BLUE PAPERS

Water & Heritage for Sustainable Development

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

Leiden-Delft-Erasmus
Universities

2023 (Vol. 2 No. 1)

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Journal Description

Blue Papers: A Journal for Empowering Water and Heritage for 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 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.

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Cover image: Traditional building systems in Makoko, Lagos (Source: NLÉ, 2011, CC BY-NC-ND 4.0).

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Content

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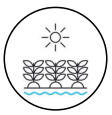
Capturing Water, Culture and Heritage through Icons: A First Attempt

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 socio-cultural 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 run-off, 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).

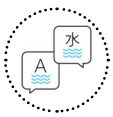
Places of Worship
Humans have created religious spaces for revering water and they may use water to express reverence for or connection with a spirit or deity. Structures such as churches and temples contain elements related to water, or can be part of the management of water resources.

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.

Sustaining Our Future by Valuing Water and Culture

Angela Lusigi
Resident representative at United Nations Development Programme (UNDP), Ghana

Leonardo da Vinci described water as "the driving force of all nature," yet today, the world is facing a water crisis. If we reflect on the history of development interventions, we can see that people of various cultures have responded to similar hydrological situations by creating structures using what they knew and what they had. Local solutions were efficient, and some continue to be efficient today, because people considered the limits imposed by climate and context, included members of their communities directly in water governance and passed on appropriate intangible social practices down through the generations. And yet today, deforestation, unsustainable land use and poor disposal of industrial waste is polluting rivers and lakes, increasing gaps in access to safe water in many communities in Ghana and across Africa.

Water is directly or indirectly linked to the achievement of the other goals on the UN Agenda 2030. In this Decade of Water Action, we must value the multiple uses of water, from agriculture to power generation, transport, industry, domestic use, ecosystems, fisheries and livelihoods, to help transform this looming crisis into an opportunity to advance sustainable development. On the other hand, acknowledging the cultural values behind water practices and heritage management will help ground development plans in local contexts and conditions. The essence of water binds "people, planet and prosperity."

Throughout my career including my current position, a common task has been to reunite the threads that bind people's prosperity with the prosperity of the planet. New tools, technology and investment intended to accelerate progress toward the SDGs should aim to identify and increase SDG-aligned actionable investments for tackling not only socio-economic challenges but also for compensating for disturbances to other-than-human ecosystems.

Blue Papers argues for integrating water-heritage governance and management. It proposes rethinking common approaches to tackling contemporary challenges that we have ourselves caused and now face. The journal, which highlights the true value of water, prompts us to take action to protect this vital resource and its tangible and intangible qualities. I support this multidisciplinary reflection for action toward a sustainable future and I hope that the journal will commit to the UN's promise to #leavenoonebehind: from humans to non-humans. Implementation requires stepping out of one's box to analyze our risks from a broader perspective, including multiple dimensions and sources of knowledge that have been relegated to memory.

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Preface

Editorial Issue 1/2023: Water and Heritage in Action: Commitments for a Sustainable Future

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

Water awareness is inextricably linked to climate change awareness. In 1987, renowned climate scientist William W. Kellogg wrote an article about "the evolution of awareness" of humankind's impact on the climate. He noted that over 150 years separated the first observations of this impact to the first explicit mention of the greenhouse effect in 1957 (Kellogg 1987). Over 35 years after Kellogg's article, "awareness" is no longer the greatest challenge: it is "action." The Water Conference of 1977 in Mar del Plata, Argentina, which aimed at establishing an international water resource management program, proposed an Action Plan to guarantee orderly administration of water resources as a key element for improving socio-economic conditions and quality of life for humankind (United Nations 1983). However, the plan did not result in widespread action and one reason was the broadness with which it was written. The 1977 Action Plan addressed countries generally, without considering specific climates, political structures, economic differences or socio-cultural contexts.

Almost 50 years later and halfway into the Water Action Decade (2018–2028), progress on water-related goals and targets remains alarmingly off-track (United Nations 2023). The Water Action Agenda and the UN 2023 Water Conference promises a different approach and calls for commitments and actions. The president of the General Assembly remarked on the need for game changers: methods, strategies, approaches and programs able to connect multiple disciplines, levels of governance and ways of thinking to enhance cooperation across actors, sectors and scales for sustainable development, beyond a "business as usual" approach (United Nations 2022).

The editors of *Blue Papers* are fostering action and commitment in ways that include developing *Blue Papers* as a global platform for gathering and sharing information and for exchange and collaboration across diverse disciplines, both in academia and in practice. They aim to promote understanding and analysis and to disseminate knowledge that connects water, culture and heritage to sustainable development. They argue that such a platform is needed for capacity building, the collection of knowledge and the development of guiding principles. They aim to:

1. Connect water and heritage by connecting system-based tools such as the UNESCO Historic Urban Landscape approach to system-based tools in water management.

2. Embed heritage sites in everyday practices and larger-scale systems to preserve heritage in a time of climate change.
3. Include disenfranchised groups and Indigenous people and their practices in decision making on water and heritage.
4. Develop new concepts and methodologies for connecting water and heritage through storytelling to bolster water awareness and citizen science.
5. Educate professionals and citizens through open online courses, serious games, open data and apps.
6. Connect tangible objects and structures to related intangible water practices.
7. Redefine the language, methods and frameworks of water, culture and heritage to include human and non-human actors.
8. Retrieve existing practices that respond to seasonal and water change.
9. Diversify water and heritage discourses and practices, bridging the gap between nature and culture, organic and man-made.
10. Explore new practices and rituals for water awareness and engagement.

Volume 2 Number 1 (2023) of *Blue Papers* includes critiques of current approaches and examples of how to change to a more context-based, culturally sensitive, and long-term form of water management that is not anthropocentric.

In Part I, Sandra Pellegrom sets the stage to get from commitments to action by proposing the Sustainable Development Goals (SDGs) as a comprehensive framework addressing water and heritage management. Carola Hein reflects on the role of history in connecting water and heritage. In their articles, Eddy Moors and Eriberto Eulisse criticize existing capacity-building programs and broader; that is: and broader development paradigms, stressing the importance of rediscovering human coexistence with water and developing long-term perspectives and paths. Carlota Houart changes the perspective using the concept of "hydrosocial territories" to acknowledge the interrelations between humans and other-than-humans and favor more socio-ecologically just and biodiverse water worlds. This idea is also at the heart of Karl M. Wantzen's contribution, which presents the publication *River Culture*, a multidisciplinary collection of adaptive strategies resulting from human-nature interactions. Sylvia Amann considers another role of culture, analyzing how it can change policy making based on silo-thinking. Charlotte Jarvis, Maria Pena Ermida and Ole Varmer discuss the importance of including underwater cultural heritage in marine spatial planning through integrated ocean and coastal management policies. Expanding on underwater cultural heritage, Gabriel Caballero, Bretony Colville, Elena Perez-Alvaro and Saranya Dharshini examine the current state of protection and advocacy, while also discussing the challenges of this heritage.

