses create new imprints amid existing configurations, where rhythms and patterns emerge (Latour 2005). Monsoon rhythms, dry periods and festivals impose a cyclical pattern on Dhaka's urban and rural life, co-producing its spaces and rhythms (Cullen 2022). Consequently, the occupation of space, with its "economic activities changing throughout wetting and drying" (Jackson et al. 2022), influences social events, festivals, food and mood. The monsoon season,

^ Fig. 2 This collage depicts various activities within liminal spaces along different rivers in rural Dhaka, including dwelling in an alternative boathouse, fishing, gathering under a Banyan tree to enjoy folk songs and kite flying. Women are engaged in agricultural tasks like planting paddy and winnowing rice, while a bustling *haat-bazaar* scene adds vibrancy to the setting. Traditional architectural elements like bamboo platforms coexist with modern concrete steps serving as *ghats*. The scene culminates in festive celebrations like the Baisakh Fair and traditional Panta Ilish preparation, which take place alongside boat races, encapsulating the essence of culture in a monsoon-fed landscape (Source: Salma Begum, 2022).

with unfurling "Kal Baishakhi jhor" (Kal Baisakhi storms), which Barad (2007), as cited by Bremner (2022), calls the "iterative process of space-time mattering" (Bremner 2022), transforms Dhaka into an interconnected water body, flooding streets and affecting daily life and ecology. This seasonal inundation is often perceived as a hazard but it is crucial for aquifer replenishment and biodiversity, making the monsoon Dhaka's water agency, with the city resembling an island (Ashraf 2012) bordered by monsoon-fed water routes.

Ghats, adaptable to changing monsoon conditions, play a crucial role in Dhaka's urban landscape by providing informal access routes and promoting vertical connectivity (Kondolf and Pinto 2017). These culturally significant emerging liminal spaces form a substantial part of Dhaka's urban reality, blurring the boundaries between the natural landscape and the city's sociocultural fabric. Unlike the larger, stepped *ghats* in Varanasi, Dhaka's *ghats* offer vibrant, communal spaces within narrow streams, blending the city's dynamic water environment with its cultural life.

These ambiguous spaces in Dhaka are "liminal spaces" (Howitt 2001), at the edge of ecosystems, where interaction and transformation

thrive. Constantly shifting between land and water, they blend varying wetness levels with local practices, festivals and seasonal adaptations. This creates a contextual matrix that challenges traditional notions of public space in a "rain terrain" (Mathur and Cunha 2014; fig. 2) with *ghats* as a key example.

Challenges

Rivers are part of Dhaka's economy and ecology. They are the dynamic spine structuring the city, yet they are experiencing severe challenges posed by human intervention. Common ongoing threats since the 1960s include illegal settlements on stilts, the filling of wetlands and land grabbing due to high land prices. Consequently, the city suffers from social-environmental challenges such as flooding, waterlogging (Hossain 2017) and a lack of public open space.

Buriganga-Turag, a distributary of the Ganges that served as a lifeline for centuries, is now facing challenges from air pollution, water pollution and, since the 1980s, the illegal intrusion of land grabbers (Hossain 2017). The phenomenal growth of brick fields along the southwestern fringe of Turag-Buriganga, as well as other building material factories, produces air and water pollution (Hossain 2017). Herrero and Montero (2018) creatively frame the problem by questioning, "Is garbage the new mining?"

While Turag-Buriganga is the new hotspot of "garbage mining," the Hatirjheel-Banani-Gulshan integrated lake system is the new ecological and social axis that flows through Dhaka's densely urbanized and consolidated neighborhoods, imprinting wrinkles of sociocultural significance. This wetland, at present the most significant water retention and detention basin, historically was part of Begun Bari Khal, con-

nected to the Buriganga through the Dhanmondi Lake, Katasur Canal, and Turag River to the west of the city and the Balu on the east – meaning this was the most extensive urban void connecting the city's two significant peripheral rivers (Habib 2006). During the Mughal era, the lost Pandu River blessed the same transect, making this area the second central business district with the Karwan Bazaar and European houses with gardens. Thus, the public space along this central corridor became prominent for the first time, with the emergence of the Karwan Bazaar reflecting the *ghats*' presence. However, in the 1970s this ecological balance began to erode with the disappearance of the canal and the advent of urbanization (Habib 2006). Before the reconstruction of the Hatirjheel Canal in 2013, the Begunbari Canal was almost completely filled in by 2006 and grabbed by informal settlers. This illegal encroachment significantly altered the area's fabric, as informal settlements increasingly took over the once ecologically rich and agriculturally productive land (Ahmed 2017). The most striking example is the Karail Baste area of Banani, between Dhaka's most expensive residential neighborhood and a sprawling informal settlement that houses around 200,000 people. *Ghats* along the Banani Lake in the Karail area feature a dynamic mix of social and economic actors, contributing to the lake's vibrancy and plurality.

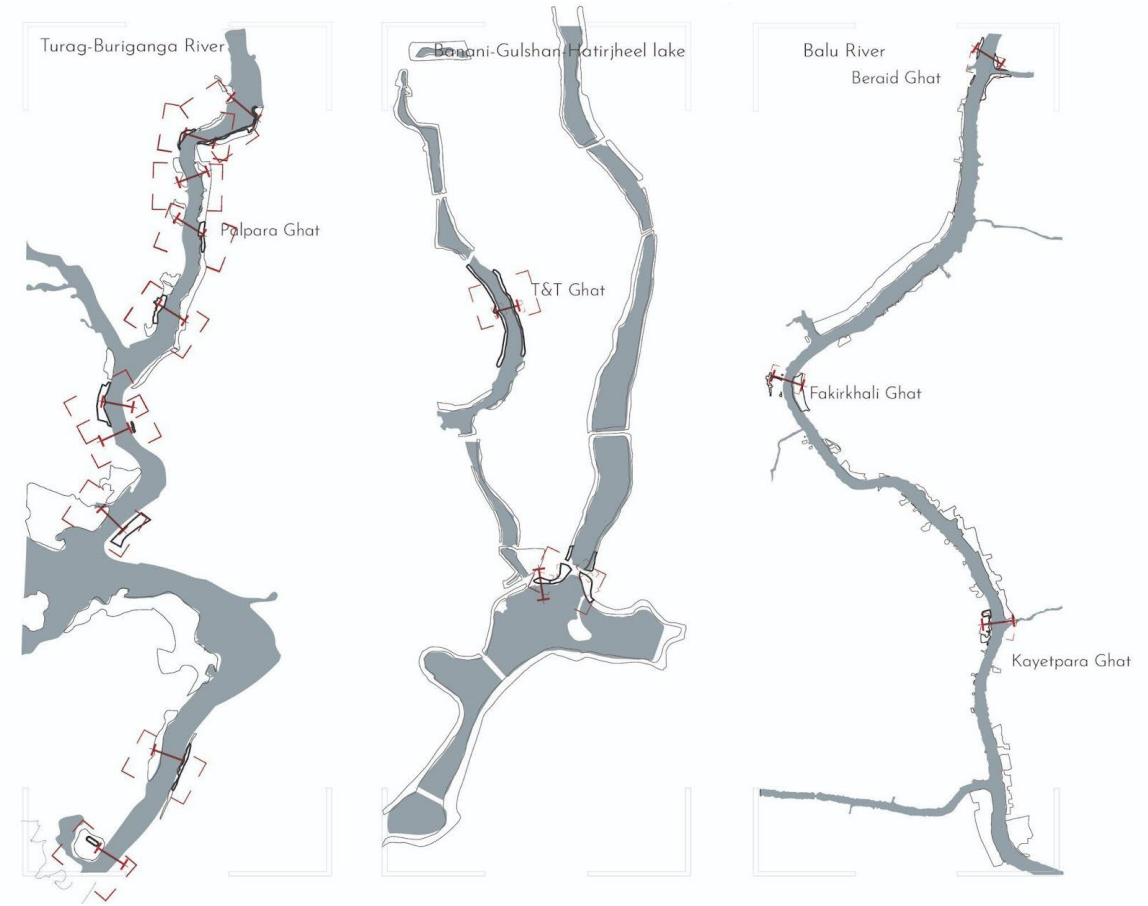
The socio-economic context of people living adjacent to the areas along the confluence of Hatirjheel and Gulshan Lake is similar to that of Banani Lake. We see more vibrant urban nightlife, with the presence of men, women and children. From the afternoon on, the Jheelpark hosts people of diverse occupations and is appropriated by food vendors and hawkers. Every evening until 10:00 pm, this space becomes a place of *mela*, highlighting the presence of female hawkers quite different from the *mela* nature in the Balu River. Unlike the urban void within the city, the Balu River on the eastern fringe mirrors the traditional setting of a water-based civilization, with agricultural rituals, distinctive local beliefs and practices, and traditional ecological knowledge (TEK). Balu River, historically a cradle of the local *haat* system (a weekly open-air market), as evident from James Rennell's Bengal map from 1778 (Rahman, Zaman and Hafiz 2016) where it is marked as Nawarah Haat, continues to be the heart of the site in the transect along with the Beraid Ghat across from it. However, this landscape has undergone considerable transformation since the eighteenth century. A key inflection point was in 2018, when the Nawara area was filled in with sand, leading to the disappearance of natural wetlands and the emergence of new *ghats*. This trend proliferated southward, evidenced by the increased settlements around Fakirkhali Bazaar and the development of a substantial shipyard at Nolchota. Despite these alterations, certain areas like the Kayetpara transect have managed to retain their natural settings such as muddy slopes shaped solely by water fluctuations. Highlights of the cultural landscape include weekly *haat bazaars*, seasonal fairs and a *Nauka Mela* (boat fair) during the monsoon season. Along with the "boathouse" – a house on stilts which floats on the water during the monsoon season – the *ghat* ties the knot between water and human activities.

However, while the emerging practices are still compatible with hydrological living, in terms of planning and policies there are so far only general suggestions. The current Dhaka Structure Plan, 2016–2035 (RAJUK 2021), for example, mentions the need to preserve open space and create a green network to promote ecological balance and biodiversity. However, there is no such discourse on defining public space through a local lens nor the terminology crucial to cop-

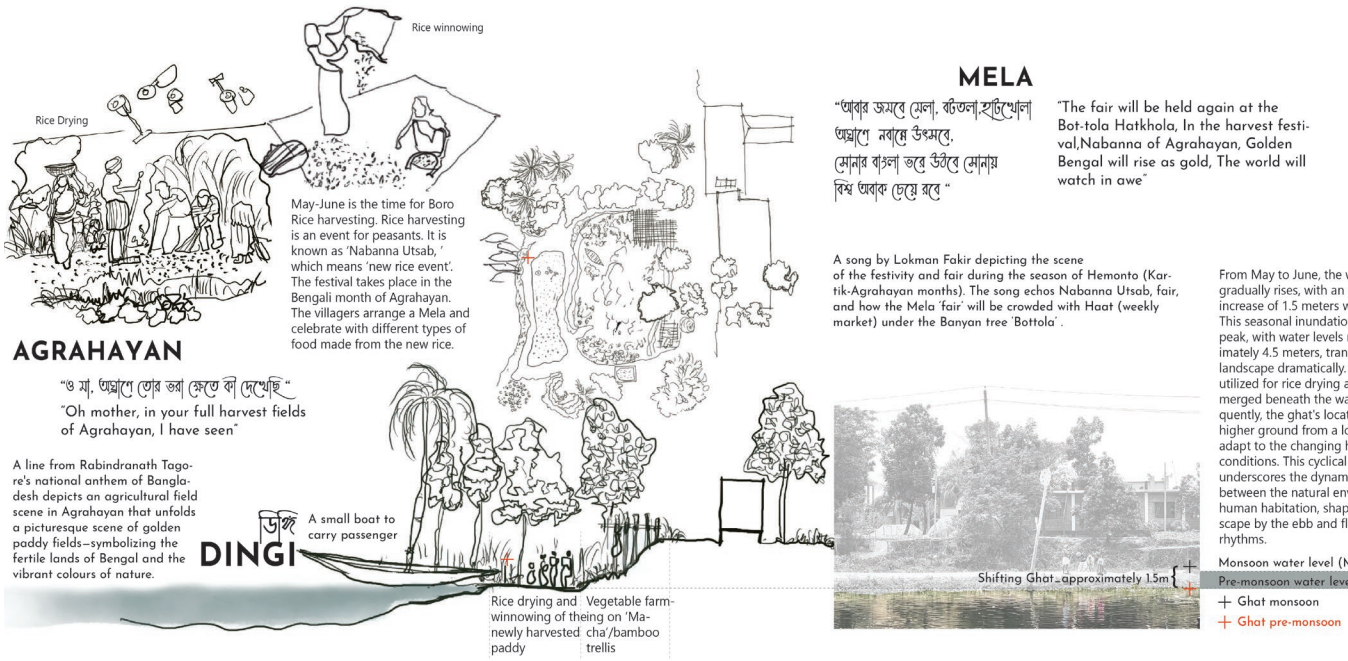
ing with the public space and climate crises. Although *ghats* have provided a hinge between land and water, and for centuries have served as public space, that has not been recognized in Dhaka's discourse on urbanism. The colonial imprint could be one reason that public spaces, such as promenades, racecourses, and parks, have often been viewed through a colonial lens, focused on controlling water or domesticating nature rather than playing along. However, this research and paper suggest an alternative perspective; instead of a top-down approach to imposing plans in the name of development, a bottom-up approach involves observing the occupation or appropriation of space by inhabitants based on seasons, timing and daily needs, which could offer a contextual solution. Instead of looking at the city from a colonial perspective, the local lens might be an alternative way to deal with the public space crisis, where *ghats* might be the language of a monsoon-shaped country.

Ghats and Plurality in Making Public Space

Ghat spaces tucked within various creeks along the river emerge seasonally as pocket spaces (fig. 3). They change shape, size and height, and therefore are articulated in varying ways with their surroundings. Diverse rhythms and everyday practices (Begum 2021) in these pocket spaces allow for unique moments when plural-



^ Fig. 3 Pockets along the Turag-Buriganga River, the Banani-Gulshan-Hatirjheel Lake area, and the Balu River in Dhaka, Bangladesh (Source: Salma Begum, 2024).



^ Fig. 4 Seasonal variation articulates pocket spaces during pre- and post-monsoon periods and undergoes gradual scale transitions through water expansion and recession along the Balu River. The seasonal activities of rice harvesting and husking occupy a space within this varying threshold, which becomes flooded with water during the monsoon season (Source: Salma Begum, 2021).

ism is enacted. *Ghats* invite, mediate and facilitate interactions and encounters between diverse communities in various temporalities and at various scales. Consider zooms from three transects (fig. 4) of different settings: the fully developed peri-urban Buriganga River area to the west, the centrally consolidated urban lakeside at Banani, and an eastern peri-urban area with emerging development along the Balu River. These three locations reveal variations in level of development, water-land relations, and the many practices that unfold in the *ghats*. The three transects also experience different seasonal variations in local climate.

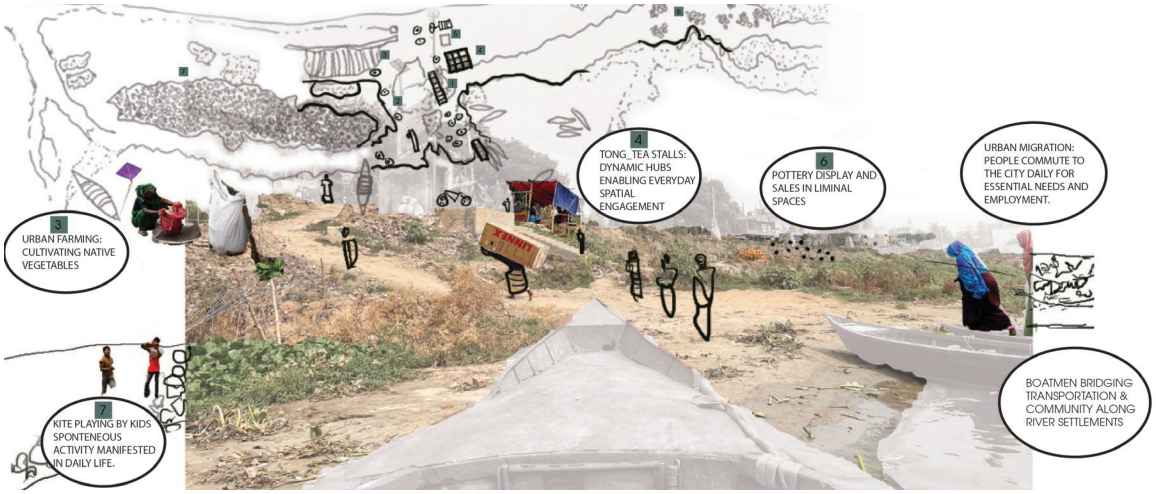
Reading Urban Edge along the Turag-Buriganga

A stairway leads to a *tong*, a cozy tea stall hosting four to five people, while a small hut known as *khupri* is a resting area nearby. Opposite the tea stall, there is a vegetable garden, enclosed by bamboo fencing, where indigenous crops like red spinach are grown. A pottery display area nestled amid earth and lush vegetation lies toward the southern extension. Local children often use the *ghat* to fly kites (fig. 5). The *ghat* adapts to the changing environment as water levels fluctuate from 0.5 m to 3 m during the monsoon season. During periods of high water, new bamboo structures, such as platforms or bridges, often emerge. These structures facilitate transporting passengers between boats and land. At Palpara Ghat, the stairway becomes the new *ghat* when the lower riparian area is submerged. The *ghats* change their location and height as the water spreads and rises.

The Dense Urban Condition at Banani T&T (Telegraph and Telephone) Ghat

The second transect traverses a densely urbanized and consolidated area adjacent to an integrated lake, Banani-Gulshan-Hatirjheel. The T&T Ghat, affectionately known as *Matir Rasta* or Road of Soil, serves as a gateway to the Karail settlement, originally a village (Shafique 2021). Situated between the Bangladesh Water Development Board forest and Banani Lake, this liminal space hums with cultural festivities, particularly *melas* (fig. 6), which catalyze community interaction and celebration. These diverse folk fairs, varying in scale and character, are intricately connected with the movement of water. While daylong and weeklong folk fairs like Pohela Baisakh and Nabanna Utsab offer diverse experiences, daily *melas* along the water's edge last a few hours. From late afternoon to nightfall, the *melas* feature street vendors, whose wares include toys sold in colorful stalls and local foods like *peyaju* (fried lentil ball), *singara* (fried vegetables or a triangular meat wrap), and *am vorta* (smashed green mango with spices). Spaces transform instantly from empty pockets to bustling clusters of activity or "spectacles in a kinetic city" (Mehrotra 2021). T&T Ghat, a space "in-between," a system of thresholds (Borio 2023), is a crossroad of possibilities for making and remaking. T&T Ghat's ephemeral nature lends itself to new meanings. It could be considered a "third space" (Crawford 2008) – based on Soja (1996), following Lefebvre (1991) – shaping perceptions and interactions within the urban landscape.

At the crossroads of ecology and culture, the *ghat* represents the ability of humans to coexist with water, which is necessary, according to Greenway (2022), to co-produce riverine communities and river environments in a sustainable way. Taking an eco-social approach to "river culture" (Wantzen et al. 2016) involves understanding the value of cultural activities and adaptive nature in a way that is helpful for developing policies of



^ Fig. 5 Palpara Ghat, along the Buriganga-Turag River, evolved organically as a result of spontaneous adaptations made by inhabitants. The *ghat* accommodates urban farming on the left, a *tong* (tea stall) at a higher elevation to the right and a pottery sales area along the Turag—Buriganga River (Source: Salma Begum, 2021).

river management that ensure healthy cohabitation of humans and water. *Ghats*, with so much to offer as public space, reflect a sociocultural identity shaped by river-human dynamics, blurring boundaries between natural and artificial.

The *ghat* area is a vital nexus for the Karail neighborhood, epitomizing a unique spatial character and facilitating daily interactions and exchanges between residents in high-rise Gulshan and those in low-rise, vernacular Karail neighborhoods. Its cultural significance and *mela* activities create a dynamic environment of pocket urbanism, enhancing the urban landscape and shaping the identity of its inhabitants (Hall 2006). T&T Ghat, a public space and a place of encounter between high-income and low-income communities, with its fairs and festivals, embodies informality and temporality in the urban milieu.

Unveiling Voids in a Riparian Landscape along the Balu River

The Balu River, east of Dhaka, defines an ecologically very significant transect that reveals a landscape deeply intertwined with water dynamics. During the monsoon season, the 1.3–2 m floodplain becomes submerged, prompting sociocultural adaptation. With the interplay of becoming wet, then dry, and vice versa, gradients of wetness and vegetation create an interface where practices such as fishing, rice drying and winnowing, boat making and repair can thrive. The riparian buffer with its alluvial silts, supporting agriculture and orchards, conceals rural settlements (Begum 2021). Between linear forested land and water plains, both formal and informal *ghats* serve as public spaces, adapting to fluctuating water levels and hosting markets. The three primary *bazaars* are spaced at 2 km intervals along the Balu River. Kayetpara Bazaar and *haats* feature permanent and temporary small, colorful bamboo canopy structures (*samiana*), that "blend culture, religion and commerce. These social practices produce public space" (Low 2003).

Moreover, Kayetpara Ghat hosts boat-making workshops, transforming into a Nouka Mela boat fair during wet periods. The importance of boats in this fluid landscape is self-evident.

^ Fig. 6 The *mela* is a unique, temporary, lively social event associated with many Bengali festivals and everyday life that occupies a liminal space (Source: Salma Begum, 2022).

They are means of transport, alternative dwellings (fig. 1) for fishers in the monsoon season and for nomadic Bede people throughout the year, and they facilitate commerce. Other pockets offer variations on these activities, including seasonal rice husking.

The cultural landscape includes boat houses, rice farming and chatting spaces like *macha* (Ashraf 2014). This liminal space of *ghat* that is continually evolving because of water dynamics has aptly been termed "rain terrain" (Mathur and Cunha 2014) or "other ground" (Cunha 2019).

Despite their widespread use, *ghats* do not appear on the official map of the city. However, recognizing *ghats* as public spaces in urban contexts is crucial because of their cultural, social and environmental significance. Living with water in this way has been central to community life for centuries. Bringing diverse groups of people together promotes social cohesion and inclusivity. Their sustainable design and use of local materials like bamboo exemplifies both LEK and TEK. Future urbanism might learn valuable design and policy lessons from *ghats*. TEK is informed by centuries of learning: making *ghats* float on water requires an understanding of water dynamics, and in the case of a single bamboo bridge, precise knowledge of bamboo construction, including load-bearing capacity and the optimal placement for balance and stability. Social dynamics also affect how the *ghat* is accessed and used based on time and season. Construction requires communal involvement and coordination, which makes the community's bond more robust and the knowledge is passed down to generations. Cultural practices like these are also entangled with folk beliefs, which are readily apparent in South Asia, especially in Bengal, popularly known as Khanar Bachan (Khana's proverb/maxim). Khana is a woman figure from mythical stories from the first century BC (Mannan and Barua 2011), whose sayings are based on a deeper understanding of local ecology than held by technocrats. The phrases offer solutions for almost all levels of planning, including house orientation and construction.

Conclusion

By considering liminality and gradient space, it is possible to gain a new understanding of the idiosyncratic character of public space in Dhaka's shifting terrain. *Ghats*, influenced by hydrological and geomorphological processes, play an important role in the co-production of public spaces, as documented here, along with Dhaka's three major water bodies. The notion of "gradient spaces" acknowledges the blending of water, mud, dry ground, local practices, festivals and seasonal adaptations, and challenges conventional notions of ground and public space. These "gradient spaces," functioning as public spaces, are Dhaka's only remaining ecological "land" refuge. Perhaps this provides a foundation to expand future "soft" urbanism in ways that foster sustainable development and social cohesion.

Ghats should be recognized as public spaces in the riverine culture framework and included in the Dhaka Structure Plan to prevent urbanization from swallowing these spaces. Depending on the context, these spaces could be treated as a form of aquatic urbanization to preserve the area's only ecological refuges. Understanding the *ghat*'s cultural and ritual importance will help ensure an urbanism that aligns with local traditions and practices.

Policy Recommendations

- In urban policy and planning, *ghats* should be recognized and included as significant public spaces.
- Considerations of folkloric beliefs, cultural practices, the arcane lexicon of mythical tales, the latent meaning of rituals and the sacredness of everyday practices should play an important role in eco-cultural approaches.
- TEK, such as that involved in constructing raised and adjustable platforms, deserves respect and inclusion in urban policy and planning.

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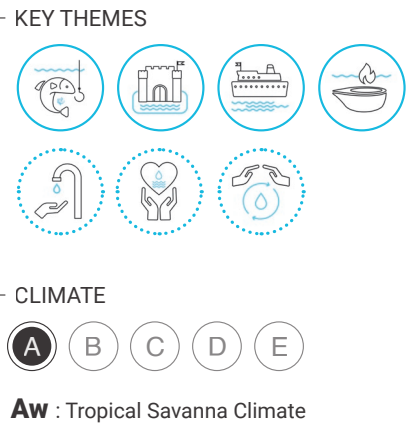
The Floating Urbanism of Cambodia's Tonlé Sap

Bruno De Meulder and Kelly Shannon
KU Leuven

For decades, the floating villages of Tonlé Sap, a lake in Cambodia, have demonstrated ingenuity by necessity and adaptability to the seasonal rhythms of nature. The villages are examples of ephemeral, floating urbanism, a response to discriminatory land tenure practices that is able to adjust to ever-increasing fluctuations in water levels exacerbated by global warming. The villages' Indigenous knowledge systems and practices (IKSP) display a distinct intelligence, in which water-based modes of living and livelihoods are connected with a resourceful understanding and use of locational assets. Conducting intensive fieldwork by boat and living in the floating villages for ten days in August 2023, the authors gained knowledge of local expertise through observation and informal interviews. They documented livelihoods and modes of settlement that suggest a pause in the neo-liberal market-driven globalism sweeping Cambodia. Here they relate their research to existing literature and studies (primarily ethnographic and policy-oriented) of the region's unique monsoon culture of floating villages with a culturally specific identity that combines hierarchy and heterarchy.

Keywords: *Indigenous knowledge systems and practices (IKSP), gallery forests, fishing settlements, wetness, heterarchy*



< Fig.1 Clustered settlement in wetland ecotones, Kandieng (Source: Bruno De Meulder and Kelly Shannon, 2023).

Seasonal Gradients of Wetness

The Tonlé Sap, the largest lake and wetland complex in Southeast Asia, lies in the central Cambodian plains. It is part of the vast Mekong Delta system and is often referred to as the delta's "beating heart." It is a natural floodwater reservoir, which provides protection from flooding in the wet southwest monsoon season (May–October) and ensures dry season flows (November–April) to vast areas downstream. It is renowned for a remarkable phenomenon: during the monsoon season the massively increased flows from the Mekong reverse the direction of the Tonlé Sap River and the lake's coverage expands from 2,300 to 15,000 square km and from a depth of 1.44 to 10.3 m (Kummu 2009, 1415). The distance of the maximum and minimum waterlines is approximately 10 km, although "waterline" is a relative term since the edge of the lake is a subtle gradation of wetness – from wetlands to reed beds to gallery forests to mud to sediment-heavy water – that stretches for many additional kilometers and continually moves back and forth (Evans 2002, 8; fig. 2). In and around the lake, displaced Vietnamese and Khmer fishing communities live in villages called *kompong* ("landing place" in Malay) (fig. 1). They operate as constellations and are interdependent through trade with rice-growing villages situated on slightly higher ground.

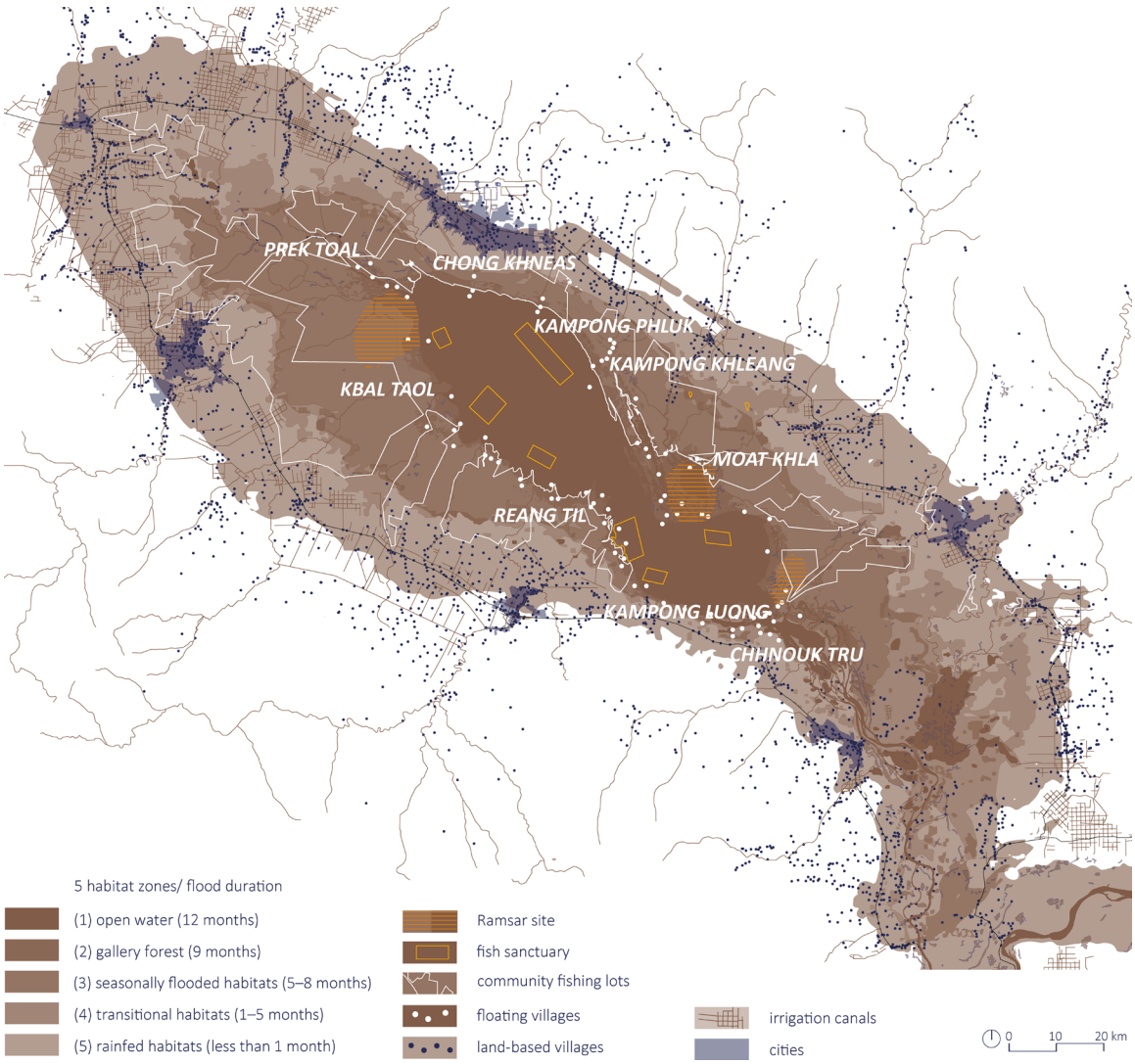
Settlements and productive landscapes on and around the lake were initially developed using Indigenous knowledge systems and practices (IKSP), which persist in numerous floating fishing villages. Throughout the settlements, there are rituals and beliefs known as *neak ta*. *Ktom neak ta* (spirit houses) are considered the physical embodiment or nesting places of negotiation between humans and the wild and between land and water. They are strategically located in relation to water and forests. The spirit houses, always on stilts, are usually accompanied by one or several trees and not only protect the community and fishermen from the dangerous waters of Tonlé Sap, but also serve as navigational beacons (hence their common location where the river mouth meets the lake during the dry season). Today there are also mobile telephone antennas.

The depth of the lake and the ecology of the plains to the east and west of the lake vary significantly due to the geological evolution and sedimentation of the territory (Carbonnel 1972; Molyvann 2003). The Tonlé Sap Lake was long considered a backwater swamp connected to the Mekong River via the Tonlé Sap River. The area southeast of the lake has accumulated massive amounts of sediment over millennia, resulting in the expansive and connective hydrology of the Mekong Delta since the Holocene.

The lake (and the entirety of the delta system) is facing dramatic changes and threats, particularly concerning its ecological health and biodiversity, and these are severely affecting the inhabitants. Water flows are being disrupted by aggressive dam-building upstream and by the construction of irrigation schemes (with large embankments and reservoirs), buildings and roads. Along with the consequences of global warming such as increasing atmospheric and water temperatures, frequency of extreme weather events and variability of rainfall (Nuorteva et al. 2010), changes in the hydrology of the Lower Mekong Basin are wreaking havoc on the annual flood pulse, adversely affecting fish migration and floodplain habitats. Meanwhile, local inhabitants who live in permanently floating villages on the lake and Tonlé Sap tributaries are caught in a dilemma. On the one hand, socioeconomic development has led to livelihood diversification (people have moved away from

relying only on subsistence fishing) and access to social services. On the other hand, entire villages are at risk of disappearing altogether as trapped sediment upstream results in a loss of fertility, which undermines fish and farming livelihoods, and flooded forests are predicted to become permanently inundated (and die).

The sociocultural constructs of the floating villages and the lake's stilt villages are existentially threatened. An entire water-based cultural heritage is in jeopardy. Most worrying is an enormous new "smart" Cambodian-Chinese project of the Danong Agricultural Development Group, which promises to transform many parts of the Tonlé Sap floodplain into a "Fish and Rice Corridor," through an infrastructure investment of $12.7 billion, and to include "agro-industrial management and operations" on 750,000 ha of land in four of the lake's provinces (Battambang, Pursat, Siem Reap and Kampong Thom) (Socheata 2023). In pursuit of specific investor interests,



^ Fig. 2 Tonlé Sap ecologies, water landscape systems, floating villages and nearby land-based settlements (Source: RUA, 2021. Based on Open Development Cambodia and other national databases).

this project of "agro-industrial management and operations" mirrors policies of the French colonial regime (1863–1954). As a result, local heritage values and traditional water management practices will be greatly changed, as they have previously, or they will cease to exist.

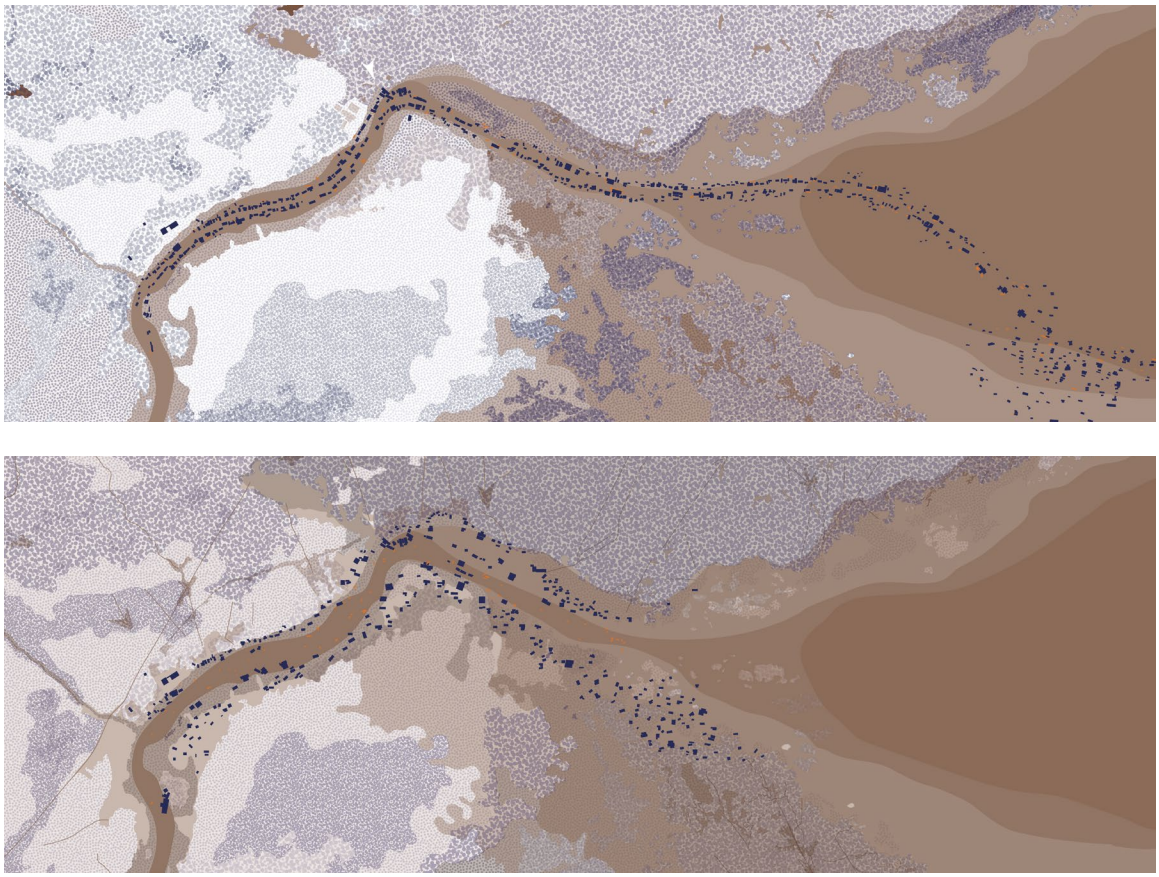
Shifting Morphology and Floating Typologies

It has been speculated that the movement of trade goods across the lake and accompanying ancient ports and settlements has existed since Angkorian times (802–1431 AD) (Pottier et al. 2012). Floating settlements developed as a result of the French colonial system of fishing lots (primarily operated by Vietnamese) and expanded with Chinese-owned commercial fish lots (Gottesman 2004). Although fish lots have subsequently been outlawed, numerous floating villages engaged in subsistence fishing survive. Since their establishment, the floating villages of the Tonlé Sap – ranging from a few to hundreds of families – shift locations in response to changing water levels.

The floating villages have been through numerous iterations of colonial and postcolonial policies and programs, all paralleled by subversive, non-planned forms of self-organization, while residents adeptly exploit the region's environmental idiosyncrasies. The villages are "outside" of government planning systems and the configurations of both their buildings and their fish nets are reflective of local customs. They are often out of reach of authorities and survive "under the radar." The IKSP has developed in this context.

As Tijen Roshko (2011) explains and as we observed during our fieldwork, entire villages typically move three to six times annually, either into the lake or retreating to river mouths. In the dry season, the villages are loosely dispersed in the lake, with fishing occurring in and along the shores of the lake and streams as well as along the edge of protected natural areas. In the wet season, the villages retreat further and further into local tributaries to avoid the danger posed by storms and waves on the open water. The villages have a compact morphology and fishing takes place in all areas where the water is high enough, including in the flooded habitats of grasslands, shrublands and gallery forests.

The villages that are collectively known as *Prek Toal*, at the mouth of the Sangkae River in the northwesternmost area of the lake, exemplify these seasonal movements. The area is simultaneously part of one of three core protected areas (the other two being Boeung Tonlé Chhmar and Strung Sen) of the one declared in 2001, UNESCO Tonlé Sap Biosphere Reserve and one of the lake's most intensive fishing areas (Sithirith 2011). During the dry season, *Prek Toal* extends linearly into the lake and culminates with an egg-shaped concentration favoring the southwestern shore. The string of settlement begins in the west, in the river close to a *wat* (Khmer temple) and school – both on tall stilts and nestled into the gallery forest. Rhythmically spaced houses, aligned with the direction of the river's flow, are punctuated by larger clusters with commercial functions. There is a concentration of larger houses in the river's bend and mouth. A church, pulled out deep into the lake with the village, marks the point where the linear arrangement, which defines a water highway, dissolves into a dispersed pattern. During the wet season, the floating houses retreat into vegetally protected wetlands and into the river. The string of houses and commercial structures is more condensed and almost all the houses anchor along the riverside, following the tree line. Commerce remains in the more open water of the river to take advantage of passing traffic. At



^ Fig. 3 Seasonal migration. *Kbal Taol* villages in the dry season (above, March 2017) and wet season (below, January 2014) (Source: RUA, 2021, based on Google Earth Pro imagery).

the river mouth, clearings in the gallery forest accommodate clusters of houses (fig. 3).

Other villages, such as the one in Kampong Khneas (in the mid-section of the western shore), migrate less dramatically within a river mouth at the edge of a flooded forest. In the wet season, houses cluster around trees, to which they are fastened with a rope. Some households have an additional platform adjacent to the house that they use for work and today many houses are equipped with solar panels. Commerce and services, recognizable by the size of the platform, align one trajectory of the main water route (fig. 4).

Hierarchy and Heterarchy

The morphology of the floating villages is both hierarchical and heterarchical. It is based on customs and beliefs but also adjusts to the seasons and water flows. Village alignment follows social rules, with different ethnic groups (Khmer, Vietnamese, Chinese and Cham) tending to cluster near their respective wats, churches, temples and mosques. In Khmer settlements, the material wealth of a house has been considered secondary to "the location of a residence and its proximity to sacred sites (which) acted as more significant indicators of power and status" (Edwards 2007, 43). Houses are grouped together, with

extended families tethering their floating houses to one another. Near these family clusters, you can often find small-scale fish or crocodile farms, floating animal pens and work surfaces as well as bamboo or vegetal fenced enclosures. The family's fleet of fishing boats and canoes is also typically located nearby. The floating houses are built on wooden platforms and kept buoyant with steel barrels, large ceramic vessels and bundles of plastic bottles. They usually have an open veranda at the front and cooking and toilet/shower facilities at the back. There are also inhabited boat typologies, with a variety of sizes all of which combine living spaces with that of net and fish storage. The quality of building materials and craftsmanship varies from house to house, but they are primarily post-and-beam constructions made of wood, bamboo and other lightweight materials that allow easy mobility. The houses range in size from 3 to 8 meters wide and 6 to 20 meters long (Sithirith 2007, 8).

The largest floating settlement in the lake, Kampong Luong, reveals a wet season ordering system. A double row of larger houses with commercial areas (shops, tailors, mechanics and barbers) align to form a busy water highway that starts in the estuary and extends into the lake. In this line of housing, there is no ethnic differentiation. Behind this area, there is an ethnically grouped heterarchical assembly of house clusters that fit within a creek and lake following minimal rules of neighborliness, such as keeping a respectful distance and leaving passage. On opposite edges of the lake, two towers mark the river for navigation purposes and connect the village to the outside world: each tower is a *neak ta*, a treehouse for the spirit world, and a mobile phone antenna for twenty-first century communication (fig. 5).

Along the northeastern shore of the lake and along the Strung Sen River, there is another settlement pattern characterized by clusters of floating houses that form Indigenous "water squares." There are two rows of buildings along each shore. The first is nestled in low-lying scrub and trees along the shore, the area with

^ Fig. 4 Settling in the river mouth and among trees, Kampong Khneas (Source: Bruno De Meulder and Kelly Shannon, 2023).

^ Fig. 5 Settling in the river mouth and among trees, Kampong Khneas (Source: Bruno De Meulder and Kelly Shannon, 2023).

^ Fig. 6 A system of water squares, Kamong Svay (Source: Bruno De Meulder and Kelly Shannon, 2023).

the most abundant vegetation. Between the houses and the scrub, you can find large stocks of big ceramic vessels that are used as floats for the houses. A smattering of clearings host vegetable gardens. The second row of houses, often accompanied by small functional buildings such as workspaces, fish cages and occasional floating gardens, is positioned closer to the center of the river. This configuration results in a rhythm of water squares, which are often defined by extended family clusters. There is a hierarchy among these squares, with the largest marked by tall stilt buildings such as the wat and school and the largest houses of the village (fig. 6).

Valuing Indigenous Knowledge Systems and Practices (IKSP)

In the past decade, the Cambodian government has increased regulations for the use of common pool resources, primarily in response to overfishing and to protect biodiversity. One downside of these policies has been extreme inequality in access rights and other privileges that have been enforced by extractivist (neo-) liberal policies since the late nineteenth century. These inequalities are expanding in scope and scale as a result of planned Chinese investments. It is uncertain whether the floating villages, which form a marginal world between the formal and informal, legal and illegal, and on and off the map, can withstand another round of regulatory impositions and survive with their resilient self-organization in the lake's margins. The growing recognition, lived realities and the reinvigoration of IKSP in many parts of the globe highlight the urgent need for alternative approaches to human settlement and engagement with the world. In particular, there is a need for approaches that are attuned to context-specific assets and limitations. IKSP offers a *leitbild* with the double meaning of this German notion: a guiding image (as in a policy strategy or governance model) as well as a mission statement (the vision that defines actions, plans and programs) (De Meulder and Shannon 2022).

Policy Recommendations

- IKSP, as living heritage that is not nostalgic, reveals possibilities of settling with nature. New development such as irrigation schemes, transportation infrastructure and settlement/productive systems in the monsoon regime of Cambodia can benefit from a nuanced understanding of IKSP, which offers guidelines for where (and where *not*) to develop based on the wisdom of age-old systems of environmental stewardship that continuously adapt to changing conditions. IKSP offers an inspirational opening to renewed forms of environmental ethics and responsibility for healing massive disturbances of human and non-human habitats. A deep understanding of the floating village's culture of hierarchy and heterarchy could aid Cambodia's government in its pursuit of sustainable development in light of SDGs 11,13,14 and 15.

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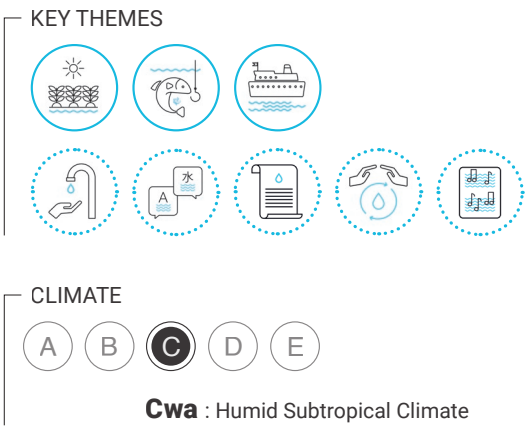
Settling-on-the-Move: Birsing Char-scapes in the Brahmaputra Valley

Swagata Das, Kelly Shannon and Bruno De Meulder
KU Leuven

Chars are shifting riverine islands. This article focuses on Birsing Char, part of Birsing Jarua Village Panchayat, in the Brahmaputra River near the Indo-Bangladesh border. Generations of families have migrated across this porous border, settling in the Lower Brahmaputra Valley. This migration has intensified the sociocultural othering of Bengali Muslims amid Assam's identity politics and India's rising authoritarianism. Through fieldwork and interpretative mapping, the article uncovers forms of alternative knowledge, including local spatial practices and intangible heritage like songs and poetry, threatened by infrastructural development, policies of the Indian government and climate change. It explores how such knowledge can be harnessed and inspire alternative development policy and design in the context of global warming in the Brahmaputra Valley and in Assam's sociopolitical climate. The case underscores the urgency of recognizing marginalized chars as vital to the region's water legacy, as they contribute both to local livelihoods and broader ecological systems.

Keywords: *fluid landscapes, porous borders, cultural resilience, worldviews, climate change*



< Fig. 1 The cropping system is naturally adapted to water levels in the monsoon season (Source: Swagata Das, 2021).

Braided Brahmaputra, Shifting *Chars* and Porous Borders

As the Brahmaputra River enters Assam State in India, the sudden flattening of slope and confluence of tributaries give rise to an oscillating braided pattern, creating alluvium deposits in the form of river islands, locally known as *chars*. They are extremely transient, a "uniquely fluid environment where the demarcation between land and water cannot be well defined or made permanent" (Lahiri-Dutt and Samanta 2013, 1). While *chars* can appear legally ambiguous, they are crucial for many people: the last state survey conducted in 2002–2003 estimated 2,490,097 inhabitants in 2251 *char* villages of Assam (Directorate of Char Areas Development 2004). The actual number could be much higher as *charuas* (*char* dwellers) move in and out of *chars* before and after the survey is conducted, leading many to be excluded from official records.