Part II opens with an interview with Kunlé Adeyemi, who introduces the African Water Cities project and methodology, at the intersection of rapid urbanization and climate change. Eriberto Eulisse presents the world inventory of water museums and interpretation centers, a attempt to initiate a worldwide census of institutions, practices, and organizations associated with water-related values to promote awareness and education. The case studies focus on the role that the past plays

in current water governance and resources management or that it might play in the future. In her case study of the Dutch Caribbean States and Territories, Suzanne Loen highlights the heritage of colonial water exploitation and its relationship to present-day inequalities and challenges. Sannah Peters, Maarten Ouboter and Jeroen Oomkens focus on water hazards-driven urban planning in Amsterdam, and how past decisions and narratives can drive present-day actions and inform more effective design principles for future city planning. Majid Labbaf Khaneiki and Abdullah Saif Al-Ghafri address how unbalanced local water governance disrupted a symbiotic relationship between upstream and downstream communities in the Abarkooh basin in central Iran. Mariëtte Verhoeven, Fokke Gerritsen and Özgün Özçakır discuss a historic aqueduct that still characterizes the Istanbul cityscape. Andrew Bernard, Christopher Fullerton, Meisha Hunter, Tonja Koob Marking and Priyanka Sheth narrate the history of the Erie Canalway in transporting goods, people and ideas, and they consider how it can be useful even today. Danna Albanyan closes this issue with her interdisciplinary analysis of the port district of Jeddah in Saudi Arabia and how revamping projects can align key pillars such as local economy, water management, sanitation, and social and cultural identity.

The time for creating awareness has passed. These articles no longer call for awareness, nor pose a broad "call to action." Instead, they present actionable concepts, tools and methods to operationalize the Water Action Agenda in specific cultures, contexts and climates.

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Editorial

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 widely in the field of 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: *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).

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Matteo D'Agostino is a researcher at 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 organizations.

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Carlien Donkor is a 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's thesis focused on the subject of integrated urban water design and how factors including climate change and urbanism pose a risk to the design and planning of historical water cities like Milan. Other interests include volunteer work.

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Queenie Lin is a PhD candidate at History of Architecture and Urban Planning, Delft University of Technology, with a research focus on the sustainable preservation of climate-challenged Dutch overseas settlements in VOC Asia. She is currently working under the UNESCO Chair Water, Ports and Historic Cities and the PortCityFutures research group. She was also a PhD candidate in Cultural Heritage and Arts Innovation Studies, Taipei National University of the Arts, and that and her previous MA training in art and architectural history (University of Virginia, USA), conservation of fine art (Northumbria University, UK), and underwater cultural heritage certificate (UNESCO Foundation Course), equipped her for professional experience in academia, museums, research institutes and thinktanks in Asia, America and Europe.

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Editorial Team

Hilde Sennema is a historian with a master's degree in architectural history. After working in the field of urban planning and heritage, she is now finishing her PhD on post-war reconstruction in port cities at the Erasmus University Rotterdam. Between 2018 and 2021 she wrote a weekly column in the Dutch newspaper *Financieele Dagblad*. In 2022 she joined the UNESCO Chair of Water, Ports and Historic Cities at Delft University of Technology to work as a researcher and lecturer. Besides port cities, her research interests include public-private relations in public space, and the cultural meanings and representations of water.

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Zuzanna Sliwinska is an Msc Architecture student, and currently an editor at an independent periodical of the Architecture Faculty (*Bnieuws*) at Delft University of Technology. Zuzanna has professional experience in large-scale urban projects focused on sustainable manufacturing and food production. Her research interests focus on countryside conservation in fast-developing Asian countries with a focus on southern China. Her current master's thesis explores the potential of adaptation and persistence of cultural heritage among rural communities through the perspective of water-related practices in Northwest New Territories, Hong Kong.

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PART I Challenges, Concepts and New Approaches

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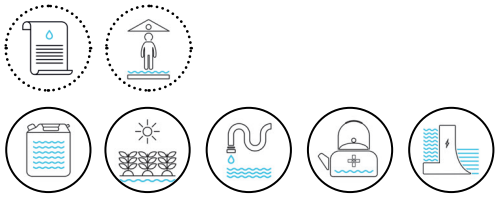
The UN SDGs as Compass for Sustainable Water and Heritage Management

Sandra Pellegrom
National SDG-Coordinator (Netherlands)

Working toward sustainable development requires careful balancing of the past, present and future. Water is a crucial element of the SDGs, because each intervention in the water system will have either a positive or negative impact on other parts of the system and on other goals. Water connects: literally and figuratively. Working toward sustainable water (and) heritage management is urgent and can greatly contribute to other important goals. In designing a solution for the future, it is necessary to consider not only technical, but also behavioral and cultural perspectives in a comprehensive approach. This article explains the urgency and importance of working through the lens of the SDGs as an encompassing framework.

KEY THEMES



< Fig.1 Traditional Dutch watermill (Source: Sjaak Kempe, 2017. CC BY 2.0, via Wikimedia Commons).

Introduction

The Sustainable Development Goals (SDGs) are a powerful compass for those working for water and a comprehensive approach is key to achieving them all. The conceptualization of water as part of a larger system can help promote overall sustainable development. The 17 SDGs were adopted by all 193 member states of the United Nations in 2015. The ambition is to achieve them by 2030. This deadline is important since failure to solve the challenges expressed in the SDGs will lead to crisis. The goals embody all issues to be addressed for human well-being now and in the future and this means caring for people, for society and for the planet. Economic development is also a goal, but it should be inclusive, sustainable and a means to achieve the other goals.

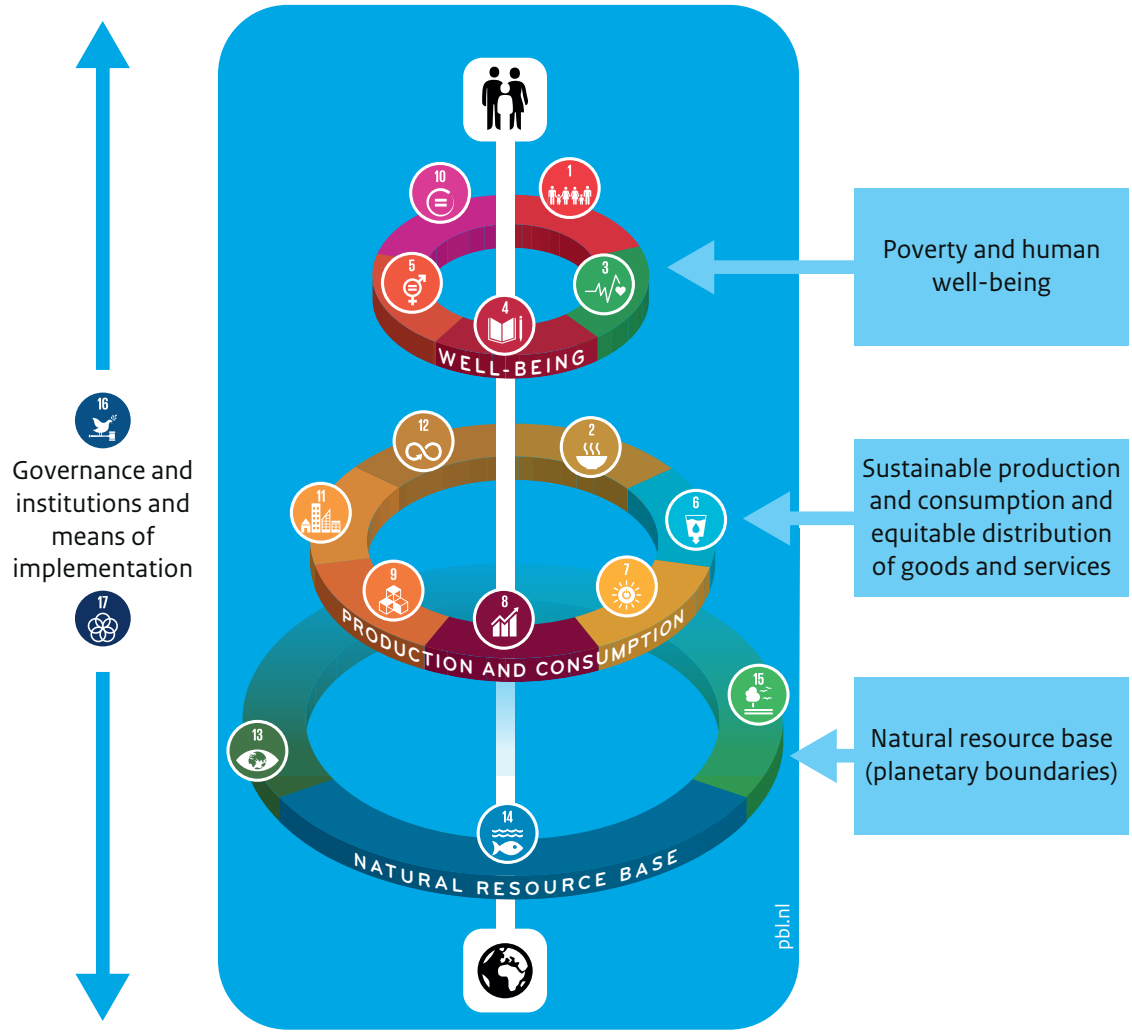
The SDG Agenda

The power of the SDG agenda lies in the interconnections and intersections: the recognition that no goal will succeed without also promoting the other goals. To achieve any success, we need to pursue them all. At the same time, the goals do not always automatically support each other. To avoid inadvertently achieving certain goals at the cost of others, we need to understand and mitigate potential trade-offs. This requires careful assessment, collaboration and sometimes also negotiation. The "SDG Wedding Cake" (fig. 1) shows that people can only live in well-being and peace if their society is inclusive and well-governed (top layer of the cake), if their economy is supportive (middle layer) and if we have a healthy planet that can regenerate the resources we are using (bottom layer of the cake).

SDG 6, summarized as "clean water and sanitation," promotes universal access to sustainably managed water and sanitation services. At first sight, the goal seems to focus on drinking water, however it is effectively tied to the entire water cycle. Failure to protect our water resources means we will run out of water, which is why reducing the pollution of water sources and promoting water efficiency, sustainable water management, and protecting and restoring water-related ecosystems and support for developing and un(der)developed countries and communities are part and parcel of this goal.

Water is a crucial element of the SDGs, because each intervention in the water system will have an impact (positive or negative) on other parts of the system and on other goals. Water connects: literally and figuratively. Many UN reports warn that water stress is increasing worldwide, endangering many, if not all the other goals: human well-being, health, food and economic production all depend on water. Pollution and water-related disasters risk reversing many advances that have been made in human security, housing and infrastructure, and they threaten natural ecosystems as well as biodiversity, forests and soil (HELP, n.d.).

There are many examples that demonstrate the relevance of other SDGs for water managers and other professionals that deal directly or indirectly with water. Consider water smart agricultural methods, such as using geodata to guide water usage or water efficient production processes using gray water. Water agencies in the Netherlands have been looking into filtering reusable materials from wastewater to contribute to the circular economy, and are exploring new energy generation options using water. The Dutch government has recently announced a policy to ensure that water and soil are the leading determinants of spatial planning decisions; this policy will also help boost climate adapta-



^ Clustering of SDGs from the environmental perspective (Source: PBL Netherlands, 2016).

tion in our low-lying country (Government of the Netherlands 2022).

Professionals in a variety of fields are starting to engage with sustainable development through the lens of water, for instance looking at innovations in water filtering and reuse in the realm of building design and housing. There are many opportunities for water professionals to contribute to solving pressing challenges outside of their immediate fields of focus. This involvement also provides opportunities for innovation, partnership and new, more integrated, products and services.

Connections are crucial in the SDG agenda. This also applies to connecting lessons from history and our heritage to our present challenges. In designing tomorrow's solutions, it pays to look at the past.

^ Fig. 2 Water is related (from "strongly" to "indirectly") to all Sustainable Development Goals (Source: PBL Netherlands, 2022).

SDGs: Learning from Past Mistakes to Design Better for the Future

Working toward sustainable development requires careful balancing of past, present and future. Many of the structures and practices that are part of today's unsustainable system are remnants of the past. Our economic successes, for instance, have brought significant improvements to human well-being and food security. However, to achieve a more sustainable, future-proof way of increasing human well-being, we need to find ways to balance the degree to which we pursue different SDGs and to do so over time. This means correcting unsustainable aspects of decisions made in the past and preserving elements that speak to our local and national identity. The SDGs provide a helpful compass as we work toward solutions that balance different ambitions without locking us into short-term solutions that do not work for the future.

The 2030 Agenda for Sustainable Development is future-oriented, but its focus and tenor are very much grounded in recognition of our past. The core lesson is that the economic, social and environmental dimensions of development need to be addressed holistically. Criticism of a one-dimensional approach to growth is not new. The Club of Rome's report, *The Limits to Growth*, warned that infinite growth is impossible on a finite planet (Meadows et al. 1972). Research by the United Nations Development Programme (UNDP 2020) shows that up until now nearly all countries that have raised human well-being standards have done so at the cost of planetary health.