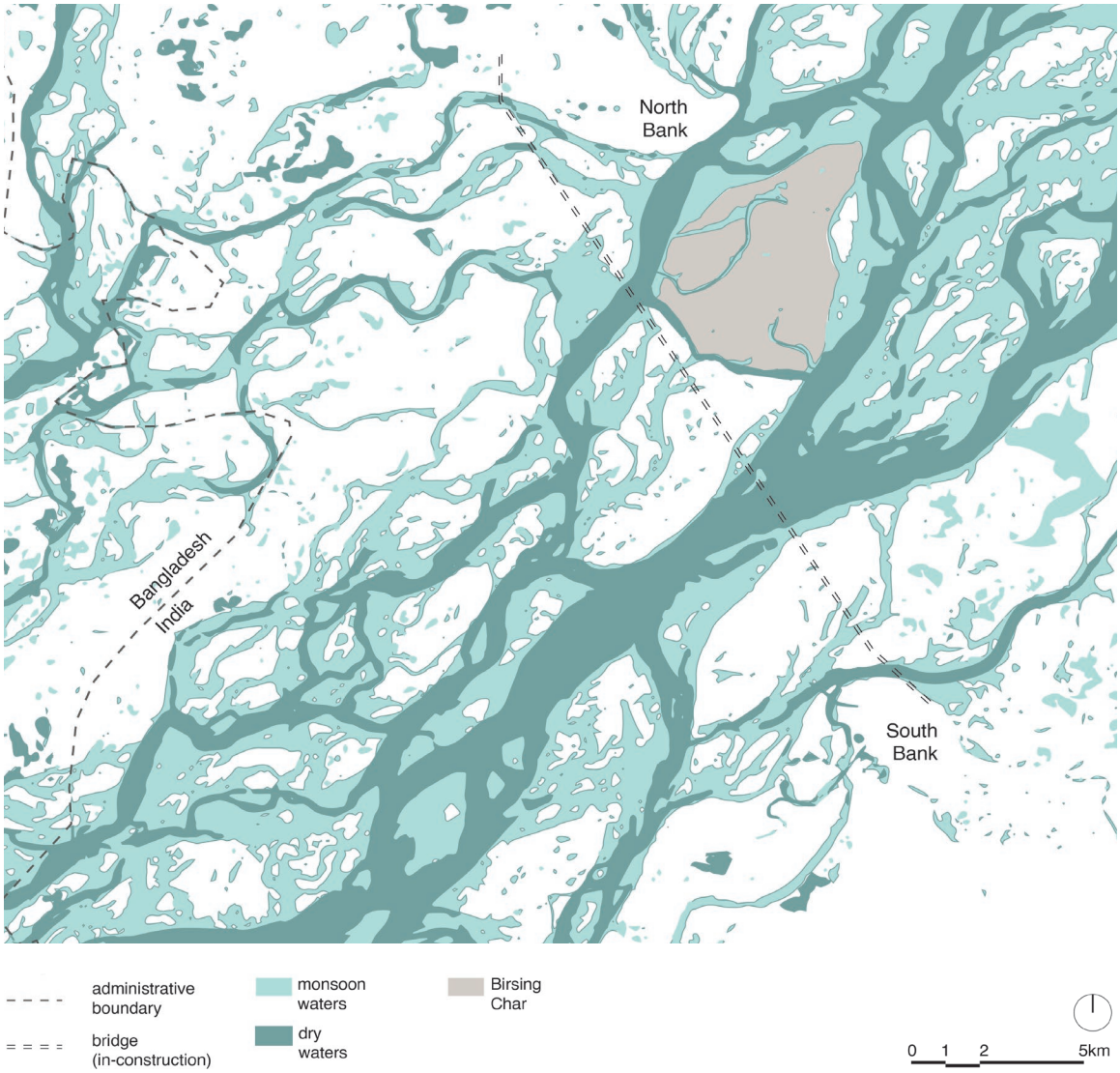
Many people's everyday lives do not adhere to categories of land and water, as they choose to "inhabit an undivided wetness" (Cunha 2018, 292). In the downstream area of Assam, generations of migrants navigate the fluid Indo-Bangladesh border (fig. 2). The shifting nature of these fluid territories renders administrative borders obsolete, creating a gray zone of statehood and non-statehood, along with a corresponding array of freedoms, restrictions and constraints.

Between Seen and Unseen: Sociocultural Othering of Bengali Muslims in Assam

In Assam, the interplay of rivers and land has always been closely linked to citizenship and immigration. In the nineteenth century, the British colonial state encouraged land workers from East Bengal (now Bangladesh) to migrate to Assam, transforming the Brahmaputra's floodplains into the "British empire's eastern-most jute frontier" (Saikia 2019, 1405). The colonial "Line System" not only restricted settlement areas and limited immigrants' economic activities (Chakraborty 2009), but it also created terminologies such as "immigrants" and "native" (Das 2023, 18) to categorize the population in Assam. These categorizations persisted through India's 1947 Partition and Bangladesh's 1971 Independence, fueling social tensions and contributing to endemic violence (Iqbal 2010), including the 1983 Nellie Massacre.[1]

Since 2016, with the rise of a right-wing Hindu government throughout India, including in Assam, Bengali residents have faced significant discrimination due to their religion. Bengali Muslims have experienced systemic violence, being perceived as "illegal immigrants," while Bengali Hindu migrants have been viewed as "refugees" (Das 2023, 27). This differential treatment has intensified the scrutiny and political marginalization of Bengali Muslims, particularly in *chars* near the Bangladesh border. Most *chars* in the Lower Brahmaputra are inhabited by descendants of Bengali Muslim migrants, popularly and derogatorily called "Miyah." In Assam, the recent implementation of the Citizenship Amendment Act (CAA), along with the National Registry of Citizens (NRC), exacerbates the stigmatization of cross-border migration from Bangladesh and promotes further ethnic and religious intolerance (Menon 2023). The CAA, passed by the Indian government, controversially grants fast-track citizenship to six religious minorities

1. During the anti-foreigner Assam movement (1979–1985), a mob comprising Tiwa, Koch, Hindu Assamese and other local ethnic groups killed over 2,000 Bengal-origin Muslims in Nellie, Central Assam. Rumors of imminent Muslim attacks on Tiwa villages incited the violence, prompting activists and local villagers to launch a preemptive assault on unsuspecting Muslims.



^ Fig. 2 The braided Brahmaputra River forms an ever-changing mosaic of environments shaped by nutrient-rich silt, sandy sediments and water channels. (Source: Swagata Das, 2024. Based on global-surface-water.appspot.com, Google Earth imagery accessed onJanuary, 6 2022 with excerpts of a Bhatiali song from Rahman, 2021).

Bhaitali song (Bangladeshi folksong)

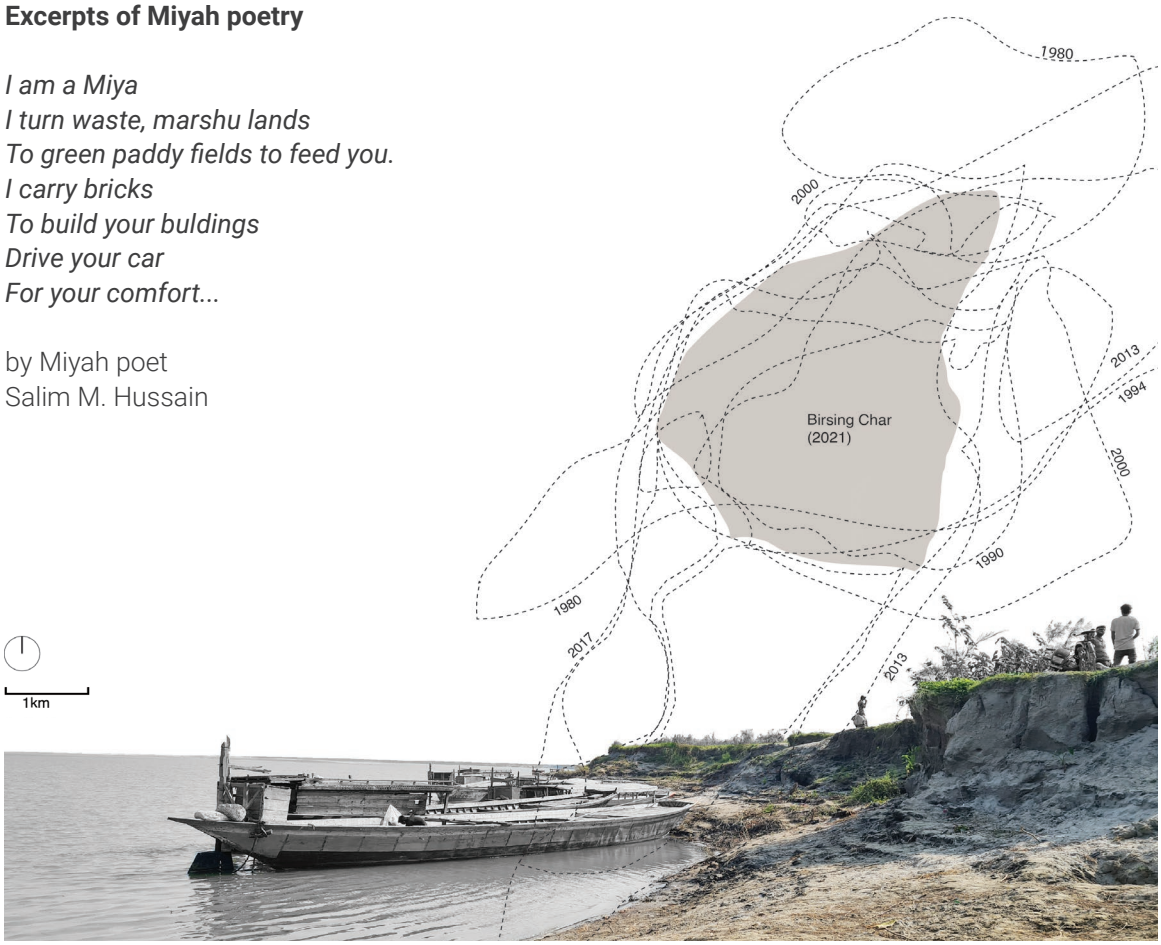
O ki ore,
pagla re nodi
eiglai ki tor riti re bidhi
Boshotbhangiya korlu
re chharachhari...

(Oh mad river
is this your true nature
You have destroyed our homes
and forced us to live apart...)
Source: Rahman 2021

Excerpts of Miyah poetry

I am a Miya
I turn waste, marshu lands
To green paddy fields to feed you.
I carry bricks
To build your buldings
Drive your car
For your comfort...

by Miyah poet
Salim M. Hussain



^ Fig. 3 Inhabitants adapt to the ever-shifting dry-land *chars* by moving, a way of settling that navigates danger and exploits local assets. It strongly contrasts with conventional notions of landownership and revenue mechanisms introduced during British rule. (Source: Swagata Das, 2024. Based on Google Earth imagery, sunflowercollective.blogspot.com and fieldwork carried out in December 2021).

while explicitly excluding Muslims, India's second-largest religious group.

Meanwhile, in 2019, Assam released its updated NRC list, which excluded a sizable portion of the Bengali-Muslim population. Although terms like Miyah are avoided in the wording of policies and the state refutes that the CAA and NRC are linked, their combination in the border territory of Assam threatens to render many stateless (Menon 2023) by introducing new political and economic uncertainties for the already marginalized *charuas*. In response, resistance movements, like the Miyah poetry movement, attempt to reclaim power and local identity. Figure 3 includes an excerpt from a poem that occasioned a police report being filed for "communal disturbance" (Bahn 2019).

Just as the state seeks to define who is Indian and who is not, it is equally obsessed with creating and enforcing more strict land-water sep-

arations, which undermine the fluid landscapes of *chars*. Monofunctional land use planning, a colonial legacy, does not correspond to the fluid *char*-scapes. The distortion caused by sociocultural othering (Lahiri-Dutt and Samanta 2013), also deeply rooted in colonial-era policies and exacerbated by contemporary legal measures, has further marginalized movement patterns of the *charuas*. The pejorative discourse has crafted a narrative that views *chars* primarily as territories to be saved against such othering, thereby obstructing a nuanced understanding of the intertwining of water, culture and the heritage of Assam's *char*-scapes, which now face additional challenges from climate change.

Chars as Places of Transition, Exchange and Seasonal Occupation

Chars are sites of rich water heritage with site-specific and dynamic relationships between fluid landscapes, human migration and cultural resilience. Along the Indo-Bangladesh border, *chars* serve as grazing lands and formal and informal cattle markets. The presence of the Indian Border Security Forces complicates the informal cattle trade, but subversive strategies, including bribery, sustain the lucrative business (Sur 2020). The continuously shifting river channels hinder efficient state control, while Bengali-Assamese inhabitants have acquired an intimate knowledge of how to move and reside (bypass and hide) within the idiosyncratic landscape. Such complexities frame an understanding of administrative borders as temporary (and permeable) barriers to exchange. *Chars* are also considered "granaries of the (Indian) state" (Chakraborty 2009, 3), producing significant amounts of paddy, jute and seasonal vegetables.

During the dry season (2021) and the monsoon season (2023), Das conducted fieldwork in a relatively stable *char*, locally known as Birsing Char,[2] revealing the fluid lives of Bengali-Assamese *charuas*, who must navigate an administrative gray zone due to religious discrimination and shifting waterscapes. Das traced the everyday life of a landless migrant family comprising a husband, wife and child who had settled in the relatively unstable part of Birsing Char, which gets seasonally flooded. They occupy a sole dwelling constructed on a mound with a mud plinth, thatched walls and tin sheet roofing (fig. 4). Their migration from various *chars* to relatively stable ecologies reflects generational patterns of relocation and highlights the appeal of Birsing Char for migrants with precarious citizenship status. First, certain villages on the *char* have been included as revenue villages (administrative units with land surveyed and entered into official records), granting them some form of state legitimacy. Second, the *char* population is comprisesd entirely of Bengali Muslims, offering a sense of communal refuge. Nevertheless, uncertainty looms since the land is prone to extensive erosion. People have developed various ways to simultaneously occupy nearby territories for complementary yet diverse livelihoods. The settlement culture developed over generations flexibly exploits a variety of continuously changing locational assets while navigating restrictions and avoiding state control.

Fieldwork revealed three distinct movement patterns of household members. Major floods

2. *Chars* do not have official names. Over the years, members of villages who have been displaced by flooding and erosion settle on *chars*, which then take the names of the original villages. In this case, the former village of Birsing split into three parts (Birsing Pt. I, Pt. II, and Pt. III) and occupies most of the higher stable ground of the *char*.

prompt long boat journeys by the entire family. The male member's seasonal migration with a neighbor occurs during the monsoon (June–September). They live on boats and engage in fishing during the lean agricultural period, while the woman and child sustain the family by cultivating kitchen gardens and bartering. Finally, daily movements between the Birsing Char and Dhubri towns are prompted by seasonal changes in *ghats* (passages leading to a river), as their livelihood includes farming, fishing, trading and livestock rearing. The settlement culture weaves together a multitude of localities, activities and agencies (of different family members and, by extension, the wider networks). Beyond serving as landing places for boats, *ghats* also function as public spaces with marketplaces and bays for loading and unloading. Dhubri town, once a bustling river port during British rule, now has four *ghats* used by local vessels to transport people and goods to and from neighboring *chars*. *Ghat bazaars* (fig. 5) on the north bank operate every Monday and Thursday, transforming the riverbank into a marketplace where *char* inhabitants trade essential commodities and products for survival.

The construction of the Dhubri-Phulbari Bridge (Choubey 2024), part of a spree of state-driven infrastructure development on the Brahmaputra, will soon restrict these movements. The bridge will cross the Birsing and other *chars*, threatening to erase (or severely limit) the local way of life by extending state control over the hinterlands. Official trade routes will replace traditional water heritage elements and practices in *ghat* bazaars. Traditional water routes will disappear, and charua-operated boats will be without freight.

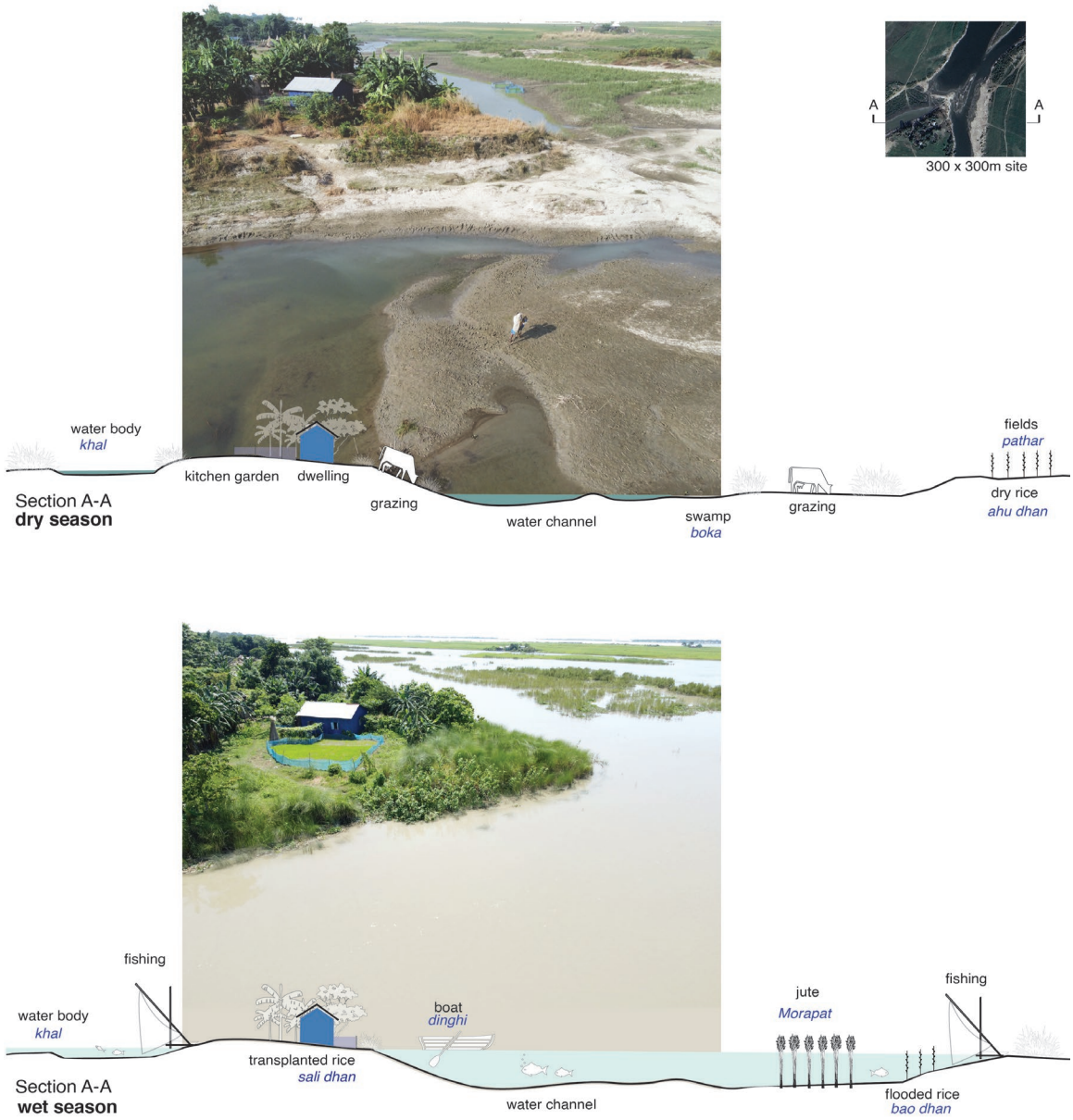
Fieldwork revealed that cultivation, attuned to seasonal cycles and water levels, remained the primary livelihood for the studied *char* family in 2021 and 2023. Drawing on his agricultural expertise, the male member plowed the sandy terrain and fertilized it with cow dung, poultry waste, ash and paddy husk before the arrival of monsoon. These organic fertilizers decompose in the rainy season to form fertile topsoil. The *chars* are typically covered in tall grasses and reeds set ablaze before sowing *ahu* (dry rice) in March/April. Harvest precedes the high water in July, with cultivation resuming after the floods recede. Leveraging the soil's moisture, winter crops like rapeseed, mustard and various pulses are sown post-monsoon to ensure sustenance during lean, dry months. Sali rice saplings thrive in manicured fields adjacent to homes, nurtured by rainwater and flood-borne silt before transplantation to fields. Low-lying areas, submerged during monsoons, are utilized for cultivating *boro* rice along with jute with longer stems (fig. 1). The knowledge of the *char*-scapes and sustenance practices stand as a testament to the resilience of *charuas*, which can support their livelihoods across seasonal transformations and the ever-changing environment.

Char-scapes as Water Heritage Rooted in Culture and Nature

Char-scapes exemplify a multifaceted water-related heritage. *Charuas* have developed an adaptive crop calendar that mixes crops for risk distribution and the efficient use of water levels. Beyond farming, communities harness water-adapted livelihoods, engaging in fishing, boat-making and using boats to transport passengers. In times of need, they shift to non-farming livelihoods like carpentry, daily wage labor and small businesses, often coupled with seasonal out-migration. Religious and spiritual beliefs fortify their sociocultural resilience, while traditional ecological knowledge

^ Fig. 4 One family's inhabitation of a *char* reveals the territorial scale of occupation, different types of dwelling and movement within the landscape (Source: Swagata Das, 2024. Based on fieldwork in December 2021 and July 2023).

anticipates flooding and erosion. In essence, the *chars*' water-related heritage is a dynamic living legacy. It includes the practical knowledge (Scott 1999) that the *charuas* acquired over generations. The settling-on-the-move culture of the *charuas* contains a set of relations



^ Fig. 5 Seasonal waters and shifting geographies prompt inhabitants to adopt their livelihoods and cropping systems (Source: Swagata Das, 2024. Based on fieldwork).

between a multitude of locations (all with continuously evolving locational assets), activities that exploit these assets, and actors (ranging from different extended family members to the networks that link them with the wider world). These sets of relations dance with the natural rhythms of the river as well as with the whims of state politics while regularly being disrupted by catastrophic floods, large-scale infrastructural interventions and eruptions of violence

between communities in this sensitive border area. Clearly, this settling-on-the-move culture embraces as much the opportunities offered by their refuge space, the *chars*, as by avoiding dangers and subverting state politics. The settling-on-the-move culture, until now, has proven sustainable.

Recently, climate change has impacted *chars* with erratic rains, higher temperatures, extended monsoons and an increasing number of extreme weather events (Das and Khanduri 2021). Flawed disaster management and eco-hydrologically insensitive development in Assam increase exposure to "natural" hazards, prompting communities to seek external state support and migrate away from the *chars*. One can wonder, however, whether, rather than relocation and subordination to the state, a new iteration of the settling-on-the-move culture of the *charuas* would be more advantageous. The practical knowledge acquired by the *charuas* has continuously and opportunistically been adapting to changing conditions. Rather than losing such living practical knowledge and shifting to supposedly more rational practices, it might be worthwhile to imagine how to maintain and adapt the practices of the *charuas* to the new conditions generated by global warming. For the *charuas*, their daily lifestyle is integral to such a living heritage (as embodied practical knowledge). It should be leveraged to achieve inclusive, sustainable development, social cohesion, equity and community well-being.

Conclusion

Charuas acknowledge the river's fluctuations, including flooding, which is not considered a risk but simply part of the natural cycle. In a culture of risk assessment, fervor for technological advancement and its attendant "fixes," awareness of flooding, erosion and sedimentation as intrinsic natural processes has been fading. However, in recent years, global warming has brought these processes back into focus. Additionally, the number of climate refugees migrating to India is expected to rise as the climate crisis intensifies (Asian Development Bank 2012). Migration driven by ecological factors is part of state-making processes in Assam.

Throughout history, *chars* have contributed to Assam's agricultural production and economy, and chars have been important places of refuge for Bengali Muslims. Their defiance of categorization, where water and land naturally recede and flow, have hosted undermined communities threatened by the CAA and NRC. Today, they invite contemplation of alternative realities and narratives that envision *char*-scapes as uncharted territories, retaining the freedom that their inherent illegibility offers. Simultaneously, they could function as productive landscapes to generate new economies, combined with specific densities to support them.