This apparent contradiction was addressed in what is known as the Brundtland report, *Our Common Future* (World Commission on Environment and Development 1987). This was the first call for "sustainable development" in which environment and human well-being were addressed together. The report also stated that only in this way could the needs of the present be met without compromising the ability of future generations to meet theirs. This thinking forms the backbone of the SDGs, in which a systems approach is key.

To be effective, systems thinking needs to acknowledge the power of systems from the

past, both the ones that we want to overcome and those that can serve as stepping-stones to a sustainable future. This means not only looking at interlinkages within environmental systems but also the way environmental systems interact with, for instance, social structures and governance, and the role that culture plays in the choices we have made (Maas et al. 2022). Looking at the past can be informative. The Dutch have managed water successfully for centuries (fig. 3), but it is also important to understand why certain solutions were chosen, as it helps to look more holistically at new approaches. It is also important to understand the trade-offs of the past, for example in terms of social equality. Not all solutions of the past would be acceptable today. For example, the construction of a beautiful city like Amsterdam depended on income generated through trading and sometimes involved exploitative practices.

Achieving a sustainable future will require looking beyond the immediate, technical task at hand; it will mean hard work to forge new coalitions and sometimes it will require compromise. It also means recognizing that we are dealing with complexity and uncertainty, as well as urgency.

Conclusion

These pressures could lead to tunnel vision – focusing only on one goal – but this will not lead to the best solutions, however tempting a single-minded strategy may be. Leaders in business indicate that considering a problem from a broader perspective leads to better and often more cost-effective solutions (e.g., Polman and Winston 2021; Sluijters 2022). Today's challenges are interconnected in so many ways, and therefore the solutions we design must also be connected. Working on water for sustainable development, in short, means avoiding the tunnels but taking the road that allows for a wider view. Many inspiring innovations and partnerships are sure to be encountered along the way.

Screening future scenarios through the lens of the SDGs will help to identify not only potential synergies but also possible negatives: trade-off risks that may be avoided or mitigated once they are understood. An example is looking carefully at the effects of water solutions on women and gender relations, or affordability for everyone. Also, if potential trade-offs are not carefully managed, water could be adversely affected by actions taken in pursuit of food security and renewable energy.

The majority of the interrelations between SDGs are positive, in particular for water – meaning there are many opportunities for synergies and smart investing in water and other goals at the same time – if we take the time to understand the systemic interconnections (UN 2019, 41, box 1–2). The way we deal with our water has a strong influence on the way we live and how we feel. In designing a solution for the future, it is necessary to consider not only technical, but also behavioral and cultural perspectives. Combining the holistic perspective and the systems approach of the SDGs with cultural and historical knowledge will provide water professionals with all the necessary tools to ensure truly sustainable water solutions for generations to come.

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Toward a Research and Action Agenda on Water and Heritage? A First Attempt at Refining Terminologies, Concepts and Priorities

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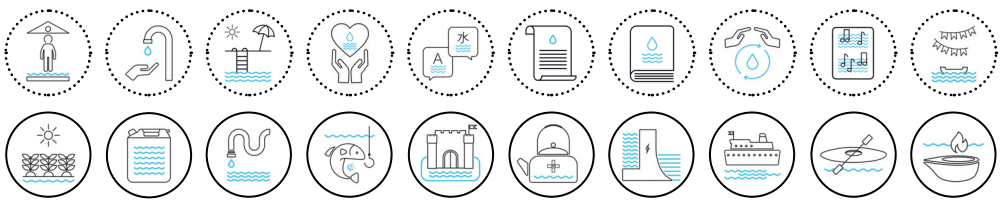
Over the last several years, a variety of academic and professional partners have started to explore the relationship between water and heritage. A key challenge for communication and collaborative action in this important and growing field is a lack of shared terminologies, concepts and priorities. As water managers around the world look for inspiration from the past, heritage professionals focus on the protection of water-related sites and practices, historians explore continuities and spatial planners anticipate future needs. As a result, the future-oriented field of water management, the preservation-focused interests of heritage, and the analytical or design-oriented fields struggle to intersect, as do professional practice and academic analysis. A closer investigation of the respective interests and thematic foci of each group involved in the water and heritage field is much needed. Such an investigation needs to start with a clarification of goals, terms and concepts of both water and heritage in order to clarify different research agendas and to facilitate collective action.

KEY THEMES



< Fig. 1 The Fairmount Water Works in Philadelphia. A cultural heritage site at the nexus of of water management, history and heritage (Source: SkipL, via Wikimedia Commons).

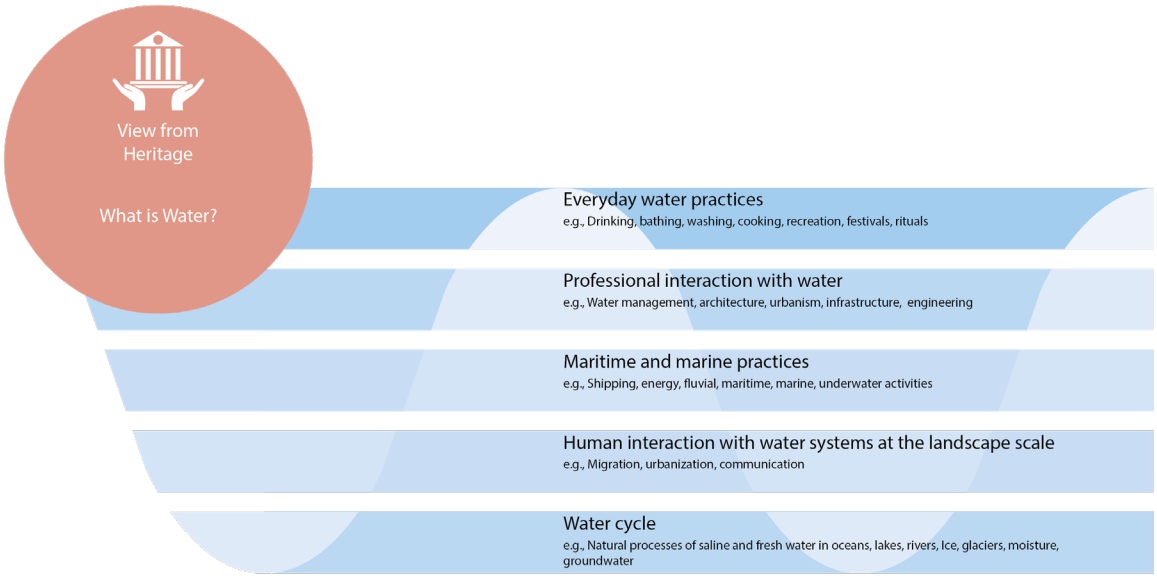
Blue Papers has set out to explore the multiple ways in which water systems, spatial and cultural practices intersect; it aims to use this exploration of the past and its heritage to facilitate sustainable development. The many different interests and themes in this field and the lack of shared terminologies and methodologies can hinder progress toward sustainable development. Mutual understanding of water, heritage and the impact of long-term development on the present and the future, requires careful reflection. It means, for example, analyzing historic practices for their future relevance, building upon traditional skills, promoting living heritage and protecting identity-strengthening heritage, thereby contributing to sustainable development.