Policy Recommendations

- Planning policies need to acknowledge the fluid landscape of *chars* beyond conventional land-use categories and treat them as a distinctive case. The State Action Plan of Climate Change for Assam should include a dedicated chapter addressing the potential and vulnerability of *chars* and outlining new visions of the char environment and economy to build resilience in Assam's floodplains.

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Fluid Ontologies: Colonial Legacies and an Indigenous Oceanic Worldview in the Sulu Archipelago

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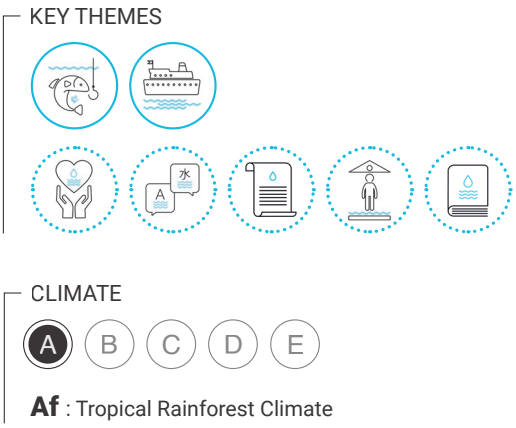
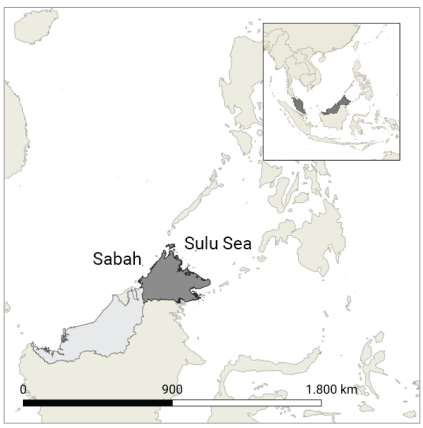
In recent decades in Southeast Asia, dramatic social, economic and political changes have profoundly impacted the lives of Indigenous populations. In Malaysia, the Sama Dilaut, known as the "sea nomads," are under pressure to abandon their traditional way of living at a time of rapid modernization. Over centuries, the Sama Dilaut have developed a harmonious relationship with their environment, practicing sustainable small-scale fishing methods that have minimal impact on marine ecosystems. In their worldview, humans are not considered exceptional but interconnected with the ocean and species that inhabit it. This contrasts with the Western-centric worldview, where nature-culture dualism prevails, viewing humans as separate from nature and encouraging exploitative attitudes toward the environment. This article outlines and acknowledges the value of the Sama Dilaut culture, knowledge of the sea and struggles against dominant power structures. It advocates for recognizing Indigenous rights to ancestral lands and seas and integrating Indigenous knowledge and communities in conservation practices. These goals are essential for achieving justice for Indigenous peoples and offer significant potential in the search for alternative approaches to combating climate change.

Keywords: *Indigenous culture, sea nomads, marginalized community, oceanic worldview, Sama Dilaut*





< Fig. 1 Bajau Laut stilt houses outside Bodgaya, Semporna (Source: Abrahamsson, 2018).

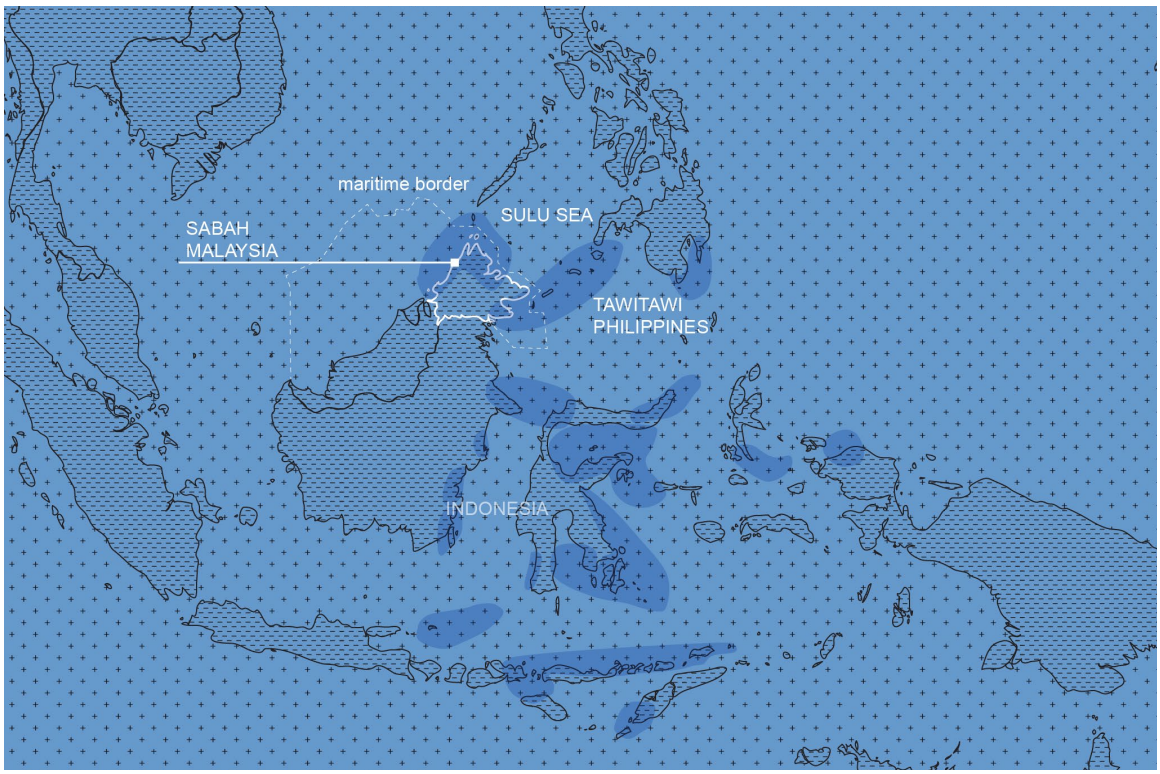
Introduction

Historically, as terrestrial beings, humans have developed a predominately land-based lifestyle and culture. Compared to land, the ocean has been perceived as distant and unfamiliar — a mysterious and unpredictable space. This perception has contributed to the dominant view of the ocean as external and alien, a space of "others." It wasn't until the late twentieth century that the ocean rose to the forefront of geopolitics and cultural and environmental studies.

The 1945 Truman Proclamation, which extended US control of all the natural resources on its continental shelf, catalyzed the global declaration of a 200-nautical-mile Exclusive Economic Zone (EEZ) by nations worldwide. Decades later, the United Nations Convention on the Law of the Sea was established, leading to the remapping of all the oceans on the planet. Simultaneously, an unprecedented number of transoceanic studies emerged, including notable works like Paul Gilroy's *The Black Atlantic* (1993) and Epeli Hau'ofa's *Our Sea of Islands* (1993). The discovery of the relationship between sea-level rise and anthropogenic climate change has also drawn increased public attention to the ocean (DeLoughrey 2019). In this context, the interdisciplinary field of "critical ocean studies" emerged (DeLoughrey 2019), challenging the terrestrial-biased definition of culture (Williams 1976) and seeking alternative ways of understanding the ocean. Critical ocean studies represents an important shift from a long-term concern with mobility across transoceanic surfaces to theorizing oceanic submersion, thus rendering vast oceanic space into an ontological place with multispecies engagements (DeLoughrey 2019).

Critical ocean studies is linked to the theoretical movements that challenge the dominant Western power-knowledge paradigm and the marginalization of Indigenous knowledge and non-human actors. Sandra Pannel (1966) has argued that Western perceptions "tend not to recognize these spaces as culturally defined" but as "watery voids." Scholars seeking alternative oceanic imaginaries often turn to Indigenous peoples and cultures known for their interconnected relationship with the environment and other species. For maritime Indigenous peoples, the marine environment is not just a source of economic bounty but the center of their cosmology and rituals.

This article sheds light on a group of maritime Indigenous people called the Sama Dilaut (also known as Sama Badjau or Badjau Laut) residing in the Sulu Archipelago of Southeast Asia. In a region with a history of colonialism, rapid modern development and fragile ecosystems, the Sama Dilaut face multifaceted challenges that endanger the continuity of their Indigenous lifestyle and livelihood. These challenges include social discrimination, political injustice and declining fish supplies due to unsustainable commercial fishing and climate change. This article demonstrates their culture's challenges and tenacious vitality, thriving wherever there is room in the shadow of modernity. In the twenty-first century, although most scholars conducting fieldwork among Sama Dilaut have documented the decline of their boat-dwelling lifestyle (Nimmo 2006), a resurgence of boat-dwelling communities has been observed along the coast of Semporna in Sabah (Abrahamsson 2011; fig. 2). This article reveals how these Indigenous people cope with the impact of modern society and offers valuable insights regarding the harmonious coexistence of humans and the ocean. It serves as a call to researchers and designers from various fields to recognize and value Indigenous knowledge and perspectives, which have long been marginalized by the dominant



^ Fig. 2 Location of Sabah in relation to the maritime border of Malaysia and the Philippines (Source: Di Fang, 2024).

Western knowledge production system. Shifting our perspective this way will open the door to alternative scenarios of our collective future and potential solutions to the ecological crisis.

The Origin, History and Tradition of the Sama Dilaut

The earliest mention of people identifiable as the Sama Dilaut (meaning "people of the sea" in the local language) goes back to the sixteenth century (Sather 1997). The assumption is that they adopted a maritime lifestyle centuries ago to supply the high demand for high-end sea products such as *trepang* (sea cucumber) and shark fin. Since then, from that area, they have spread throughout the adjacent region of the Sulu Archipelago. The sea-dwelling Sama Dilaut are known as exceptional divers with excellent fishing and navigating skills, and they have historically played a significant role in maritime trade in Southeast Asia. They can hold their breath underwater for a long time to catch the fish, using homemade spearguns, swimming goggles and swim fins (Schagatay 2011; fig 6). In addition to fishing, seaweed cultivation is also a common way to make a living.

There are different theories about the origin of the Sama Dilaut and how they spread and settled on different islands in the Sulu Sea. Linguistic reconstruction has placed the home area of the Sama Dilaut, who speak proto-Sama, around the Zamboangan coast of southwest Mindanao and the neighboring island of Basilan (Pallesen 1985). According to Robert Blust (2007), the historical migration has resulted in the "geograph-

ically displaced language" of the Sama Dilaut, severing their culture and language from the dominant Philippine and Malaysian cultures.

The Sama Dilaut were traditionally animistic and this orientation is retained in contemporary Sama Dilaut communities. In their mythology, the supreme deities are *Umboh Dilaut* (lord of the sea) and *Dayang Dayang Mangilai* (lady of the forest). *Umboh Tuhan* is regarded as the creator deity who made humans equal to animals and plants (Hussin and Santamaria 2008). They also have *umboh* (ancestor), which refers to ancestral spirits believed to influence fishing activities (Jubilado et al. 2011). In the Sama Dilaut worldview, the gods and goddesses are not bound to a specific place but are present wherever the sea is. This outlook, centered around a special relationship with the ocean, can be described as an oceanic worldview.

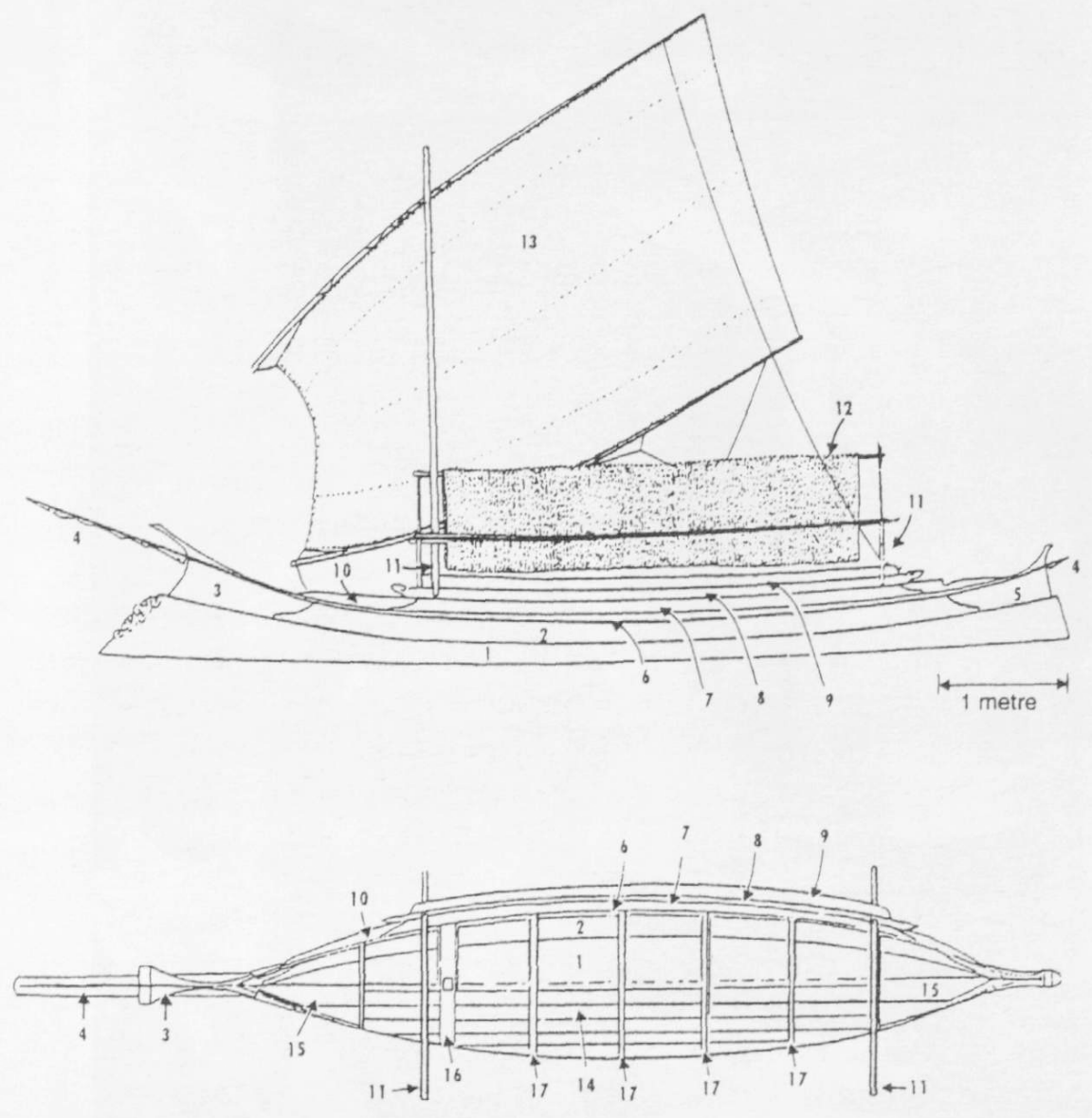
The *lepa* (houseboat) plays an important spiritual role in the lives of sea-dwelling Sama Dilaut (figs. 3 and 4). In the nomadic past of the Sama Dilaut, before a young man was to be married, his family would build or buy him a *lepa*, so he and his wife could live as an independent fishing unit. Upon his death, his *lepa* would be disassembled and serve as his coffin for burial. Family *lepa* usually tow smaller dugout canoes called *buggoh* or *birau* made from a single log (fig. 5). The boat-dwellers, usually related to each other, would share a common place where they moored their boats, eventually forming a "moorage" collectively. Before undertaking long or dangerous journeys, a *lepa* is often blessed with magic spells to protect it from pirates. The Sama Dilaut also pledged to *Tuhan Dilaut* and the *umboh* for protection at sea (Sather 2001). The ocean is their homeland, and the *lepa* ties them together while ancestral spirits guard them wherever they travel, from the cradle to the grave.

Sama Dilaut in the Bordering State of Malaysia-Philippines under Colonial Legacies

Unlike land-based cultural communities, the Sama Dilaut does not recognize land ownership and arbitrary nation-state borders imposed by land-based power. They recognize only the sea, the reefs, sacred sites and burial grounds, mostly found in mangrove areas partially submerged in water, as their "ancestral domain" (Alamia 2005). They see the sea as a single interconnected space where they can move as far as the water flows, as their ancestors have been doing for centuries (Solomon 1970). Free movement on the water is the lifeline of their culture, defining the periphery of their place, family connections and food sources. However far they travel, the tie with their ancestral lands and seas is unbreakable, and they regularly visit their places of ancestral origin. Many Sama Dilaut who settled along Sabah's east coast migrated from the Southern Philippines and periodically have returned to Philippine waters, often to their places of ancestral origin in the islands of Tawi Tawi and other sites in the Sulu Archipelago or Palawan (Acciaioli et al. 2017).

Sabah is a Malaysian state bordering the Southern Philippines. Historically, it was ruled by the Sultanate of Sulu before the British North Borneo Company came to power in the nineteenth century. After colonization, it became part of contemporary Malaysia. Due to its relationship with and proximity to the many islands that comprise the Sulu Archipelago, it is a major destination for migration among the Sama Dilaut in the Southern Philippines.

Both colonial and post-colonial governments view the Sama Dilaut's transboundary movements as security threats and have attempted to sedentarize and accommodate them in stilt houses on land. Between 1901 and 1910, the



^ Fig. 3 Sketch of a *lepa*: 1 *Teddas* (keel), 2 *Pangahapit* (strake), 3 *Tuja*' (bow section with raised poling platform), 4 *Jungal* (side-pieces ending forward in a projecting bowsprit and aft in a small stern projection), 5 *Tuja' buli'* (stern section), 6 *Bengkol* (lower sideboard forming fitted gunwale), 7 *Kapi kapi* (middle sideboard), 8 *Koyang koyang* (upper sideboard), 9 *Dinding* (wall of living quarters), 10 *Ajong ajong* (forward side-piece) (Source: Sather, 2001).

British North Borneo Company introduced new policies restricting the Sama Dilaut's mobility and incentivizing permanent settlement. In 1963, Sabah gained independence by signing the Malaysia Agreement, which included specific conditions to ensure special interests and safeguards for Sabah. Embedded in the constitution and federal laws, these conditions have

^ Fig. 4 A *lepa* used by a family on Danawan Island (Source: Abrahamsson, 2011).

^ Fig. 5 Sama Dilaut kids in a *buggoh/birau* (dugout canoe) in Omadal (Source: Abrahamsson, 2015).

made entry and residence registration in Sabah extremely strict.[1]

The strict border controls have reinforced the arbitrary post-colonial national borders that divided the transboundary maritime region, exacerbating the pressure on the Sama Dilaut to abandon their nomadic lifestyle. Under this pressure, some have settled permanently on land and adopted a more terrestrial lifestyle over time. Others have continued to ply the seas in their *lepa*, at least for part of the year. Many have built stilt houses in coastal areas where they live outside the fishing season and engage in other activities such as seaweed cultivation (fig. 1). Consequently, the moorages of the Sama Dilaut are being replaced by sedentary settlements along the shorelines, most of which are rather permanent (Jumala 2011). Even more troubling than this shift toward sedentarization, the Sama Dilaut are often regarded as illegal migrants in Malaysia despite long periods of habitual residence. Their lack of legal status severely threatens their most basic human rights and subjects them to discrimination by the government and other groups (Acciaioli et al. 2017).

Coastal development driven by economic growth and tourism further exacerbates Sama Dilaut's displacement. With no legal status and limited knowledge of the administrative system, they are stigmatized as "uncivilized" and "backward" by the government and other groups, leading to their removal from coastal areas to maintain a positive image for tourists and consumers. In the documentary *Sama Dilaut*, Rosalyn Dawila Venning, the founder of the Indigenous Children's Learning Centres (ICLC), a non-governmental organization, talked about her experiences working with Sama Dilaut children in an educational program. She shared how the kids were often picked on because people thought they smelled like fish. To help with this, Venning and the teachers would wash the children at the start of the school day, hoping to ease the stigma and help them fit in better with their classmates.

Additionally, the establishment of Marine Protected Areas and competition from commercial fishing companies further restrict the Sama Dilaut's access to their traditional fishing grounds. These economic activities and conservation efforts follow a Western style of development and overlook the rights, livelihoods and profound knowledge of Indigenous peoples like the Sama Dilaut, contributing to their marginalization and displacement from their ancestral domains.

In the first week of June 2024, Malaysian authorities evicted hundreds of sea nomads from their homes off the coast of Sabah state. Their houses and boats were burned in an effort that the authorities claimed was aimed at boosting security and combating cross-border crime. This operation targeted the Bajau Laut (Sama Dilaut in Malay) community living on seven islands in Semporna, including Pulau Bohey Dulang, Pulau Maiga, Pulau Bodgaya, Pulau Sebangkat and Pulau Sibuan (Latiff 2024).

The loss of their traditional livelihoods has forced many Sama Dilaut to adapt to land-based urban lifestyles with little knowledge or support (Abrahamsson 2011). Without the right to land, legal identity or access to legal employment, they face food insecurity and exploitation by other ethnic groups. The once vibrantly rich sea-nomadic lifestyle of the Sama Dilaut now

1. United Kingdom of Great Britain and Northern Ireland and the Federation of Malaysia, North Borneo, Sarawak and Singapore. 1963. "Agreement relating to Malaysia." https://web.archive.org/web/20110514204944/http://untreaty.un.org/unts/1_60000/21/36/00041791.pdf.

^ Fig. 6 Bajau Laut speargun fishermen, Kulapuan Island, Semporna (Source: Abrahamsson, 2012).

faces extinction due to the legacy of colonization, modern economic models, and biased land-based systems.

Conclusion

The ongoing struggles of the Sama Dilaut reveal the deep scars left by colonial legacies and the persistent marginalization of Indigenous knowledge and ways of life. The forced sedentarization, legal discrimination and loss of access to their traditional fishing grounds reflect the broader issue of how modern, Western-centric models of development continue to undermine Indigenous communities. In recognizing the rich oceanic knowledge and sustainable practices of the Sama Dilaut, we find not only a call for justice but also a potential pathway to more ecologically sound and inclusive futures.

A report from the World Bank (Sobrevila 2008) demonstrates that areas where Indigenous peoples have traditionally lived tend to have greater natural biodiversity than other areas. For centuries, the Sama Dilaut inhabited areas with some of the richest marine biodiversity without depleting natural resources. Spencer Greening (La'goot/Tsimshian) has explained the conceptualization of nature for Indigenous people (Reed et al. 2024): "There isn't really a word for [nature] in a lot of languages. And so it only becomes something when we other it. In an Indigenous sense, nature is just our place, our home, and where we belong to. And you wouldn't need to define it in that way. But [. . .] in the Western sense, we're able to define it because we've othered it." Many scholars have echoed this point in describing Indigenous relationships with more-than-humans. According to Robin Wall Kimmerer (2013), more-than-humans in an In-

digenous context must be broadly understood as relatives or teachers for humans, who have the least experience with how to live reciprocally with the world around us (Reed et al. 2024).

To form new visions of a collective future that includes all species and nature together, we need a transformative shift away from the prevailing Western-centric ways. Recognizing Indigenous peoples' rights and culture is the first small but crucial step toward this larger change. To protect the Sama Dilaut, a maritime-based Indigenous group, there is an urgent need to reform the current land-based system to include ocean space. By recognizing their rights and embracing their oceanic worldview, we not only protect their heritage but also enrich our understanding of the ocean as a material and cultural space. This ultimately enhances the concept of "thinking with" the ocean and exercising the interconnectedness of all life.

Policy Recommendations

- Recognize Indigenous rights to both ancestral lands and seas.
- Integrate Indigenous knowledge and communities in conservation practices.
- Promote cultural preservation.
- Enhance education and awareness.