What we define as heritage also translates into the actions that we undertake in relation to heritage. Some elements of the past are worth preserving, others are ones we want to overcome. The more we talk about water management, the more we lose the idea of water values. To support the concept of Valuing Water (UNESCO 2021), analysis of water and heritage can help. It is therefore important to choose carefully the words associated with different types of heritage and the remnants of the past. This article aims to provide a first attempt at linking the two fields, turning its gaze from one field to the other, and ultimately adding an analysis of the different aspects of exploring water and heritage.

Such an approach aims to look at water as a natural and cultural system that has developed over a long period of time at the hands of multiple actors that include laymen and professionals: people have built structures, developed institutions and cultural practices for millennia to provide water for their daily needs, to use water to feed themselves, to live with water and to defend themselves against it. Water managers have refined their practice over time, creating dikes and dams, pumping stages and hydro-energy plants. As technologies have evolved and the scales of water management changed, historic structures and practices have declined. Historic structures that were no longer deemed useful were adapted, abandoned, or demolished. Some of the historic water practices or management structures continue to function as part of a modernized system, others have been preserved for their historic or heritage value. They stand as reminders of human achievements of the past, of historic practices or knowledge.

The term water must be understood through the multitude of hydrological systems, through the multiple scales of flows, spaces, practices and cultures and it must be defined in relation to people and the ways in which they live. Historians and heritage scholars need to learn the language of water to communicate with others about the relation between water and heritage. The term heritage also deserves scrutiny, taking into account how it differs from history. Heritage is a contemporary concept. In its everyday use, people may use heritage to refer to any element that is of value to them, tangible and intangible. It is different from the concept of history and its relation to the present and the future merit close examination. History as a discipline focuses on the analysis of the past; its relationship with the present and the future is complicated. Only some historians are willing to connect past events and experiences explicitly to the present or future. This attitude is being challenged as evidenced in recent discussions (Steinmetz-Jenkins 2020; Miles 2022). We can't ignore the fact that the built environment in all its forms influences our behavior today and our plans for tomorrow.

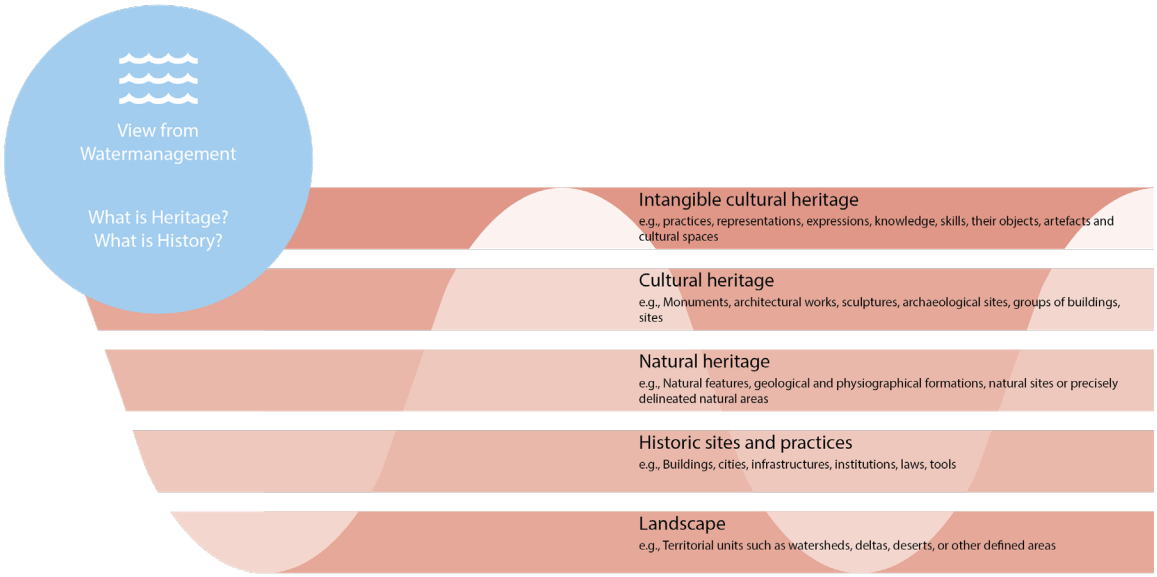
Historical understanding of the systems in



^ Fig. 2 The view from heritage: What is water? (Source: Carola Hein).

which water is embedded can help us reconceptualize and question contemporary systems and advise future design. Time is a key factor in all our actions. We need to act swiftly to address the future of water. Yet, our current problems are the result of past decision making and the failure to change. People lived sustainably with water for a long time because they did not have another choice. A long-term perspective on the past allows for assessment of systemic changes and affords a more comprehensive analysis and a better understanding of history and heritage in relation to water. To facilitate engagement among the various disciplines, even among related fields, water must become part of multiple conversations about history, heritage and culture. The following section therefore aims to disentangle the various notions of water, history and heritage.

Figures 2 and 3 aim to introduce key aspects of each field to the other, asking first: "What is water?" and then inquiring, "What is heritage? What is history?" They show that there are multiple aspects of water, heritage and history, which, when explored together, will require different types of interventions. For example, a UNESCO World Heritage property, by definition, requires protection, even when the properties of the site are only partly sustainable, or even require special investment. Other buildings and practices that are considered or even registered as natural, cultural or intangible heritage locally or nationally can invite actions of adaptation and re-use, and some of them can actively contribute to sustainable development. Other remnants of the past are important in terms of analysis, but are not ones to be continued. To build a research and action agenda for water and heritage we therefore must carefully analyze the different aspects and definitions of water and heritage, and their interlinkage. Figure 4 provides a first attempt at different categories of analysis and action in the broader field of water and heritage.



^ Fig. 3 The view from water management: What is heritage? What is history? (Source: Carola Hein).

Three examples give an idea of the breadth of the task of connecting water and heritage and the different activities that this entails. One is an example of a living heritage and the other of a past practice that we would like to overcome. The Wouda steam pumping stage in the Friesland region of the Netherlands, built in 1920, was designated a monument in 1988 and inscribed in 1998 as a UNESCO World Heritage property as an outstanding example of Dutch water management, hydraulic engineering and as an "exceptional witness to the power of steam in controlling the forces of nature" (UNESCO 2023a). With its free-standing chimney, it dominates the landscape and, as an example of the style of the Amsterdam School, it speaks to the Dutch context and the time of its construction. The pumping station can still be used, when needed, to drain inland waters. The Wouda pumping station stands as an example of water management-related cultural heritage. It represents the resilience required for living in the Dutch delta, yet, it is not an example for future sustainable development because of how its pumps have been fueled: first by coal and then by heavy oil.