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Traditional Water Management in the Thar Desert: The *Khadeen* of Rajasthan, India

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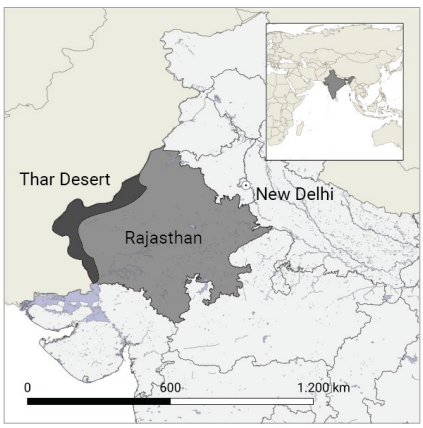
The khadeen system of the Thar Desert, in Rajasthan, is an ancient technology that takes advantage of peculiar geohydrologic formations to create temporary lakes. A careful water management practice, the khadeen are an example of age-old methods of capturing and using seasonal runoff for agriculture, ensuring water access in arid regions. Khadeen have played a crucial role in supporting agricultural activities since the sixteenth century, offering impressive yields in a water-scarce environment. However, the enduring efficacy of khadeen faces contemporary threats, including mining encroachment, labor outmigration and road development. The delicate balance between preserving traditional knowledge and succumbing to external pressures poses challenges to their cultural, ecological and agricultural significance. This paper comments on the historical, hydrogeological and socioeconomic dimensions of khadeen, emphasizing the importance of their preservation in sustaining communities and ecosystems in the Thar Desert area.

Keywords: *nature-based solutions, Indigenous technology, non-motorized irrigation, khadeen, water harvesting*



< Fig. 1 The Masurdi Khadeen (Source: Bhatta Ram, February 2021).

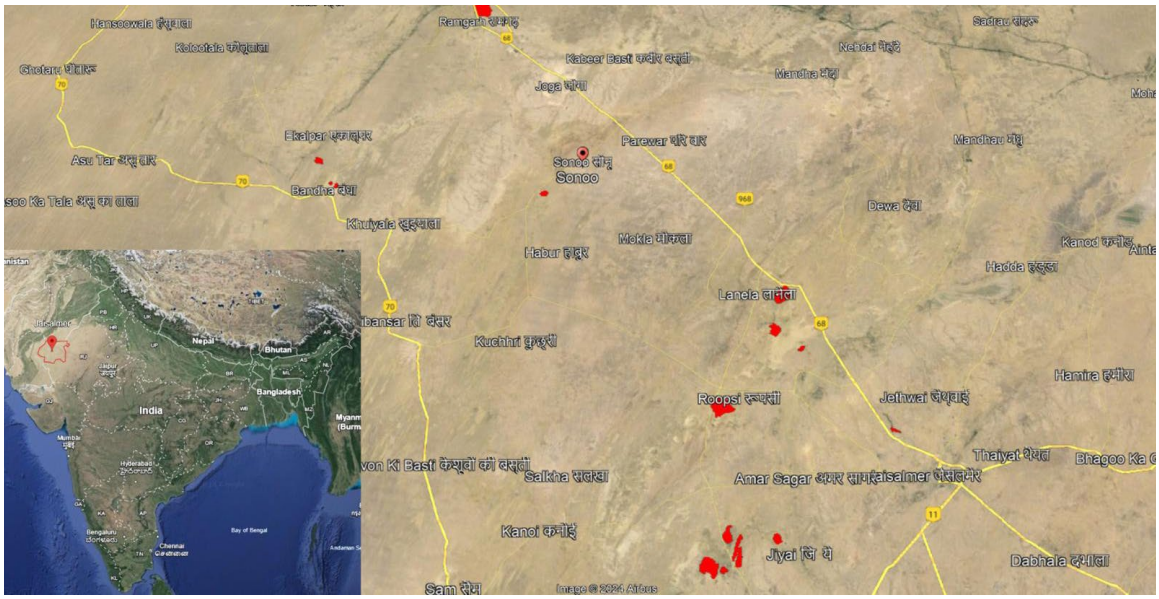
Introduction

In the Jaisalmer district (Rajasthan, India), located in the Thar Desert, water scarcity poses a considerable challenge. In approximately 60 per cent of the region, the annual rainfall is quite low, reaching a meager 200 mm on average. The monsoon season, from July to mid-September, sees 90 per cent of the area's precipitation, usually in the form of torrential rain. In addition to strong winds, high temperatures and elevated groundwater salinity, this contributes to a complex ecosystem where access to water is not a given.

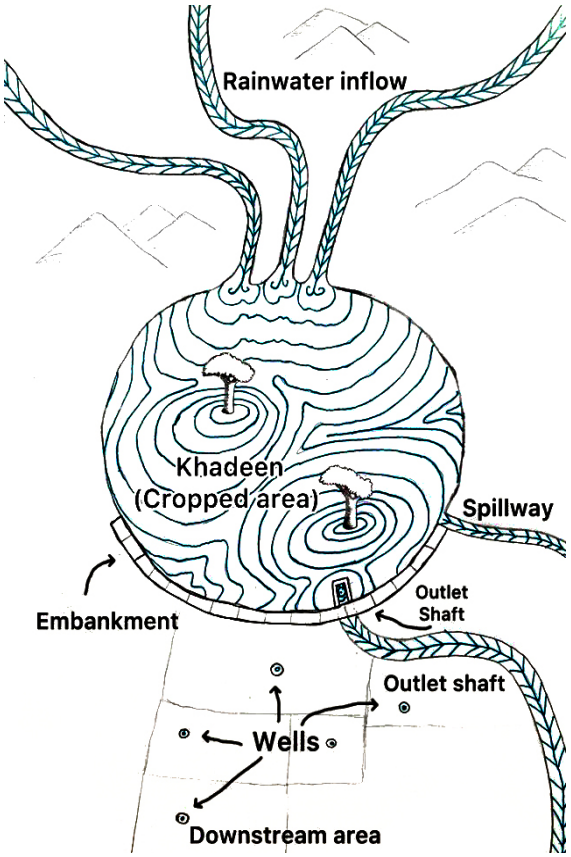
During dry periods, various non-motorized infrastructures used for harvesting, storing and managing water make it possible for area villages to have access to water. Traditional hydrogeological knowledge, with its correlated water practices, is deeply embedded in the cultural and religious ethos of Rajasthan and has played an important role in the economic prosperity of the Thar Desert's urban centers. For instance, elderly community members clean the catchment before the beginning of the rainy season to eliminate rubble and facilitate the centralized collection of rainwater runoff. Additionally, since well-diggers play a crucial role in society, they can count on donations from community members (Miśra 2001). This hydrogeological knowledge revolves around a detailed understanding of where freshwater is likely to be found within the desert landscape, and which tools and practices are needed to access it, resulting in a meticulous approach to water management embedded in people's everyday lives. In areas of the Thar Desert where motorized approaches remain less effective because of material constraints, these non-centralized and non-motorized water practices play an important role in accessing water.

Practices for Water Scarcity

For centuries local people have used a variety of infrastructures to access water in the Thar Desert, including ponds, *kua* (wells), *beri* (narrow, shallow wells) and *khadeen* (temporary lakes)



^ Fig. 2 Shown in red are 19 of the 800 *khadeen* of the Jaisalmer district. The location of the district is highlighted in the map on the bottom-left (Source: Google Earth, 2024, adapted by authors).



^ Fig. 3 Illustration of different elements of a *khadeen* (Source: Pierantonio La Vena, co-produced by Bhatta Ram, 2024).

(fig. 2). These are a lifeline for the local people, granting access to water for domestic uses and livestock (Agarwal and Narayan 1997). While ponds and *khadeen* are used for rainwater harvesting, *beris* allow access to shallow percolation water (locally referred to as *rejani pani*), and *kuas* access the deeper groundwater (known locally as *patal pani*).

The *khadeen* is a traditional water infrastructure used in Rajasthan, which accumulates seasonal runoff, enabling agricultural practices even for relatively water-intensive crops (fig. 3). The study of *khadeen* allows stakeholders to appreciate how practices of care for water resources have ensured the continuous inhabitation of this region, within strict hydrogeological and climatic constraints.

These temporary lakes were (and are) created to capture rainwater during the monsoon season, storing it in the shallow layers of the soil during drier months. They are built by interrupting the course of seasonal rivers with an embankment, creating a reservoir fed by the upstream catchment (fig. 4). The resulting structure ensures the practice of agriculture even in years of scarce rainfall.

Building a well-functioning *khadeen* requires locating specific characteristics in a landscape, such as the course of temporary rivers and shallow groundwater quality. In most parts of the Thar Desert, the deeper groundwater is too saline for human consumption or agricultural use. To preserve freshwater after precipitation, the *khadeen* is built as an artificial perched water table, constituted by an impervious geologic layer, below a previous layer (fig. 5). This protects the infiltrated water both from surface temperatures and subsoil contamination.

Construction and Functionality of a *Khadeen*

A *khadeen* creates an artificial lake from the seasonal precipitation falling in a valley (or water catchment). An embankment, or wall, is the main structural element of the *khadeen*, preventing lake water from flowing away. The embankment can be built out of stone, dirt and, in recent years, cement. In addition to the embankment, the construction of *khadeen* can involve raising dikes along the two sides. The length of the dikes is calculated based on the expected seasonal influx of water in the reservoir and can sometimes reach 5 to 7 km.

The lakes created in this manner infiltrate gradually downstream and dry up. The speed of this process depends on the underlying impervious layer, the amount of yearly rainfall and the integrity of the catchment. *Khadeen* are usually emptied of water in September so that wheat can be sown on the lakebed for the winter season (from October to March). The water is let out through an outlet shaft, and it is used to irrigate other fields downstream (fig. 6).

The sediments collected in the catchment and the biotic activity in the lake confer fertility and humidity to the soil at the bottom of the basin. These conditions allow the cultivation of wheat and other (relatively) water-demanding crops in a region where their growth would otherwise be impossible. In normal conditions, *khadeen* have a relatively high productivity, yielding 15 to 20 times the amount of wheat sown (Miśra 2001). Downstream from the embankment, agriculture is supported by shallow well irrigation, fed by the gradual percolation of the lake's reservoir.

***Khadeen* and Heritage**

Khadeen have played an important role in defining local people's relations with water, inspiring a cautious use of scarce water resources. Their dependence on rainfall demands a meticulous approach to preserving rainwater. To this day, *khadeen* allow irrigation in the area more reliably than modern, motorized water technologies.

According to Mishra (2001), it is likely that *khadeen* were originally created as a replica of naturally occurring water pools (known locally as *deobandh*), which allowed access to water along the trade routes crossing the Thar Desert. However, *khadeen* construction was initially occasional, sparse and marginal. Since the thir-

^ Fig. 4 Stone embankment overrun by vegetation at the Bada Bagh Khadeen (Source: Pierantonio La Vena, 2023).

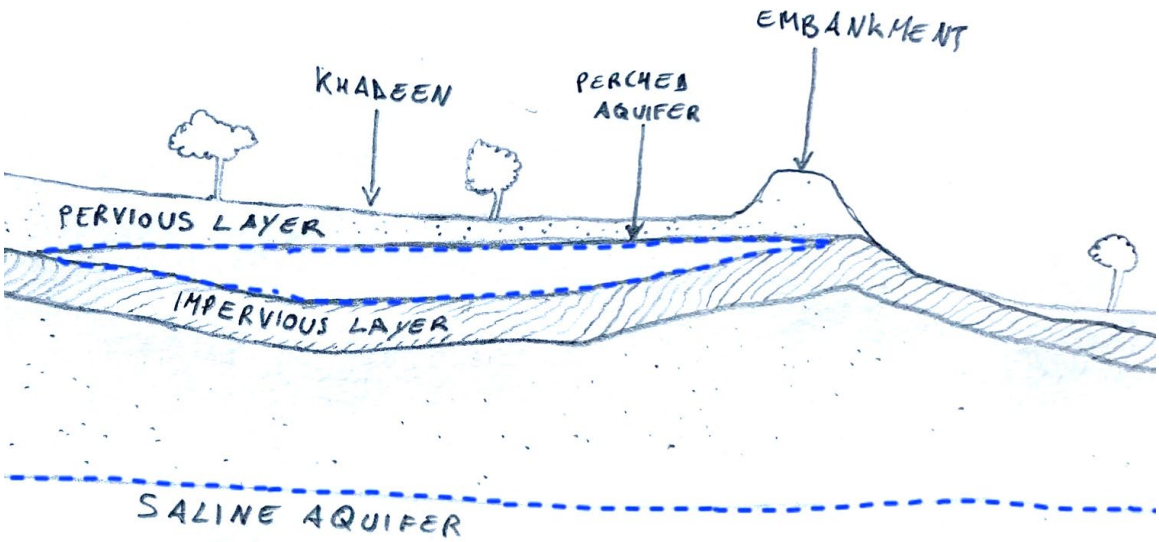
teenth century, the district of Jaisalmer has witnessed creation of several *khadeen*, including interconnected khadeen systems, at the hand of the Paliwal Brahmins. Originally from Pali (central Rajasthan), the Paliwal Brahmins seem to have played a crucial role in transforming the landscape of the Jaisalmer district, particularly in the emergence of agriculture, until they abandoned the area in the early eighteenth century, allegedly due to conflicts with local rulers (Rezavi 1995). Although isolated *khadeen* were previously used in the area, this group is credited for the construction of interconnected systems of *khadeen*, which drain into one another (Miśra 2001).

Khadeen often take the name of the village in which they are located. For example, the Masurdi Khadeen takes its name from the nearby village of Masurdi. It is not easy to establish the total number of *khadeen* present in the region: Malik and Singh (2023) mention a total of 650 structures, while Singh and Singh (2018) report 800 of them, including those of more recent construction. The local government has promoted the construction of new *khadeen*, both to encourage settled livelihoods and to promote agriculture. However, according to Agarwal and Narain (2008), the older *khadeen* are structurally more solid in a way that is difficult to replicate in more modern ones.

These more recently built *khadeen* tend to be smaller and are meant for individual rather than communal use (Agarwal and Narain 2008). The *khadeen* in Dabbla Par and Ekla Par have been built with the specific purpose of supporting the settlement of nomadic groups such as the Bheel tribal community.

Among the *khadeen* of older manufacture, the Lanela Khadeen extends over 758 ha, and is used in a communal capacity by members of a dozen villages (Singh and Singh 2018). Masurdi Khadeen (fig. 1) spans over 300 ha and is used communally by ten villages. The Jajia Khadeen, extending over a few hundred hectares, will be decommissioned in the upcoming years as its catchment will be converted into a mining site (Malik and Singh 2023).

The Bada Bagh Khadeen extends over 29 ha and



^ Fig. 5 Hydrogeological cross section of a *khadeen* (Source: Pierantonio La Vena, co-produced by Bhatta Ram, 2024).

^ Fig. 6 Outlet shaft at the Bada Bagh Khadeen (Source: Pierantonio La Vena, 2023).

historically belongs to Jaisalmer's royal family. Its imposing stone embankment is adjacent to a complex of cenotaphs commemorating royal family members and is often visited by tourists. Although *khadeen* are (and have been) generally used communally, the use of Bada Bagh Khadeen has recently been privatized, with a yearly contract that yields up to ₹600,000.00 (roughly $642.00) to its owners. The local community of Mali, an occupational caste group traditionally working as orchard gardeners and farming the *khadeen* under a sharecropping system – which allowed the community to cultivate the land in exchange for 50 per cent of the agricultural yield – has lost access to the land.

Discussions over the heritage dimension of *khadeen* cannot ignore how local communities are entangled in wider socio-political tensions resulting from increasingly neoliberal policymaking in the region, which in some cases prevents vulnerable social groups from accessing the cultivable land central to their agrarian livelihood.

Concerns for the Future

Traditional water management practices related to *khadeen* face contemporary challenges threatening survival. The recent advent of mining industries constitutes one significant threat. The extraction of minerals and natural resources can disrupt the natural flow of water in a catchment, affecting the recharge of *khadeen*. Additionally, contamination stemming from mining activities has the potential to adversely affect the quality of water stored in *khadeen*, putting agricultural practices at risk.

Another pressing challenge is the outmigration of labor from rural areas to other regions in Rajasthan or beyond. As younger generations seek better economic opportunities in urban centers or near the Indira Gandhi Canal Irrigation Scheme – a canal stretching 650 km from the Harike Barrage in Punjab to the district of Barmer in Rajasthan built to expand the area of irrigated land in the Thar Desert and increase the local production of food crops – the communities that have historically maintained and nurtured *khadeen* find themselves dwindling. This outmigration results in a decline of traditional knowledge and a disconnection from age-old water conservation practices. Dwindling numbers of committed community members can jeopardize the maintenance and upkeep of khadeen, putting these vital water reservoirs at risk.

Urban development threatens *khadeen*, since it may lead to encroachment on *khadeen* areas. The development of roads disrupts the natural flow of water to the basin at the bottom of the catchment. These changes compromise the natural flow of water into the *khadeen*, reducing their ability to collect and store water for extended periods. Furthermore, in an era where water is increasingly commodified, communities practicing traditional water conservation face increasing pressures to participate in the water market, leading to the exploitation of local water resources for profit. As scarce water resources are diverted toward the tourism and mining industries, less water is allocated to agriculture and communal use. *Khadeen*, originally designed for community sustenance, are challenged with resisting such external commercial and market forces, which alter their original purpose and raise issues of distributional justice.

Conclusion

The study of *khadeen*, along with other water conservation structures, illustrates how practices of care for water resources ensure sustainable and resilient livelihoods in an environ-

ment characterized by water scarcity. In the Jaisalmer district, these structures have been and continue to be instrumental to agriculture for centuries, yielding impressive production in the face of scarce precipitation. However, these time-tested structures face contemporary threats, which can compromise the community-based capacity in which they function.

The delicate balance between traditional practices and external pressures necessitates urgent attention to safeguarding the social, ecological and food-security significance of *khadeen* in the Thar Desert. As challenges loom, concerted legal and administrative efforts are needed to ensure the preservation and revitalization of these ancient water harvesting systems, securing a sustainable future for the communities they have long supported.

As these structures are being converted to serve private and commercial interests, historically marginalized communities are denied access to the source of their subsistence. This process, considered functional to the industrialization of rural spaces, leaves skilled farmer groups with no other option but to migrate to urban areas and seek work as "unskilled laborers."

This results in the gradual delegitimization of the water practices surrounding the *khadeen*, which can ultimately threaten the existence of an invaluable system of water knowledge. The loss of *khadeen*, which depend on communal efforts and practices, would represent the loss of an irreplaceable chapter on adapting to water scarcity. As more and more regions of the globe experience unprecedented levels of water scarcity, *khadeen* and their communities could instead play a central role in shaping successful adaptation to climate change.

Policy Recommendations

- There is an urgent need for the government of Rajasthan to adopt an integrated policy approach and support *khadeen* as a cultural and ecological resource. Policies should focus on providing legal recognition to *khadeen*, increasing community awareness, and promoting sustainable tourism in the Thar Desert area.
- The government should recognize the *khadeen* as protected heritage sites, as well as support local communities and encourage community-led restoration projects by expanding existing governmental schemes (e.g., the Mahatma Gandhi National Rural Employment Guarantee Act) to support the restoration and protection of *khadeen* and provide employment for local communities.
- The preservation of historical *khadeen* for the present and the future should include related water management knowledge in school curricula and efforts to raise public awareness about their importance.

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Traditional Khmer Water Practices: A Case Study of Phnom K'to, Vietnam

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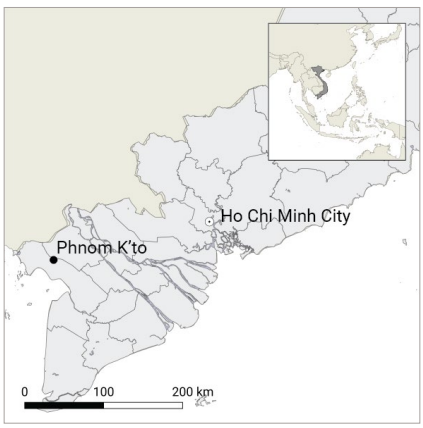
Phnom K'to (Cô Tô Mountain) is the easternmost peak of a small chain of granite outcrops of Vietnam's Mekong Delta. It reveals a long and rich tradition of water management that is often overlooked in present-day development. Although the region is under Vietnamese control, it had centuries of Khmer rule and inhabitation. Today, the marginalized Khmer settlements around Phnom K'to are spread across varied terrain, from rugged mountains to muddy floodplains, with monsoon-fed and flood-cycle cultivation. The Khmer's traditional water practices were carefully adapted to topography and water variations, forming interconnected habitats and productive mosaics specific to Khmer society. However, their vernacular landscape has been dramatically transformed and recast by modern canals (since the nineteenth century), dike building and granite mining (since 1975), and roads and reservoirs (since the 2010s). Whereas the entire region suffers from the consequences of global warming (particularly floods and droughts) and ecological destruction, there is an opportunity to revisit traditional Khmer water practices to provide insights for reconfiguring the water system. Fieldwork-based drawings, annotated with Khmer terminology, highlight morpho-topological readings of the relationship between water management practices and settlement. The research seeks to uncover opportunities to revisit and revalue such practices to renew stewardship of the territory.

Keywords: *traditional Khmer water practices, landscape mosaics, stewardship, adaptive (re)cultivation, traditional ecological knowledge*

KEY THEMES

CLIMATE

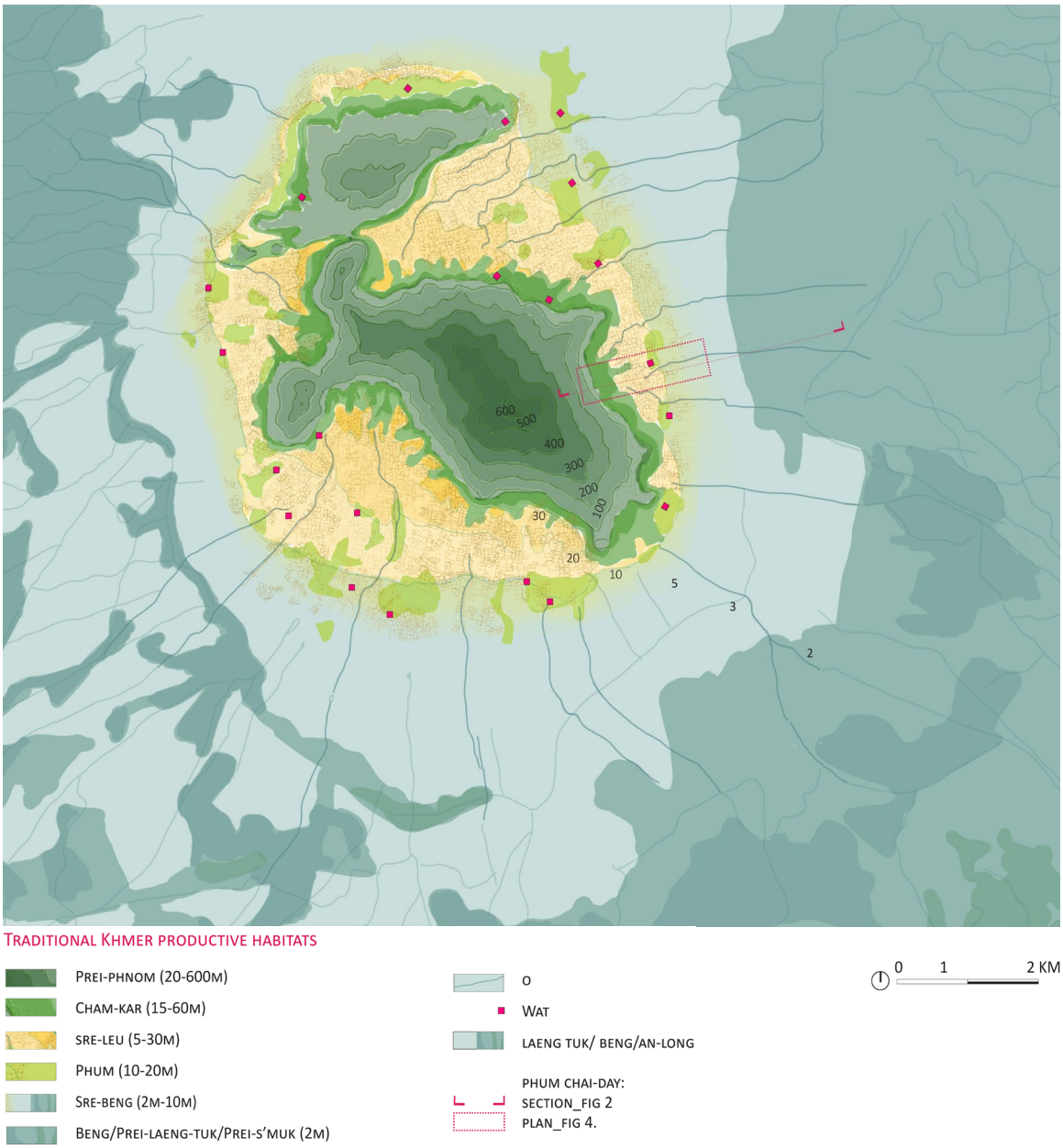
Aw : Tropical Savanna Climate



< Fig. 1 *Chamkar* (foothill garden/orchard forest) to *sre-leu* (terrace rice field) in Phnom K'to (Source: Linh Vu, 2022).

Traditional Khmer Water Systems and Habitats in the Mekong Delta

The Long Xuyên-Hà Tiên Quadrangle in Vietnam, along with the Plain of Reeds and Cambodia's Tonlé Sap Lake, form the primary seasonal freshwater reservoirs in the Mekong Delta. The Long Xuyên-Hà Tiên Quadrangle shares traditional Khmer water practices that also exist in present-day Cambodia. The transboundary flood regimes and interactions with mountainous topography have led to the development of



^ Fig. 2 Phnom K'to traditional water system (Source: Linh Vu, 2024).

a particular traditional Khmer water management system. Phnom K'to in Vietnam serves as a case study within this landscape. Phnom K'to (Cô Tô Mountain) is in the region known in Vietnam as the Seven Mountains (Thất Sơn). It is part of the Cardamom Mountains, mostly in Cambodia.

In folk tales, Phnom K'to is described as the most poetic and spiritual among the mountains in the Mekong Delta, where water is key. Its sacred mountain forest feeds several *o* (streams linking the foothills and the fields) that nurture productive habitats in the plain before merging with the flood regimes of the delta (Son 1959). Khmer cosmology is interwoven with the delta-mountain geography. Six major productive habitats are embedded in the water-topographical system, forming the Phnom K'to landscape. They are 1) *prei-phnom* (mountain forests); 2) *chamkar* (foothill gardens/orchard forests); 3) *sre-leu* (upper field/rainfed terraced rice field); 4) *phum* (inhabited garden/village) in the alluvial apron; 5) *sre-beng* (lower field/flooded rice field) and 6) *beng/prei-laeng-tuk/prei-s'muk* (marshland/swamp/flooded melaleuca forest) in the floodplain (fig. 2).

Traditional Khmer Water Management Practices and Cultural Landscapes

The Khmer Indigenous landscape has been maintained for centuries by a sequence of typo-morphologies across the topography and through habitats, from the mountain to the floodplain, reflecting the Khmer culture of respecting trees, water and soil (fig. 3). Beginning in the higher elevation, *prei-phnom* is the primary water source. It stores monsoon water, recharges aquifers and maintains biodiversity. In Khmer tradition, the *prei* (forest) is a sacred entity with limited access (Son 1959). The *mac-tuk* (mountain stream) is naturally retained at the *la-an* (ravine) foothills before being directed to fields. On the slopes, the *chamkar* is formed through selective clearing and planting, with a water management system centered on the *la-an*, *trapaeng* (natural pond/wetland) and *an-tuk* (constructed pond/water tank).

Different irrigation techniques are employed in the *sre-leu* and the *sre-beng*. Water from the foothills flows through the *o* to the *sre-leur* and cascades from one terrace to another through openings in the *pleu* (terrace wall). Various *an-don* (excavated ponds) and *o* (natural ponds) retain water, while the *andon-tuk-dei* (well) is used in the dry season. Meanwhile, in the *sre-beng*, traditional Khmer cultivation follows the Mekong flood regime, particularly through the practice of growing *srau-peang-tuk* (floating rice). Here, natural *beng* and *prei s'muk* host water and aquatic species. In the *phum*, water for production comes from common sources such as *o*, *andon-tuk-dei* or *sras* (pond of the wat). Each family typically has its own *andon*, *an-tuk* or a drilled well.

Role of the Wat: Water Management and the Social Construction of Space

Wats are Theravada Buddhist temple complexes that are the heart of Khmer society and important features in the landscape. Located in the foothills and in the alluvial apron near main streams, wats literally and figuratively sustain Khmer society and play an important role in the water management of the productive landscape (Taylor 2014, 162–90). Every *phum* has a wat; it provides a focal point for individual, religious and institutional milestones. Monks guide the community's cosmological and agricultural rituals (Le 1969). In Phnom K'to, a few extended families formed a *phum* with a wat, which ex-

Traditional Khmer productive habitats	Water terms/typologies
Prei-phnom (mountain forest)	*An-long* (all-year submerged area on floodplain)
Chamkar (foothill garden/orchard forest)	*Andon* (dug pond/shallow well)
Sre-leu (upper field/rainfed terraced rice field)	*Andon-tuk-dei* (well)
Phum (inhabited garden/village)	*An-tuk* (pond/water tank)
Sre-beng (lower field/flooded rice field)	*Beng* (marshland/swamp)
Beng/prei-laeng-tuk/prei-s'muk (marshland/ swamp/melaleuca forest)	*Hoc* (small ditch)
Features and plants	*La-an* (ravine/all-year mountain stream)
Chai-day (stupa/ash-tower in wats/phum's name)	*Le-ron* (ridge and furrow)
Daem koki (Hopea odorata, growth as wat's forest)	*Mac-tuk* (mountain stream)
Krang (garden/forest island on the field)	*O* (stream from the foothill to the field)
Ktom neak ta (spirit house)	*O* (natural pond near the phum or stream)
Neak ta (more-than-human-beings in Khmer animism)	*O-tuk* (running water/ditch)
Prei (forest)	*Pleu* (rice-terrace walls)
S'muk (flooded melaleuca)	*Prek* (channel/canal/river)
Srau-laeng-tuk (floating rice)	*Sras* (brick/stone pond in the wat)
Sre (rice field)	*Trapaeng* (natural pond/wetland)
Sre-co-beng (overlap system of sre-leu and sre-beng)	*Tuk* (water)
Daem svay (mango tree)	*Tuk-choh* (flood reversal)
Daem thnaot (palm tree)	*Tuk-haur* (water descends from the mountain)
Wat (Buddhist temple complex)	*Tuk-kraom-dei* (ground water)
	Tuk-laeng (flood-rising/flooding season)
	Tuk-reak (water drying up/dry season)

* The terms were collected during fieldwork and in discussion with a local senior social worker. They are also mentioned in the published works of Taylor (2014), Nam (1959) and Vuong (1993). Khmer terminology reveals an intimate link of language, place names and everyday practices to landforms and ecological processes. The water-related terms also embody sacred meanings and social-ecological interconnectedness in landscape construction through generations of families and the larger community. It is critical to learn from the case since local Khmer practices and terms are being replaced by Vietnamese systems and names that do not necessarily carry the same embedded meanings. This in turn, results in both a disregard and loss of traditional water management practices and spaces and a loss in water management knowledge.

^ Table 1. Khmer words in the drawings and writing* (Source: Linh Vu, 2024).

panded and has been rebuilt over time. Wats institutionalize the inhabited landscape through labor and material offerings. However, despite the wat's domination, ancient animist traditions continue to be respected alongside Buddhism. This means that the wat does not dominate nature (mountain, forest, water regimes) but instead integrates with it (Phan 2014).

Water activities in the *phum* are spatially and symbolically linked to the wat, which helps maintain and protect water sources for the community. The *sras*, built by the community using stone, is important for storing water (Le and Nguyen 2021), especially in the dry season. Since water is central to Khmer cosmology, as a component of the wat, the *sras* is sacred and its water is used carefully. Lotus is often grown in the *sras*, which minimizes evaporation and purifies the water while serving as a religious symbol.

The wat is also the center of seasonal festivals and water ceremonies, which are essential to social and agricultural life. Events such as Choul-Chnam-Thmey (New Year Festival) and Ok-Om-Bok (Moon Festival) include rituals like welcoming and praying for rain, celebrating the recession of floodwaters and offering prayers to the moon for the monsoon season. Floating altars and lights are used in ceremonies to bless the community with good crops.

Historically, wats were closely connected to a natural water source and local animist practices and beliefs, particularly those involving *neak-ta* (more-than-human beings). For example, near the *la-an* in the *phum* Chai-day, local people planted a *daem svay* (mango tree) to mark the most critical communal and perennial water source. Traditionally, shrines or sacred rocks have been placed near *la-an* in gratitude to the mountain forest *neak-ta* for abundant water; these can still be found near historical wats and ruins close to the foot of the mountain. Throughout the Khmer's tumultuous history in the region, wats have been closely linked with the building and rebuilding of Khmer communities (Taylor 2014).

Mosaics and Flows as Integrated Systems: Kinship in Landscape Operation

The cascading productive mosaics and flows in Phnom K'to have been shaped and transformed over centuries through interrelated water management processes. These processes involve micro-topographical manipulation and the maintenance of shared ecological resources, often managed through kin networks. Traditional Khmer social structures – including household members and relatives, neighbors and friends within a hamlet or nearby hamlets – mobilize groups to engage in wet rice cultivation. This labor-intensive practice relies on simple techniques and rudimentary tools that minimize soil and water disruption (Son 1959). Despite modernization and the imposition of more generalized systems, these cooperative social structures, rooted in kinship and communal labor, persist to varying degrees (Biggs 2012; Linh 2016).

Slope reclamation in Phnom K'to has created productive landscapes with minimal earthworks. Effective water management for planting requires careful manipulation of micro-topography, while seasonal water, temperature and vegetation cycles make the earthworks dynamic. Precise quantities of water are essential for plant growth, which can be difficult to achieve in extreme wet or dry periods. A common technique, the *le-ron* (ridge and furrow), helps conserve water during droughts and drain excess during wet-season overflows. Flat areas are cleared to make the *sre-leu* (upper field/rain-

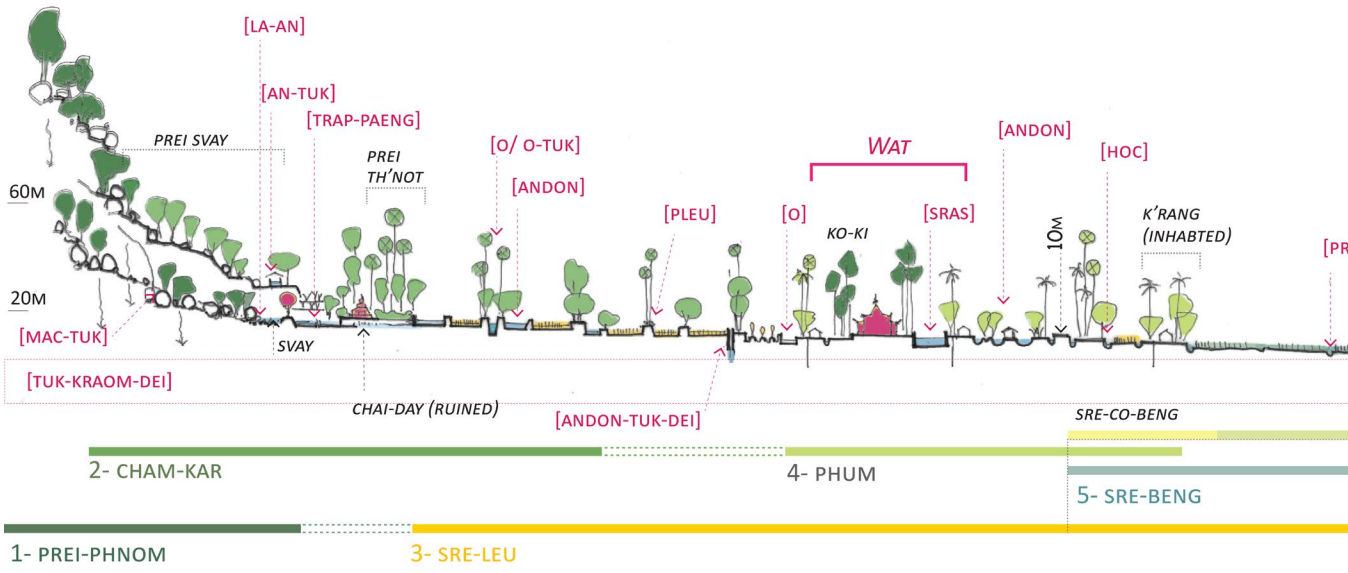
fed terraced rice field) and *pleu* (terrace walls) retain water. The topography defines an organic *sre-leu* morphology, with uneven *pleu* ranging from a few centimeters downhill to a meter uphill. These fields, typically small – often less than 0.3 ha – are crafted using simple, traditional methods that make them manageable for local farmers.

The cascading arrangement of productive mosaics and the careful maintenance of water flows create ecological connections across diverse terrains and habitats. The rough surfaces of foothills and wetter areas along streams are prioritized for *chamkar* and water retention, forming "wet-green flows" that are thick in the foothills and sparser in the floodplain. Natural streams and watersheds are reconfigured to integrate productive plots and water channels that divert the mountain water to various fields or discharge surplus water. This system incorporates a network of various ponds and wetlands, which act as micro-watersheds. Protected from evaporation by tree canopies and aquatic vegetation, these water bodies help minimize evaporation, ensuring sustained water availability for the ecosystem.

Finally, *bau-waq* (shared/aid-labor) is a Khmer tradition in which kin groups help one another in the fields, especially when planting rice, transplanting seedlings and harvesting crops. The rationale behind the collective practice is not only that it makes possible the required labor intensity but also offers a way of dealing with subtle differences in wetness and, consequently, in time-intensive work in the *sre-leu*. Many Khmer water terms, such as *la-an*, *trapaeng*, *pleu* and *o*, denote common use and care, as well as degrees of sacredness.

Seasonal Daily Stewardship: The Cultivation of Culture

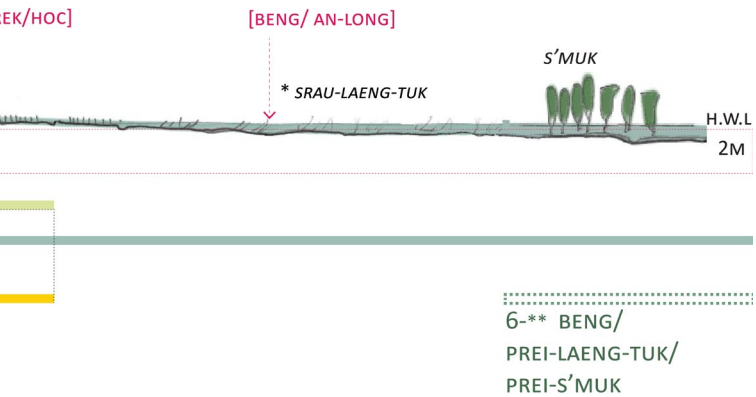
For centuries, Khmer everyday practices were re-



^ Fig. 3 Khmer morpho-typologies (and terms) pertaining to water practices are related to habitats and topography across Phum Chai-Day, Phnom K'to (Source: Linh Vu, 2022).

^ Fig. 4 The reconstructed *sras* (pond) in 1995 in Wat Chi-mung, built in 1712 in Phnom K'to. These construction dates were written on the gravestone inscription near the entry of the wat (Source: Linh Vu, 2022).

* *Srau-laeng-tuk* was replaced by the modern wet-rice.
** 6 - *Prei-laeng-tuk/prei-s'muk* is remained few kilometers away from the *phum*.
There are some initiatives to re-introduce *srau-laeng-tuk* & rewild *prei-laeng-tuk* in tri ton.



lated to cosmology, where destruction precedes rebirth (Taylor 2014, 252–71). Even today, everyday practices intertwine with water stewardship, forming natural–cultural interactions (Bourdeaux 2023). In Phnom K'to, farming takes place year-round, and everyday water practices are synchronized with the seasons. The Khmer seasons are named in relation to water regimes and their accompanying practices and rituals. In the upper fields, *tuk-haur* (run-down water) denotes the rainy season *w*hen monsoon water descends from the mountain, whereas *tuk-reak* (water dry-up) indicates the dry season. In the lower fields, the seasons are known as *tuk-laeng* (flood-rising) and *tuk-choh* (flood reversal). The beginning of the planting season is a time to pray to *neak-ta* for rain and favorable weather to start preparing the *sre* (rice field). Meanwhile, the cultivation season culminates with

harvesting and the Ok-Om-Bok festival to thank the moon being for good crops. In traditional Khmer homesteads, cultivation of the annual rice crop is adjusted to natural water conditions and does not require large-scale hydraulic interventions. Farmers grow wet rice and gather fish in the rainy season; they grow drought-resistant plants and raise herd animals that graze on fields in the dry season. They make use of the *chamkar* throughout the year.

Conclusion: Learning from Traditional Khmer Water Management to Adapt to Global Warming

Traditional Khmer water management in Phnom K'to shows how local ecological knowledge frames the morphological identity and social meaning in collective processes of domesticating landscapes. All water elements and the cascading productive mosaics embody elements of Khmer cosmology and integrate daily water stewardship with cultural traditions. The cascading productive mosaics and water elements are not only functional but also symbolically tied to the Khmer worldview.

The Khmer vernacular landscape has been continually transformed by external influences, beginning with Vietnamese colonization during the Nguyễn Dynasty and continuing through the introduction of new technologies during the colonial period and centralized state interventions (Biggs 2012; Linh 2016). Key changes include deltaic canalization in the early nineteenth century, the construction of high dike systems since 1975, the expansion of rock mining in Phnom K'to since 1985, and, since 2020, extensive road widening and paving. Additionally, large-scale water reservoirs have been built since the 2010s to support intensive agricultural production. These interventions have resulted in severe environmental destruction, intensified water scarcity and the disruption of Khmer cultural identity. The language of the landscape has been altered, as traditional terminology has

^ Fig. 5 Landscape mosaics and flows with micro-topographical manipulation and plantation are labor-intensive and involve traditional kinship patterns. Phum Chai-day (Source: Linh Vu, 2024).

been replaced by engineering jargon, erasing the cultural significance embedded in the landscape.

Given these challenges, there is an urgent need for a radical shift in approach. Traditional water practices, which have been acknowledged as relevant in global warming discourse, can aid the development of innovative approaches, including those that involve integrating technology and social organization (Krupnik et al. 2018). Traditional knowledge that is deeply rooted in the Khmer landscape and everyday practices suggests the value of cooperative strategies and community stewardship that works in harmony with natural processes rather than by imposing conventional civil engineering solutions.

Policy Recommendations

- The design of water projects, programs and policies should be informed by a combination of current scientific knowledge – such as hydrological models that address the impact of global warming – and lessons from Khmer traditional water practices and knowledge. These traditional practices, which work with the forces of nature, offer an intelligent and culturally resonant alternative to conventional civil engineering approaches. In the case of the Khmer, the traditional water terminology and management are reflected in landscape morphologies and daily practices, promoting cooperation and sustainable water management through community stewardship.

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The Longue Durée of *Weitian* Landscapes in the Yangtze River Delta

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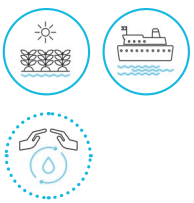
KU Leuven

The ancient weitian (polder) system in the Yangtze River Delta represents a particular form of water urbanism, integrating productive polders, villages and prosperous water towns (shui-xiang). Over millennia, the hudang-weitian (shallow lake polders) transformed the muddy plains around Taihu Lake into a highly productive area. Zhenze, founded in the twelfth century, is an important water town that initially operated within a network of garrisons and trading ports. This case study illustrates the resilience of weitian landscapes and how twentieth-century water management reshaped the small polders into larger wei-qu (polder zones) through a process of lian-wei-bing-wei (joined and merged polders). While urbanization and industrialization continue to erase many historic polders, the region's water towns are being preserved and developed, largely for tourism. The case highlights both the benefits and shortcomings of the weitian transformations, emphasizing the need for a balanced approach that both facilitates development and preserves the region's unique deltaic conditions.

Keywords: *polders, canals, deltaic landscape, water urbanism, mapping*

KEY THEMES



CLIMATE

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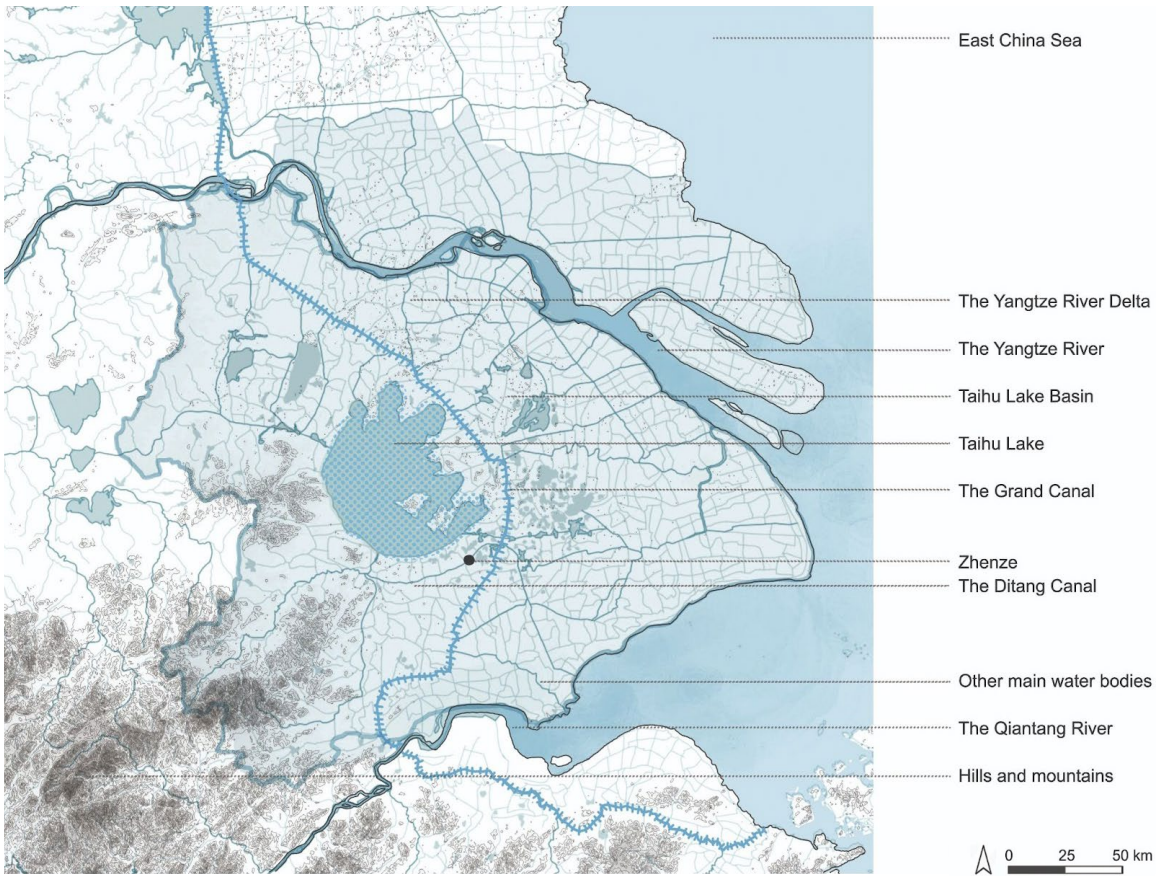
< Fig. 1 Zhenze and its waters – river, canals and irrigation channels – interwoven with clusters of various types of settlements (Source: Wei Lei, 2023).