If the relation between water and heritage is evident in the example of the pumping station, in many other cases, the former function of the site has disappeared. The historic site of Kinderdijk, another World Heritage property, features windmills that have been used to drain Dutch polders (UNESCO 2023b). The site is a model for the entire landscape of the Netherlands, the outcome of hundreds of years of living with water and developing a water management system and related institutions, in which we have to position any new intervention. The Kinderdijk site is no longer active in the traditional way, but the message of water management-related heritage is still evident. While the site may have been historically environmentally sustainable (today the main water works are served by modern pumping stations), the life of a traditional miller and his family is not one that

many contemporary people would be willing to live, making the site less than ideal as an example of social sustainability.

In the two prior examples, it is easy to see what might be worth salvaging and appreciating. The relation between water and heritage may be less obvious as we consider topics as wide ranging as the use of specific building materials and the architectural design of houses as an adaptation to rain patterns and practices ranging from drinking water provision to irrigation, from industrial processes to leisure practices. Not all historic water systems are the result of water management and not all managed sites are worth preserving. The remnants of the chemical industry in Bitterfeld in Germany, for example, are the product of decades of storage of industrial waste in the ground and the leakage of chemical elements into the nearby river. Such remnants - we probably do not want to call them heritage - need to be cleaned up and not preserved.

For water managers, it is important to understand the concept of heritage as compared to that of history. The World Heritage Convention of 1972 (UNESCO n.d.) defines both natural and cultural heritage. Such definitions are based on the notion of outstanding universal value, a concept that goes beyond individual or local appreciation of historic buildings or practices. Article 2 defines "natural heritage" as:
"(1) natural features consisting of physical and biological formations or groups of such formations, which are of outstanding universal value from the aesthetic or scientific point of view; (2) geological and physiographical formations and precisely delineated areas which constitute the habitat of threatened species of animals and plants of outstanding universal value from the point of view of science or conservation; (3) natural sites or precisely delineated natural areas of outstanding universal value from the point of view of science, conservation or natural beauty."

Article 1 defines "cultural heritage" as:

> "(1) monuments: architectural works, works of monumental sculpture and painting, elements or structures of an archaeological nature, inscriptions, cave dwellings and combinations of features, which are of outstanding universal value from the point of view of history, art or science; (2) groups of buildings: groups of separate or connected buildings which, because of their architecture, their homogeneity or their place in the landscape, are of outstanding universal value from the point of view of history, art or science; (3) sites: works of man or the combined works of nature and of man, and areas including archaeological sites which are of outstanding universal value from the historical, aesthetic, ethnological or anthropological points of view."

More recently the notion of intangible cultural heritage has been added to the list of elements recognized as cultural heritage. According to the 2003 Convention for the Safeguarding of the Intangible Cultural Heritage (UNESCO 2022), this includes

> the practices, representations, expressions, knowledge, skills – as well as the instruments, objects, artifacts and cultural spaces associated therewith – that communities, groups and, in some cases, individuals recognize as part of their cultural heritage. This intangible cultural heritage, transmitted from generation to generation, is constantly recreated by communities and groups in response to their environment, their interaction with nature and their

history, and it provides them with a sense of identity and continuity, thus promoting respect for cultural diversity and human creativity.

Over the last few decades the concept of heritage has widened to encompass: a broader, more people-centered understanding of heritage as ICOMOS states in its Delhi Declaration of 2017 (ICOMOS 2017). While broader, this approach still involves challenges: Heritage sites may not be as strongly protected as before. Weakening the concept of heritage may make it more difficult to protect relevant sites. At a time of climate change-related transformation of water patterns, it is particularly important to reflect upon its impact on heritage. The presence of water can be the reason for the historical development of a site; it can also represent a threat, even if the site was originally built for water management purposes. Given that the original function of the site has largely disappeared, preservation is often costly and difficult. Making these sites relevant for water managers can lead to new solutions in both the field of water management and heritage protection. Historical analysis within the field of water management can help establish the framework for a more comprehensive reading of heritage in relation to water management.

History and Heritage for the Design of the Future

From the side of water management, the development of a sustainable water system is the primary task. Water managers aim to facilitate healthy and safe water management structures. At a time of climate change and sea-level rise, this is a challenge that can't be answered by the continuation of current practices. Water managers today are exploring historic systems and management practices to find solutions for the future. Many are eager to better comprehend the complex tangible and intangible water systems of the past to glean lessons for the future. The ways in which traditional water management engaged ingeniously with natural local conditions, or used natural processes, including ecosystem services, to facilitate water management, can help address modern needs, even when the historic systems may not be able as such to serve modern cities, or, even when the historic systems are not preserved as such. Some water managers have an interest in what can be learned from the past, others may take an interest in preserving iconic buildings like the Wouda pumping station - yet, their focus is mainly on solutions for the present and future.

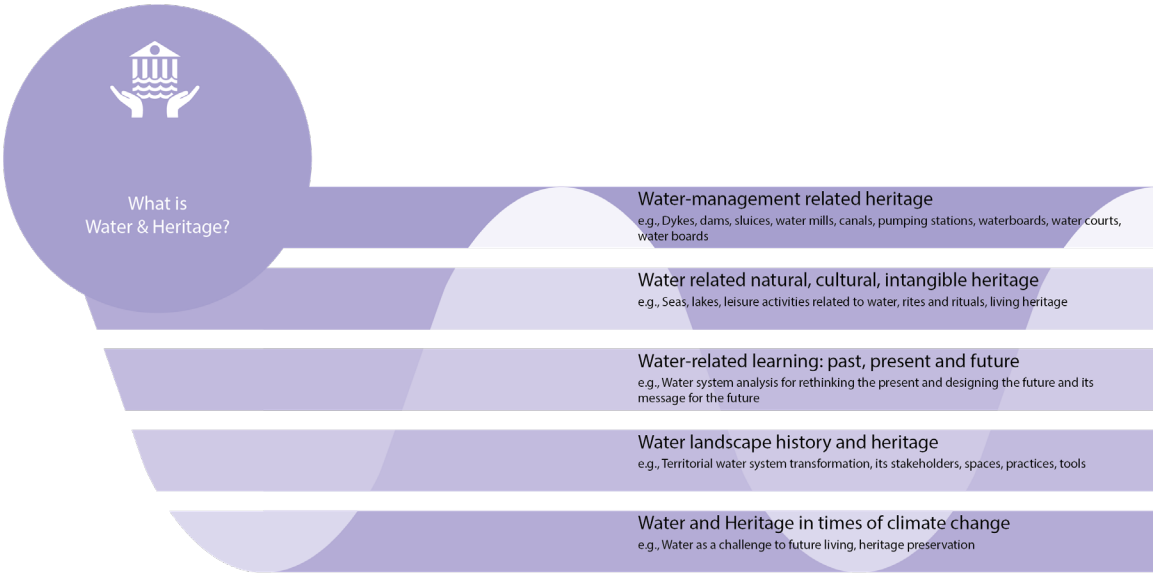
Water managers may see the past as stumbling stone, as an identity-creating agent, or as inspiration for the future. Many water managers deal on a daily basis with historic water systems, including their tangible and intangible aspects. They experience the positive and negative influence of decisions made often centuries in the past and they have to decide whether or not to continue along the same path. An old pumping house, a dike or a mill can, from that perspective, be an obstacle to innovation. If such structures are considered a hindrance, they are either demolished or they change ownership. A heritage designation of a historic monument may turn into a conflict between water and heritage professionals, between decision makers and citizens. Occasionally, the historic knowledge embedded in these sites inspires new solutions that are beneficial both for the water and heritage field. Spaces and practices from the past, such as large-scale dams, can also be impediments to a sustainable future and need to be assessed carefully. Inspiration from the past does not necessarily mean continuation of all systems.

For local communities, historic water management systems may be more than inspirations; historical and heritage practices are in fact often key to local livelihoods. In large parts of the Global South, historic irrigation systems are integral to community survival. The appearance of large-scale public or private interventions can put entire communities at risk. For example, spate irrigation is still widely practiced in Pakistan (Nawaz 2022). While such practices are important for local communities, they may not be able to sustain larger communities. Understanding the practices of the past can also help sustain buildings and practices that have been collectively identified as heritage and worth preserving. Rather than relegating heritage sites purely to the domain of tourism, such an approach can go hand in hand with preserving heritage sites in line with sustainable development, and, more generally, rethinking heritage as part of everyday practices and community systems, as proposed by the UNESCO Historic Urban Landscape approach. Integrating heritage in contemporary systems, rather than excluding it, can be part of an ecosystem-based approach that is essential to solving the multiple water problems that we are currently facing. Careful analysis of historic water practices in light of social justice and gender must be taken into account when lessons are drawn for future management; these practices also need to be accounted for in heritage narratives and preservation efforts.

While heritage recognition allows for protection, it is not comprehensive and, often, does not inscribe historical sites into contemporary water management practices. To reconnect spatial, social and cultural practices of water and cultural heritage, politicians, practitioners and people need to look at their relationship through time. The water sector can benefit from a broader understanding of the social and cultural implications of water practices of the past. Meanwhile, the heritage sector can benefit by adopting a more networked approach to heritage preservation and to sustainable development. The field of heritage is broad and diverse. Water management should find ways to contribute to heritage sites' protection, particularly, when the functional water system is at the heart of the heritage nomination, as in the case of Amsterdam's canal ring (UNESCO 2023c).

To effectively protect heritage sites and to meaningfully promote desirable water practices, it is important to encourage not only awareness but also to promote action that can help balance the different economic, social and cultural interests of diverse population groups and decision makers and facilitate a return to circular practices that were once more common. Such comprehensive practices toward water (and the environment more generally) have long been embedded in local social structures and cultures, including festivals. Celebrations for seeding or harvests were part of communal living. Paintings, songs and poems provide a cultural foundation for traditional circular practices, creating and reinforcing a mindset that supported spatial and social features. However, many important sites today are statically preserved as heritage sites and may appear only as burdens to the contemporary water management sector. They are not seen as promoting circular practices or as having any socio-cultural importance. Yet, in fact, heritage sites can contribute to promoting water awareness and contribute to better water futures.

To solve the many water problems that people are currently facing around the world, politicians, planners and citizens need an understanding of historic water systems. They also need to preserve heritage sites in ways that are compatible with sustainable development and,



^ Fig. 4 A first attempt at refining areas of research and action for water and heritage (Source: Carola Hein).

more generally, they need to rethink heritage as part of everyday practices and community systems. Understanding historic water systems through time does not mean that people should return to the past or that past practices can solve contemporary challenges (fig. 4). Lifestyles have changed and historic ways of doing things are often no longer acceptable. In the past, relationships between water and society were not perfect. But at a time of changing water patterns due to climate change – sea-level rise, flooding, new rainfall patterns, drought, etc. – it helps to understand how and why decisions were once made, how systems worked, and what impact historical transitions had, as well as to find ways to connect heritage protection to sustainable development. Such an understanding can facilitate the development of future water systems that work well with natural, social and cultural systems. To discuss water and heritage together means understanding the multiple dimensions that such a conversation can take.

Conclusion

Traditionally, water was part of society and culture because it was necessary for survival and for the sustainable development of communities. Many unique water-related cultural artifacts are today recognized as cultural heritage. Historic lifestyles may no longer be meaningful today as such, but select elements and structures, when understood in their historical complexity, can provide useful insights for the future. Such analysis needs to be broad enough to acknowledge that exploitative practices can also spread from one (potentially sustainable) community to another, resulting in unsustainable or unequal practices elsewhere. Colonial practices stand as exemplary here.

Heritage preservation of formerly sustainable

systems may no longer produce sustainable practices, as physical structures and practices have become disconnected from their original function. To meaningfully address future sustainable development, we need to design future heritage, and make sure that heritage management is part of a pattern of behavior tied to sustainable development. This also means that water management should assure the inclusion of heritage sites in contemporary development, especially for use in education and the generation of water awareness. Through value-based goals, policies and institutions (SDG 5, 10, 16) through transformative actions [education, consumption/production and partnerships (SDG 4, 12, 17)] we can regain agency. We need to take advantage of the current diversity of interest in water and heritage, take it further and make it more productive through analysis and action.

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Capacity Development and Cultural Heritage: Toward a New "Culture of Water"

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In 2020 UN Water, the entity coordinating the United Nations' work on water and sanitation, identified capacity development as one of the five accelerators required to achieve the Sustainable Development Goal on Clean Water and Sanitation (SDG 6). In today's practical application, capacity development is mostly financed to deliver a product specified in advance, not to arrange a longer time frame and process to structurally learn from various activities and discover sustainable development paths (Alaerts and Zevenbergen 2022). The inclusion of traditional knowledge and cultural heritage in our joint-learning efforts will help us enlarge capacity for a more sustainable culture of water.

KEY THEMES

< Fig.1 The culture of water: valuing water symbolized by a fountain in Morocco in the foothills of the Atlas Mountains (Source: Eddy Moors, 2022).