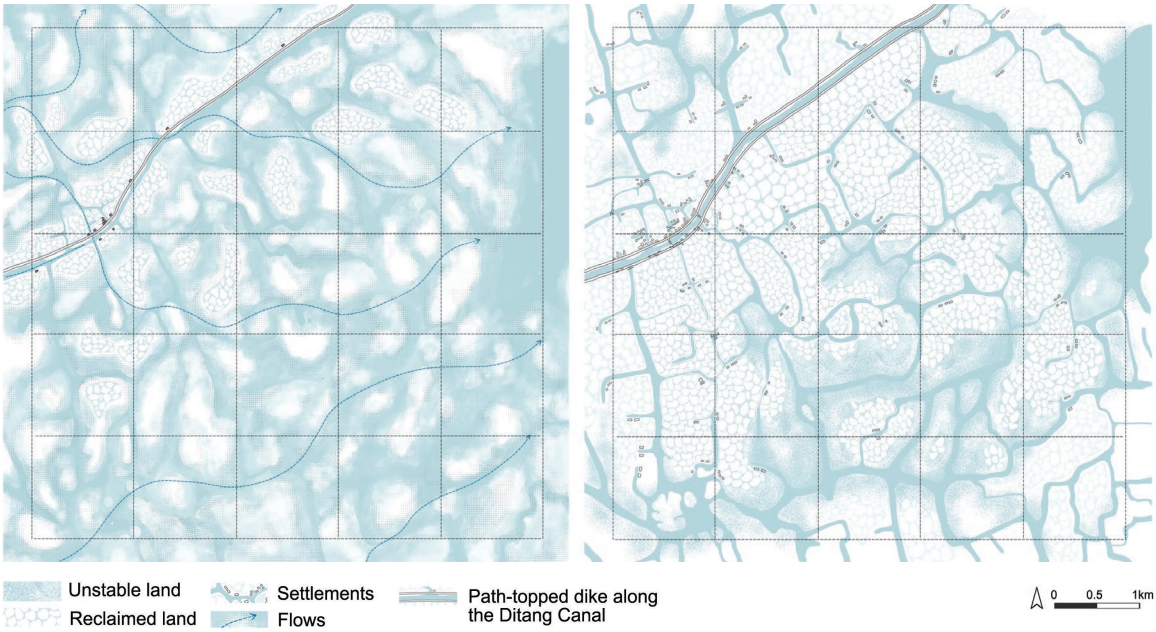
The Ancient *Weitian* of the Yangtze River Delta

The ancient system of *weitian* emerged in the Yangtze River Delta in 400 BCE. Taihu Lake (fig. 2), the region's largest natural lake, was the first area of the delta to be reclaimed. The topography of the Taihu Lake Basin tilts from northeast to southwest. Reclamation began with the relatively higher area of soil accumulation immediately alongside the lake and then expanded to areas where the lower topographies were formerly underwater (Miu 1985; Zheng 1987). During China's early dynasties (before the tenth century), kingdoms and vassal governments co-occupied the territory and developed top-down *tuntian* (garrison reclaimed fields) to facilitate agricultural activities and settlements. An extensive polder network was developed by troops when warring states sought to control grain production, ensure military supply and feed migrants fleeing rebellions in the north. *Tangpu-weitian* (channels parallel and perpendicular to the lakeshore), also known as *da-wei* (big polders), formed a hierarchical water management system with main waterways, gridded dikes and dammed channels. The unit of grid-shaped *da-wei* was comparable in size and shape to those of circumvallated cities of the same period, such as Suzhou (Miu 1985).

With China's dynastic government waning beginning in the tenth century, extensive garrison reclamation was no longer a priority. The centralized development and management of



^ Fig. 2 Taihu Lake and its spatial relationship with the Grand Canal, the larger delta, the sea and the case study town of Zhenze (Source: Wei Lei, 2023).



^ Fig. 3 Zhenze's poldering process circa 1000 CE (left) and circa 1600 CE (right) (Source: Wei Lei, 2023. Based on maps in Chronicle of Wujiang [1488] and Chronicle of Zhenze [1746]).

reclaimed lands was replaced by a land leasehold system that included tenant farmers. During this time, the Taihu Lake Basin remained a major rice-producing region, with the government claiming a significant share of production through taxation. The large-scale *tangpu-weitian* that was formerly reclaimed by garrisons was not well-maintained by the tenant farmers and gradually disintegrated. During the same period, path-topped dikes functioning as long bridges along the north-south canals were constructed, significantly interfering with the east-west flow of water from the lake to the sea. The bridge-shaped dikes slowed the flow, increasing sedimentation in the lower eastern lakeside areas. Taking advantage of the sedimentated lakeside, families engaged in reclamation leading to the development of *hudang-weitian* (shallow lakes polders), which families also maintained. These shallow lake polders were generally small and they were not dispersed in a systematic way. Their forms led to their being called *yulin-wei* (fish scale-patterned polders).

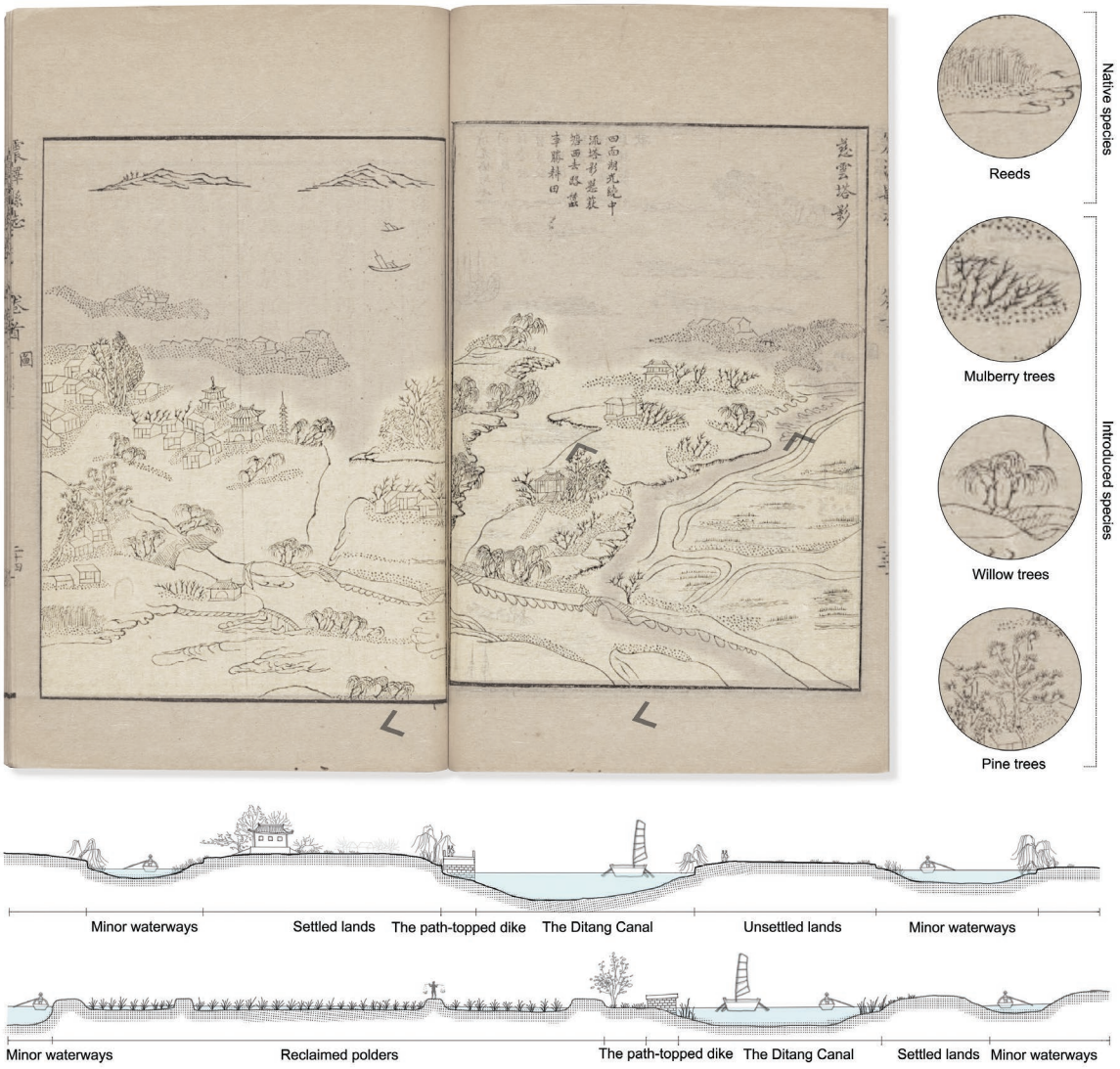
Zhenze Water Town

As the agricultural reclaimed lands continued growing in low-lying areas, water towns emerged along major canals in such areas (Wang 2016). Zhenze, once a trading port and typical twelfth-century garrison settlement, is located on the southeastern bank of Taihu Lake and along the Ditang Canal — a dredged northeast--southwest waterway. In the eighth century, the canal had been strengthened with path-topped dikes to facilitate land transportation and protect the town from waves coming from the lake.

Complemented by accelerated sedimentation (caused by seasonally lower water flows com-

bined with high sediment load), newly reclaimed lands and large-scale settlements were developed (fig. 3). From the eighth century onwards, many new buildings were constructed along the canal's dikes, taking advantage of the elevated typology and proximity to transportation. Typically, building fronts were aligned with the streets and backsides were adjacent to the canal and accessed via staircases. Bridges connected streets separated by water. Movable barriers were installed under bridges in key locations for defense purposes, creating densely settled areas surrounded by water gates, resembling fortified, gated cities.

By the sixteenth century, Zhenze was a substantial town recorded to have around 1000 families and thriving commerce (Fan 1990). From that point on, like many water towns in the vicinity of the lake, Zhenze's polder-based rice yields



^ Fig. 4 Polders for production and canal banks for settlement, as seen in Zhenze, along the Ditang Canal, as depicted in the eighteenth century (Source: Chronicle of Zhenze, 1746]; Wei Lei, 2023).

could no longer feed the growing local population after taxes were paid in rice (Fan 1990). As a solution, multi-cropping and new forms of cultivation emerged (Huang 2000; Xie 2015). Plant species were introduced that aided water management and new types of production. Willow trees were planted along dikes to make them stronger. Mulberry trees, for breeding silkworms used to make silk, were planted on higher ground, close to the settlements, and in smaller elevated areas within the paddy fields. Ornamental plants (e.g., pine trees) also appeared and indicated a growing class of affluent local families (fig. 4). The higher profits of the silk industry shifted Zhenze's reliance on polder-based agriculture to mulberry cultivation (Wang 2013; Fan 1990). The new types of cultivation and industries meant that Zhenze and other water towns had to rely on imported grains, mainly from upstream regions along the Yangtze River (Fan 1990). Zhenze remains one of China's major silk-producing towns.

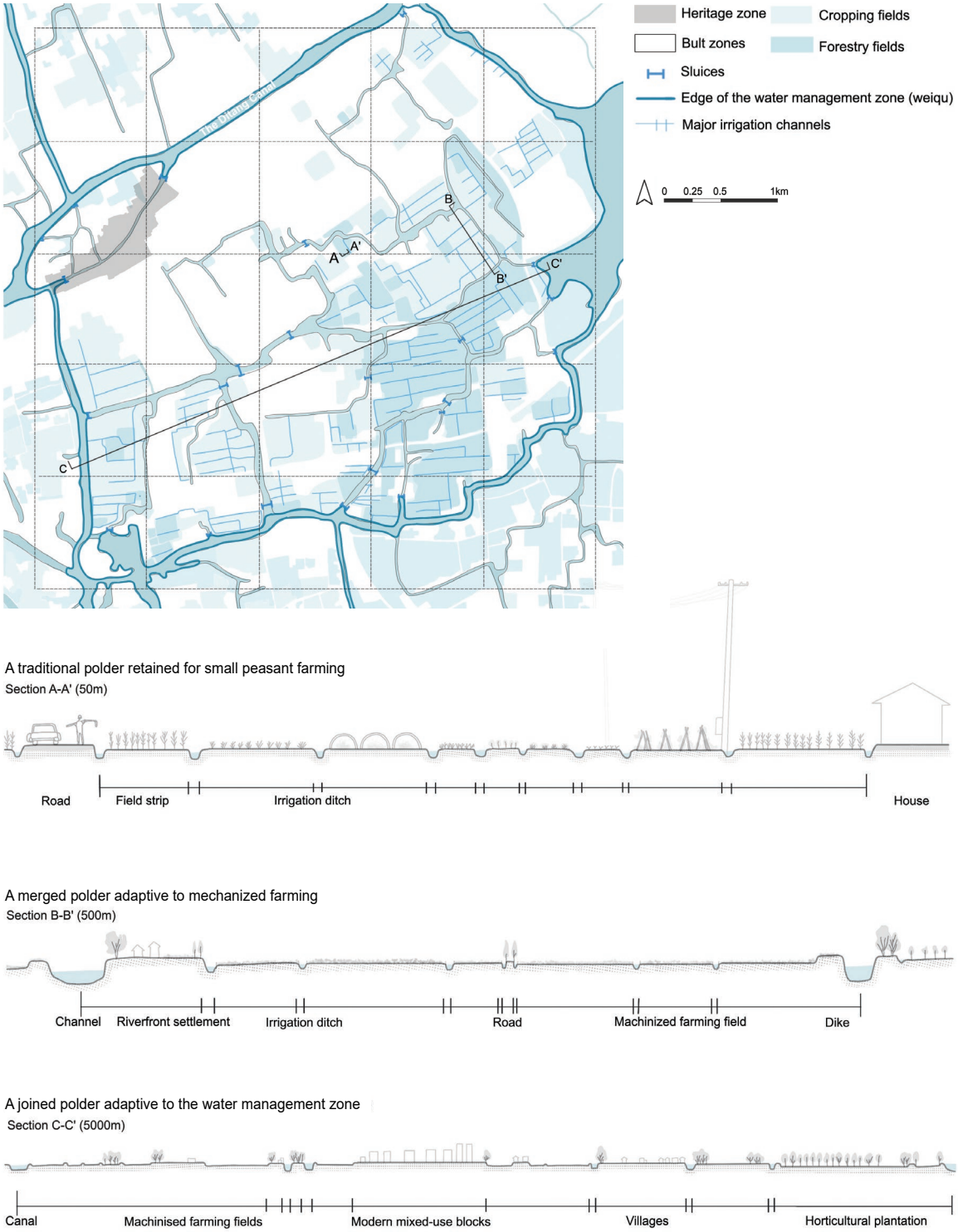
Contemporary Water Management

After the founding of the People's Republic of China in 1949, the long-standing water management system based on small polders underwent significant transformation. Because of several wars in the nineteenth and twentieth centuries and the declining silk profits, Zhenze's mulberry plantations were drastically diminished (Fan 1990). As part of the Great Leap Forward (1958–1962) and the People's Commune (1958–1984), a communist social movement introduced *weiqu* (water management zones) (Zhenze Chronicle Compilation Committee 1999). The primary goal of constructing water management zones through the *lian-wei* (joined polders) and *bing-wei* (merged polders) initiatives was to increase crop yields. Channels between the fish scale-patterned polders with *bing-wei* were filled to create greater expanses of fertile land. New gridded irrigation channels were dug, and the larger, continuous fields were adapted to mechanized cultivation. At the same time, clusters of merged polders were serviced by electric pumps and regulated by sluices. The sluices formed larger water management zones and created *lian-wei*. These water management zones, redefined by the outer dikes, resulted in a much-reduced dike length compared to the previous cumulative length of all the polders. The reduced length of dikes made them easier to improve and maintain. The new polder-based water management system was thus believed to be more flood-resistant and necessary to reach higher yields. (Jiangsu Provincial Revolutionary Committee Water Conservancy Bureau 1978).

Today, there are three types of polders that operate on radically different scales:

1. *Yulin-wei* are used for traditional farming. The few that remain are typically located near farmers' houses, where they are well-maintained and primarily used by retirees as both a local food source and for socializing.
2. *Bing-wei* are grids of irrigated fields surrounded by water and are visible on aerial photographs.
3. *Lian-wei* are often separated by major canals and lakes, dammed by channels and lakes and regulated through sluices; like *bing-wei,* they are visible from above (fig. 5).

Despite the increased size and mechanization, the fundamental idea of a polder-based water management system has not changed. Nevertheless, the water management systems of the latter two types are often difficult to perceive due to their large scale. In terms of cultural identity, the *yulin-wei* remain an important feature of the Taihu Lake environment.



^ Fig. 5 Zhenze's three co-existing hierarchical polder-based water management systems within the *weiqu* (Source: Wei Lei, 2023).

Division of the Productive, Protective and Consumptive Landscape

Before modernization, the yield production per *weitian* remained relatively low, even though fields were cultivated to their near-full capacity (Huang 2000). This was primarily because accurate water levels, necessary for various phases of crop growth, were difficult to control. The *yulin-wei* were usually only protected by a thin dike, which could withstand flooding but were very sensitive to water fluctuations and unable to maintain ideal water levels. Beginning in the eleventh century, hydrologists periodically proposed reinstalling the historic water management system based on *da-wei* (Sun and Geng 1980; Zheng 1987). Near Zhenze, a new and significantly wider Ditang Canal for contemporary water transportation was excavated in 1935 on the canal's northwestern side rather than widening the old canal. In the 1990s, the old Ditang Canal became completely redundant when the polder located in the urban core was merged with the neighboring water management zone. In 1997, the often-closed sluices were added to the entrance and exit of the town (fig. 6), rendering water transportation nearly impossible. Nonetheless, the water town has been aggressively marketed as a tourist destination, along with productive *weitian* in nearby water villages. *Yulin-wei* are showcased in agritourism operations. The once thriving legacy of the productive landscape system has effectively been rendered mute. Its protective capacity remains vital and the impeding increased consequences of global warming will prove its effectiveness,

^ Fig. 6 The addition of modern sluices between the polders forms *weiqu*. The entrance of Zhenze is now demarcated by a sluice (added in 1997) near the ancient Yuji Bridge (Source: Wei Lei, 2023).

although the entire system has been compromised through massive urbanization and the accompanying loss of permeable surfaces.

Overall, the once intricate relationship between aspects of the landscape devoted to production, protection and consumption has been severely altered. Nevertheless, the ancient water town of Zhenze itself remains largely intact thanks to its enduring silk industry, contemporary tourism and heritage conservation policies. In the 1990s, a joint application for 14 Yangtze Delta water towns was made to UNESCO World Heritage. The application included Zhenze and was considered an opportunity to boost a cross-regional cultural landscape renaissance (Kong and Jiang 2022). In 1995, the first batch of water towns was listed for national protection as Jiangsu Provincial Historical and Cultural Towns. Zhenze was included in the second batch in 2001, and in 2002, its first conservation plan was established. Nonetheless, the town's official heritage zone has a noticeable spatial boundary defined by a few historic blocks, and this remains the case following its rating as a National 4A-level Scenic Spot in 2014. Unfortunately, its water management system is not included in the conservation policy and continues to transform dramatically. The region's polder landscapes, as both cultural heritage and water management systems, still await integration into the relatively new Chinese territorial planning system that took effect in 2018 (Xie et al. 2022). Clearly, from multiple perspectives, more attention is paid to the cliched built architectural form of the water towns. Appreciation of the continually transformed polders has significantly suffered due to a shift in values and the predominance of more mechanization of water management and a focus on large-scale road-based infrastructure.

Conclusion

The millennia-old *weitian* of the Taihu Lake area of the Yangtze River Delta region is a form of water heritage that is highly sensitive to continued hydrologic engineering, reclamation, modernization, industrial transformation and shifting socio-political environments. The town of Zhenze illustrates the shifting relations of water management and polder-based practices in the Taihu Lake area. Socio-political changes in the region have led to radically different spatial configurations, in terms of both sizes and forms, of the poldered landscape. The interrelation of civil engineering (water management system), agriculture and settlements can be considered an early form of landscape urbanism, long before the "ism" was popularized in the 1990s. At the same time, their very existence as a polytechnic system is threatened by the region's excessive urbanization and the fact that they have not yet been defined as heritage (Wang et al. 2023). Instead, water towns' revenue-generating tourism-driven conservation approach largely neglects the history of their having emerged in concert with the poldered regional-scale landscape. At the same time, the small and relatively inefficient fish scale-patterned polder is favored for heritage protection more because of its striking appearance than for its role in water management and production.

Policy Recommendations

- Polder conservation is important not only in relation to heritage but also for polders' value in water management. The modernization and urbanization of the Yangtze River Delta region make it difficult to balance exploitation and natural rhythms. The contemporary deltaic hydrology and topography are witnessing more engineering intervention than at any time in history and in ways that pose significant challenges to the landscape traditions of water towns. The territory's water management could learn valuable lessons from the longue durée of the *weitian* landscapes.

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Learning from the Hydraulic Heritage of Figuig, Morocco

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In the face of water scarcity and climate change, the Figuig Oasis exemplifies resilience through the integration of culture, heritage and sustainable development. This arid region has preserved ancient water management practices that have sustained life for millennia, offering a model for achieving the United Nations' Sustainable Development Goals (SDGs). Figuig's significance lies in the potential to harmonize traditional and modern water governance systems, optimizing its hydraulic organization as a living cultural heritage to ensure the sustainability of ecosystems in desert environments amid growing water scarcity.

Keywords: *resilient water management, oasis irrigation systems, water scarcity, water governance*

< Fig. 1 Figuig Oasis: lifeblood of a fragile ecosystem in the arid desert (Source: Ouafa Messous).

Figuig: Resilient Oasis at the Edge of the Desert

Figuig (fig. 1), located in the eastern region of Morocco, 841 km from the capital Rabat and 373 km from Oujda, the regional capital, lies deep within the desert. The city is characterized by significant temperature fluctuations, ranging from 0°C in winter to 45°C in summer, with an average annual rainfall of only 150 mm. Historically, prior to the geopolitical and macroeconomic upheavals of the twentieth century (fig. 2), Figuig served as a strategic commercial hub along desert trade routes, connecting eastern Morocco with the sub-Saharan regions of West Africa (Vallat 2014). Today, Figuig's local economy is strongly dependent on its oasis and date palm groves. The ecological, economic and social balances in this context are exceedingly fragile and important, posing critical challenges to the sustainability of the region.

The example of the Figuig Oasis is particularly noteworthy due to the survival of its millennia-old traditional hydraulic system (El Fassi 2015), as well as the resilience of its traditional system of governance, which is based on communal management. The fundamental principle of this is that water use must be equitable and meet essential needs (basic domestic use) balanced with productive needs (agriculture).

The case of Figuig calls for careful consideration of governance models in extreme situations, whether they arise from water scarcity

^ Fig. 2 Section of the oasis destroyed in the early twentieth century due to a conflict between villages, triggered by a water management dispute. Ongoing urbanization in the distance (Source: Ouafa Messous, 2019).

or from social, economic or even geopolitical tensions. To prioritize the survival of the oasis and its ecosystem, both traditional and modern hydraulic systems should converge toward this goal, starting with the rationalization and optimization of water use by all possible means.

Traditional Water Management in Figuig: Subtleties of a Resilient Hydraulic System

Water management in Figuig is intricately linked to the social structure of the oasis. The inhabitants, distributed among the various *ksour* (traditional villages), collaborate to maintain the irrigation network and regulate water distribution. In the past, each *ksar* (village) had its own specific rules governing water distribution.

The *raïfi* or *aiguiadiers* (water guardians) responsible for allocating *kbarrouba* (units of time) and *tigbirte* (units of volume) (Lahlou 2017), historically have played a crucial role in balancing water rights, taking into account seasonal variations and the specific needs of each agricultural plot. Each *kbarrouba* corresponds to 45 minutes during which a specific amount of water is allocated to a plot. This time is then converted into a water volume within storage basins, allowing for flexibility and optimization in water usage. This system has not only proven effective for the survival of the palm grove but also strengthened social ties and community cohesion.

The hydraulic network in the Figuig Oasis is designed to optimize and maximize water usage. Water is sourced from various springs within the oasis, and at junction points, distributors channel the water into primary basins of various *douars* (small clusters of human settlements). From these basins, a network of *seggias* (surface channels) runs throughout the palm grove, delivering water by gravity to the plots needing irrigation. Water is also conveyed via aqueducts when the rugged terrain necessitates it. Besides the natural springs, water is brought into the oasis from external sources through *khattarates* (underground conduits) or *foggaras* (underground galleries capturing runoff) (Smith 2015). This system also includes *ahfires* (rainwater capture pits), where underground cisterns are constructed. The most remarkable feature of this hydraulic system is the use of geothermal energy to maintain water at an optimal temperature year-round, facilitated by the construction of *bahbouha* (subterranean crevices) used for both public and private baths.

^ Fig. 3 The landscape in (left) and outside (right) the Figuig Oasis (Source: Ouafa Messous, 2019).

The optimization of water usage is also evident in agricultural production methods, which maximize the use of space and water, ensuring productivity in an arid environment. The stratification of crops into three levels – date palms, fruit trees and low-growing plants – creates a microclimate that reduces evaporation and protects the lower crops from extreme weather conditions (Harrouchi 2010).

The scarcity of water resources has led to the development of a hydraulic system that makes use of all possible water resources, rationalizes consumption and intensifies usage. Thus, each water resource is used and reused at different stages based on its sacred purity and level of cleanliness: purified water isused for religious tasks like ablutions and is then repurposed for less sacred uses, such as cleaning or irrigation, depending on its condition.

The Geopolitical Challenges of Water Management in Figuig

In Figuig, water management, along with the preservation of its traditional network, has reached critical limits, unveiling a set of complex new challenges. One is a duality of local governance: The coexistence of the traditional system and modern approaches to water management reveals a stark contrast in governance, with no carefully considered or gradual transition between the two systems. On the one hand, the local population advocates for the preservation of their hydraulic heritage – despite its vulnerabilities, such as unequal distribution (Amrani 2020), inter-village tensions (Benchekroun 2018) and individual pumping practices. Water was allocated based on agricultural needs and household size to ensure food security. Conflicts arose when access, previously governed by communal rules, shifted to favor status and power, leading to the rise of individualistic practices at the community's expense. On the other hand, the administration promotes standardization to facilitate the control of water as a national resource. This dichotomy has led to escalating political and social tensions. The primary challenge, both locally and regionally, lies in modernizing traditional social structures, institutionalizing them and potentially transforming them into "Public Interest Social Structures." Preserving this heritage also requires upgrading its governance mechanisms, as well as exploring solutions to optimize water use as a vital resource.

Another challenge has been the exacerbation of border tensions. The border between Morocco and Algeria is not merely a political demarcation but also a hydrological divide. The aquifers and springs that supply Figuig are shared between the two countries, making water management even more delicate (Harrouchi 2010). Bilateral water agreements often fall short in preventing disputes, and the political tensions between the two nations further complicate cooperation (Benchekroun 2018). The coordination of water policies is frequently hindered by broader geopolitical considerations, which further complicates the implementation of sustainable solutions (El-Fassi 2015). In this context, water, initially a local concern, has become a national issue, exacerbating already strained relations, even among villages within the same oasis.

> Fig. 4 The hydraulic system in the Figuig Oasis includes many components:

1. Sources supplying the oasis with water; 2. *Seggias* (surface channels; also shown in image 5); 3–4. Storage basins; 5. Hydraulic distribution structures, such as aqueducts (see image 6) or underground canals called *fougga-rates* (see image 9); 6. Aqueducts; 7. *Ahfire*, hollow areas with underground cisterns used to store rainwater for later use; 8. *Bahbouha*, subterranean crevices used for baths; 9. Underground canals (Source: Ouafa Messous, 2019).


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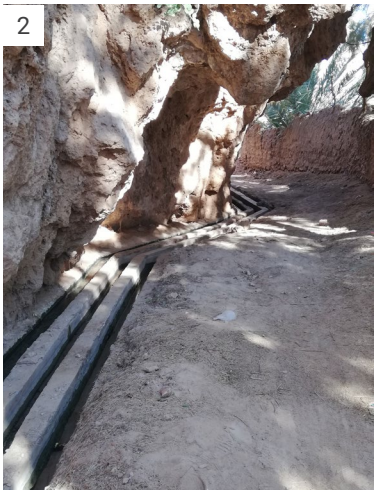
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Managing the Transition: Challenges and Tensions in Water Governance in Figuig

The late 1990s witnessed the establishment of Agricultural Water Users Associations (AUEAs) as a state initiative and as part of structural adjustment plans. These associations were tasked with representing irrigators to public administrations and organizing water management, with the aim of improving the efficiency and sustainability of irrigation systems (FAO 2019).

The transition to this new form of governance was not without tensions. AUEAs often found themselves in competition with traditional water management structures, particularly the informal arrangements between irrigators and *aiguiadiers*. In some instances, AUEAs were perceived as a way for the state to interfere in local affairs, challenging ancestral practices and institutions.

The construction of a dam near Figuig in 2010, though not yet fully operational, has accelerated the broader socioeconomic and socio-spatial transformations that have been unfolding since the early twentieth century, reshaping the oasis's traditional landscape and its relationship with water despite its conservative character.This project has strengthened the role of AUEAs, which will be responsible for distributing this "new water," but it has also raised concerns about equitable distribution and the impact on traditional practices (Smith 2015). Discussions surrounding the dam's water management have highlighted the challenges of updating water management information and integrating new users (Ministère de l'Agriculture et de la Pêche Maritime 2020).

Conclusion

In the context of water scarcity, the emergence of social, economic and political tensions underscores the urgency of finding new solutions and objectively reassessing the current situation. The example of the Figuig Oasis illustrates that the traditional water management system, which has continually adapted to challenges, deserves to continue evolving. Its integration with modern technologies, such as dew collection for localized irrigation (Hasila 2020; Yang 2024), could further strengthen this system.

The case of Figuig suggests a modern, sustainable framework: Water consumption should be based on actual needs rather than financial capacity, ensuring efficient use of resources and minimizing waste. From this perspective, viewing water as a resource for shared management projects, rather than through the lens of exclusive use, can replace inherent tensions with a societal approach that emphasizes shared benefits – a "win-win" strategy.

Finally, it is important to highlight the triptych – community goals, accepted governance and optimized solutions – demonstrated by the Figuig case. This model encourages intensified water use while clarifying both societal objectives and the principles of sustainable water management. Water use should be tiered within homes, with water being reused based on its cleanliness for tasks like cleaning and irrigation before it is sent to neighborhood and city treatment stations, maximizing efficiency and minimizing waste.

Policy Recommendations

- In adapting to climate change, water management authorities should ensure balanced sustainable development by integrating traditional and modern practices. By enhancing local communities and their governance, geopolitical risks can be reduced.

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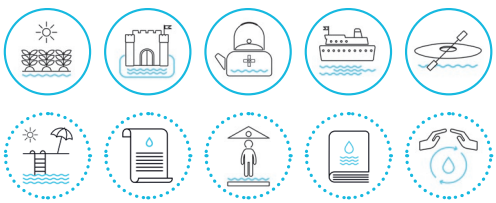
Interview with Feng Gu: Revitalizing and Activating Canal Cities through the Integrated Protection of Water Heritage of the Grand Canal

Interview with **Feng Gu**, former director of the China Grand Canal World Heritage Application Joint Office by **Kaiyi Zhu**, Delft University of Technology & UNESCO Chair Water, Ports and Historic Cities, and **Qingyong Zhu**, Guangling College of Yangzhou University

China's Grand Canal was the world's most extensive civil engineering project before the Industrial Revolution. This interview explores how the process of applying for and achieving World Heritage status has led to the improvement of the environment surrounding the Grand Canal and encouraged collaboration among canal cities spanning eight provincial administrations. It highlights the role of water heritage as a catalyst for improving the protection of historic landscapes and waterscapes as well as the Grand Canal's cultural heritage. It also addresses how these efforts have supported the integrated development of canal cities. The Grand Canal remains a vital link that promotes balanced cultural, ecological and economic development, contributing to the sustainability of various canal cities across northern and southern China.

Keywords: *Grand Canal, integrated approach, canal cities, World Heritage, cultural and ecological belts*

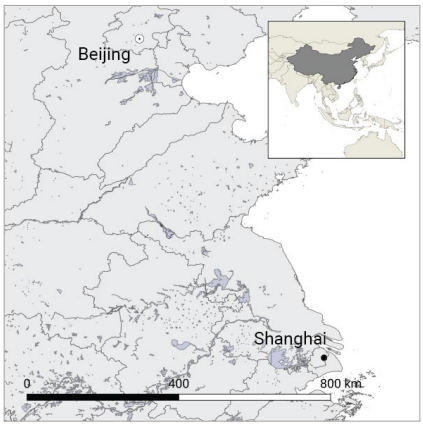
KEY THEMES



CLIMATE

C **Cwa** : Humid Subtropical Climate - southern sections (Suzhou and Hangzhou)

D **Dwa** : Humid Continental Climate - norhern sections (around Bejing)



< Fig. 1 The Qianlong Emperor's southern inspection tour through the Grand Canal, fragment (Source: Yang Xu, 1770. Public domain).

Introduction

INTERVIEWER | Kaiyi Zhu: The 22nd of June 2024 marked the tenth anniversary of the successful inscription of the Grand Canal of China as a World Heritage Property. As the former director of the China Grand Canal World Heritage Application Joint Office, why did you initiate the application 20 years ago?

INTERVIEWEE | Feng Gu, former director of the China Grand Canal Word Heritage Property Application Joint Office: It was Zhewen Luo, former director of the China Institute of Cultural Heritage, who, along with other leading scholars, first proposed the idea for the nomination and inscription of the Great Canal as a UNESCO World Heritage Property. After the success of the Great Wall, Luo Zhewen realized that the Grand Canal was the only heritage as important as the Great Wall and that it could represent our national status and spiritual values as well as our long agricultural civilization.

It all began in 2004, during China's South-to-North Water Diversion Project, which aimed to draw water from southern rivers and supply it to arid regions in the north. An exploration team conducting a heritage investigation discovered 919 pieces of so-called "cultural relics" – cultural heritage objects – in one segment of the Grand Canal. At that time awareness of the need to protect heritage was still shallow and the pre-project plan did not fully consult the heritage sector. The feasibility study did not even include a budget for heritage protection.

In response to this lack of awareness, 58 members of the National Committee of the Chinese People's Political Consultative Conference jointly submitted a "Proposal on Attaching Great Importance to the Protection of the Beijing-Hangzhou Grand Canal and Initiating the Work of World Heritage Application" in March 2006. This political support has greatly facilitated the process of applying for World Heritage status for the Grand Canal.

Kaiyi Zhu: From your point of view, what are the most significant features of the Grand Canal?

Feng Gu: The Grand Canal holds significant tangible and intangible heritage value. Ultimately, we chose to focus on investigating its "waterworks remains" in accord with the six criteria outlined by the UNESCO World Heritage Convention. This focus allows us to present physical evidence of the artificial watercourse traces, demonstrating that the Grand Canal was the world's most extensive civil engineering project prior to the Industrial Revolution.

China has been an agricultural country throughout its long history. The Grand Canal represents and sustains China's agricultural civilization, acting as an economic and cultural corridor across the country. While the Great Wall no longer plays a role today, the Grand Canal continues to function as a shipping channel, with historical reservoirs, irrigation systems and military defenses dating to the fifth century AD. It has not only been an important transport route for dynasties but has also played a positive role in north-south communication, cultural exchanges and ecological improvements. Using the north-south artificial waterway to link the east-west natural water system (e.g., the Yellow River, Yangtze River and Qiantang River) was a great pioneering move.

Furthermore, one unique feature of the Grand Canal, as highlighted by UNESCO, is the Caoyun system of dynastic management of national resources, which relied on the Canal. The imperial monopoly gathered and redistributed grain and strategic raw materials to the political center

through waterways to maintain the political center's control over tax revenues (fig. 2).

Qingyong Zhu: The Grand Canal spans more than 20 cities in eight provincial administrative regions. Why was Yangzhou selected as the leading city for the nomination files?

Feng Gu: There are many reasons. First, Hangou (fig. 3), the earliest clearly documented canal section, is located in Yangzhou, presenting a great sample for the subsequent construction of large-scale water conservancy projects in China, such as the Dujiangyan Irrigation System and Zhengguo Canal Irrigation System. Second, the Grand Canal is no longer fully navigable. Many of the canal channels within cities have lost their main function, but in Yangzhou, there are still approximately 400 million tons of freight transported each year (fig. 4). It is invaluable evidence that after 2500 years the Grand Canal can still play an important transport role in the modern world.

Third, Yangzhou and the Grand Canal have coexisted, and have risen and fallen together. Whether it was during the Sui (581–618) and Tang (618–907) dynasties, or the Ming (1368–1644) and Qing (1644–1911) dynasties, the Yangzhou section of the Grand Canal played a key role in water transport, agricultural irrigation and more. Fourth, Yangzhou is one of the first 24 designated historical and cultural cities in China as well as the historical national economic center and an important port for both domestic and foreign trade. In general, the Yangzhou Canal section reflects the linear and dynamic characteristics of the Grand Canal as living heritage.

Revitalizing the Protection and Management of Grand Canal Heritage and Cities

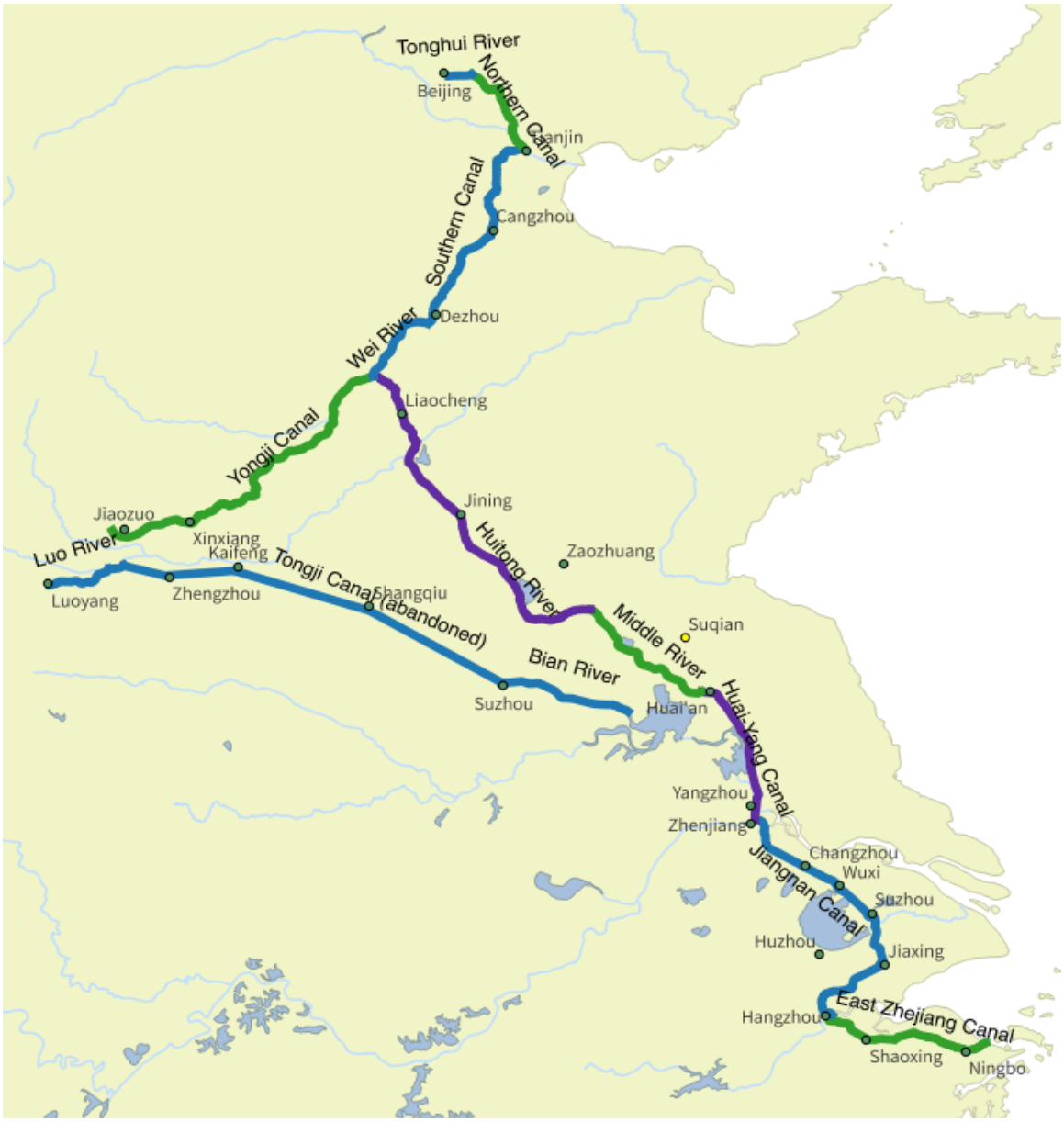
Qingyong Zhu: How has the World Heritage nomination and inscription reactivated the Grand Canal as a whole?

Feng Gu: The Grand Canal has nurtured the birth and development of many water cities along its route (fig. 5). By the twenty-first century, some of the historic docks, bridges, dikes and stagecoaches had become dilapidated, even while

^ Fig. 2 The Qianlong Emperor's southern inspection tour through the Grand Canal (Source: Yang Xu, 1770. Public domain).

^ Fig. 3 The Temple of the King (Dawang Temple), a listed cultural relic, located at the site of the ancient Hangou, honors King Fu-Chai of Wu, who ordered the excavation of Hangou in 486 BC. This project was the first to artificially connect two natural water systems, the Yangtze River and the Huai River, marking the beginning of the 2,500-year history of the Grand Canal (Source: Kaiyi Zhu, 2024).

^ Fig. 4 Busy transport scene on the Yangzhou section of the Grand Canal (Source: Qingyong Zhu, 2024).



^ Fig. 5 A map of the courses of the Grand Canal, China (Source: Groverlynn, 2016. Wikimedia Commons, CC BY-SA 4.0).

some continued to be used. In preparing the nomination files, state authorities designated many canal-related heritage sites, while listing the Beijing-Hangzhou section of the Grand Canal as a National Cultural Heritage Unit and allocating special funds for requisite restoration and conservation. In this context, administrations at all levels, along with cultural heritage protection institutions and authorities, have restored many important historical buildings, cultural heritage objects and monuments, and effectively conserved the historical canal landscapes.

Various municipal administrations have started to take responsibility for improving the water environment of the Grand Canal. In Yangzhou, for example, the local authorities in the county of Shaobo have developed new cultural and ecological belts and parks along the Grand Canal, enhancing green spaces and providing leisure and walking facilities. These efforts have substantially improved the quality of life for residents, particularly in villages and towns along the canal. Additionally, the initiatives have addressed problems of waste and direct sewage dumping, creating a virtuous cycle for the canal environment and ecology.

Qingyong Zhu: In addition to protecting and promoting canal heritage, what other benefits has the application for inscription on the World Heritage List brought to the Grand Canal and associated canal cities and cultural heritage?

Feng Gu: First and foremost, we have solved the problem of uneven development between the North and the South, which has resulted in different efforts to protect the water heritage of different sections of the Grand Canal. Particularly in many northern cities, which are heavily polluted by industry, the inscription on the World Heritage List has increased the motivation of local authorities to manage the Grand Canal effectively and protect relevant cultural heritage. The emphasis on cultural heritage conservation has contributed to the reduction of water pollution and the environmental enhancement of the Grand Canal.

Furthermore, canal cities that participated in the application had to develop conservation planning under unified principles based on their respective conditions. Representatives from the selected 35 canal cities met every spring and autumn to discuss and work together to promote the conservation of the canal heritage, forming an efficient mechanism.

^ Fig. 6 Night cruise activities on the Grand Canal drive the night-time economy of tourist attractions (Source: Kaiyi Zhu, 2024).

In addition to fostering inter-city collaboration, we also established the World Historic and Cultural Canal Cities Cooperation Organization in Yangzhou in 2009. This is a non-profit public welfare organization that is committed to promoting interactive exchanges among the world's canal cities, sharing experiences in economic, social and cultural development, strengthening the protection of canal cultural heritage and promoting mutually beneficial cooperation among global canal cities as diverse as Venice and Panama City.

Opportunities and Challenges of a World Heritage Property

Kaiyi Zhu: That's an interesting point. Would you please elaborate on how heritage conservation strategies have evolved in the 20 years since the start of the application process for inscription on the World Heritage List?

Feng Gu: Although the Grand Canal became a World Heritage Property in 2014 under an efficient working mechanism, it is important to consolidate the achievements of this designation and further strengthen the protection of the

^ Fig. 7 People use the wide walkways on the banks of the Grand Canal for resting, exercising, playing Chinese chess, performing, walking, jogging and communicating (Source: Kaiyi Zhu, 2024).

Canal. This includes emphasizing conservation efforts at the grassroots level, including environmental protection, safeguarding heritage sites and conducting additional research. At the time of inscription, the Grand Canal was still understudied, a concern shared at the time by our team of experts.

Fortunately, after 2014 the state introduced the concept of the Grand Canal Cultural Belt – a functional zone focused on the protection, inheritance and utilization of canal culture. This initiative aims for the integrated development of the cultural industry and tourism, leveraging the remains of the Canal's waterworks, ancillary facilities and related relics. It emphasizes a humanistic approach, appreciation of landscapes and contemporary cultural expressions within an international context, distinguishing it from traditional economic zone strategies (fig. 6). The physical development of the Grand Canal Cultural Belt involves enhancing water infrastructure, effectively protecting heritage sites and canal sections, and adaptively reusing cultural heritage. These efforts address gaps left during the initial the preparation process, which was more narrowly focused on achieving the World Heritage inscription.

In our efforts to conserve the cultural heritage of the Grand Canal, we have set forth three key objectives: (1) protecting the dignity of the neglected water cultural heritage; (2) ensuring that cultural heritage sites become drivers of local economic and cultural development rather than obstacles to urban growth; and (3) enhanc-

ing the quality of life for local residents (fig. 7). Over the past 20 years, the core approach has shifted from a focus on salvage conservation to improving the overall quality and integration of the heritage.

Kaiyi Zhu: What has been the impact of World Heritage inscription on the integrated revitalization of relevant water heritage and canal cities?

Feng Gu: First, to build the Grand Canal Cultural Belt, many canal cities have established museums based on their relationships with the Grand Canal, such as the China Grand Canal Museum (Yangzhou), Sui and Tang Dynasty Grand Canal Museum (Luoyang), Beijing-Hangzhou Grand Canal Museum (Hangzhou) and China Caoyun Museum (Huai'an). So the process has not only boosted the tourism economy but also provided a cultural center for citizens and an educational environment for the next generations. Besides, you can see the overall enhancement of the canal heritage with the public. For example, when we excavated the ruins of the ancient city gate along the Canal during urban development, residents around us supported the preservation of the ruins. Nevertheless, I cannot fully agree that it is correct to blindly seek the immediate protection of excavated heritage, as the conservation technologies and concepts we have at present are not advanced. I hope that we can leave something for future generations to do.

Qingyong Zhu: Do you foresee any challenges in the protection process that we should be aware of?

Feng Gu: Conservation and utilization are contradictory in heritage practice. There are many unused historic buildings, monuments and ruins that we need to utilize wisely. The rational use of cultural heritage is a catalyst for conservation, but there is of course a need to be wary of over-utilization. With China's high population density and rapid development, how to manage the environment around the Grand Canal and conserve heritage is a topic we need to study for a long time. Although experts have defined all the protection zones of this World Heritage Property and the management departments have set up a full line of surveillance, it is still difficult to supervise and monitor the surroundings. The heritage protection work of the Grand Canal is a demanding endeavor, requiring significant ongoing effort.

On top of that, I am thinking of various threats as well. As mentioned earlier, the active navigability of the Grand Canal, maintained to this day, has guaranteed north-south water transport. Under such circumstances, the shipping administration would prefer to upgrade the waterway to allow larger and a greater number of vessels to pass through simultaneously to safeguard the capacity. This ambition could also conflict with protecting canal heritage. Today the conflict between economic interests and cultural values remains unresolved due to the varied responsibilities and priorities of the many different administrations involved.

Conclusion

Kaiyi Zhu: You have highlighted many issues and challenges that can arise in the conservation of the Grand Canal heritage. What factors do you believe should be considered to better protect the Outstanding Universal Value of the Grand Canal as a World Heritage Property?

Feng Gu: I think there is a need for cooperation between various administrations, governmental departments, heritage and water authorities and various organizations, such as the shipping administration, the urban planning departments,

environmental sectors, the heritage conservation institutions, the World Historic and Cultural Canal Cities Cooperation Organization and so on. For example, for resilience and biodiversity, we need more soft canal banks and diverse species. It is therefore crucial that heritage conservation support sustainability in contemporary practices. That requires trade-offs in negotiations involving various stakeholders and the identification of common values shared by all.

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Policy Recommendations

- The implementation of heritage conservation strategies should be measured in the context of technical, conceptual and regulatory imperfections with a long-term perspective.
- Authorities and institutes with different responsibilities and interests in the management and governance of canals must collaborate to promote the overall enhancement of the canal zone's environment and the economic-cultural development of canal cities, all with the goal of heritage conservation.

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