Introduction

Capacity development may be defined as a process in which people, organizations and society as a whole unleash, strengthen, create, adapt and maintain capacity over time to achieve development results (e.g., OECD 2006). Capacity is often defined as the ability of people, organizations and society as a whole to manage their affairs successfully. Capacities and their development can be grouped in three levels:

1. Individual – improving individual skills, knowledge and performance through training experiences, motivation and incentives.

2. Organizational – improving organizational performance through strategies, plans, rules and regulations, partnerships, leadership, organizational politics and power structures and by strengthening organizational systems, processes, roles and responsibilities.

3. Enabling environment – improving policy framework to address economic, political, environmental and social factors, including economic growth, financing, labor markets, political contacts, policy and legislative environment, class structures and cultural aspects in a current and mutually reinforcing fashion.

Current Approaches

Although educating and training people to increase the capacity to maintain and reestablish heritage sites and traditional practices is essential, for the water sector the combination of awareness and the presence of a sustainable water resource is priceless. This importance is clear from the UNESCO-Intergovernmental Hydrology Programme (IHP) resolution XXIII-5 (2018). This resolution to establish a Global Network of Water Museums (WAMU-NET) demonstrates the importance of awareness raising and education regarding the value of traditional habits and heritage as well as of a forward-looking approach to see how traditional knowledge can help address contemporary and future challenges, especially those related to climate change. As the WAMU-NET (n.d.) charter states, "Today it's essential to reinstate a new relationship between humanity and water: a new 'sense of civilization' which helps to reconnect people and water in all its dimensions – including social, cultural, artistic and spiritual connections."

A clear example of the usefulness of traditional water knowledge may be found in water harvesting. Because the severity and extent of water scarcity has increased in recent decades and is expected to continue to increase in the decades to come (IPCC 2022), water harvesting has been rediscovered. A simple search on ScienceDirect using the keywords "water harvesting" shows a total of 1,528 hits, and an increasing interest from 94 hits in 2012 to 573 hits in 2022. One study (Thapa et al. 2022) identified the main factors affecting the adoption of rainwater harvesting for household uses in the Kathmandu valley of Nepal: individual willingness and awareness, individual awareness of the future water shortage and the use of rainwater to conserve groundwater. Besides contributing to the present-day sustainable use of water, cultural heritage sites and water museums play an important role in increasing awareness of the importance of water. That it is not always easy to revive indigenous water systems is clear from the work in Yemen by Aklan and colleagues (2022). They conclude that next to awareness, local policy plays an important role in realizing the return of traditional water harvesting. In a personal communication (Aklan 2023), one of the authors explained the ease

of use of groundwater was hampering the revival of traditional water harvesting techniques, even with the awareness that groundwater as a resource was unsustainable. The latter shows the importance of the second level of capacity development, the organizational level. In this specific case, current political structures should regulate the exploitation of scarce resources such as groundwater to stimulate the use of traditional techniques.

Current and Future Challenges

Similar to what has been described in Nepal and Yemen, around the world we can find other cases with similar challenges and the increasing awareness of traditional systems and of institutionalizing the maintenance and operation of these systems. Consider India with its stepwells in Gujarat, Oman with its Aflaj water supply system, Morocco with its khettaras near Marrakech and Chile with its socavones in the Atacama Desert.

These examples show the value of ancient water cultures for our present-day water challenges. Capacity development at all three levels is required to overcome these challenges and incorporate these traditional systems in our contemporary life. Cultural heritage including traditional knowledge can play an important role at two levels of capacity development: at the level of individuals and at the enabling environment level. One may ask why traditional knowledge is not already a stronger part of the capacity development at the individual level, for example, in our present-day education system. To answer this question, the development of our education system is of interest. Power (2015) discusses the history of education: from education for all, to equitable quality education for all and from learning as the treasure within to reimagining the future. The latest development is the Sustainable Development Goals, particularly SDG 4: "Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all." In the water sector, engineers play an important role. Their education and training must change to prevent the past tendency of engineers to operate in their own world, developing technical solutions that sometimes did not take into consideration the views and concerns of all stakeholders (UN Water 2020).

The Sixth International Symposium on Knowledge and Capacity Development (Alaerts and Zevenbergen 2022) showed that currently knowledge capacity development activities are still too often set up and financed for short term and pragmatic purposes with the expectation that well-described capacity solutions get developed instead of studied. One of the conclusions from the symposium concerns the short-sighted outputs of current capacity development activities. Although knowledge and capacity development should set up learning processes for and within institutions and society, today's practical application of knowledge and capacity development activities are mostly financed for delivering a predetermined product. In other words there is no encouragement to adopt a longer time frame and process so that we can learn from these activities and discover sustainable development paths. To prevent short-term, often unsustainable solutions, we need to develop local capacity and be able to learn and discover sustainable paths forward. However, funding education and training for such capacity is often neglected.

The present multifaceted problems that are part of our contemporary world including the water sector call for a different capacity. At the moment capacity development efforts are often top-down, technocentric and short-term. To

^ Fig. 2 The wickedness of water challenges, symbolising the almost compulsery need to approach water problems from different perspectives, including those of marginalised groups and the past (Source: Eddy Moors).

find inclusive and sustainable solutions there is an increasing need to enrich and pluralize our current knowledge base and create space for joint learning. Including traditional knowledge and cultural heritage will open an often-forgotten source of knowledge. Education institutions for water professionals such as IHE Delft with a strong tradition of peer-to-peer learning can play an important role in integrating knowledge of the past in both technical and social solutions for the future.

Conclusions and Future Approaches

UNESCO's resolution on the Global Network of Water Museums shows clearly the value of awareness raising and education of young people, both in terms of the value of traditional habits and heritage as well as the value of a forward-looking approach to perceive how this traditional knowledge can help address capacity challenges, especially those related to climate change. Understanding religion, culture and the traditional handling of water may help to greatly increase the awareness of all end users of water and by that the acceptance of more sustainable uses of water. Creating a teaching environment of joint learning and enriching and combining traditional knowledge and methods with contemporary knowledge and tools may lead to the more sustainable use of water. It will be important that such developments will be implemented within the Capacity Development Accelerator Initiative by the UN Department of Economic and Social Affairs and UNESCO.

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Museums for the Past and Future Meaning of Water

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In recent decades, a technologically driven water management paradigm has fostered a model of "domination over nature" with an unsustainable footprint. This paradigm has also alienated people and communities from their environment and from historical practices and forms of knowledge that involve managing and engaging with water directly. There is a need for a paradigm shift in managing water in a way that reconnects individuals to aquatic environments and water-related heritage and reflects the extraordinary transformation in our understanding of the need for biological diversity to sustain human life. The Global Network of Water Museums aims to stimulate a change of mindset toward long-term visions of water governance and heritage by reshaping contemporary thinking through education. With more than 80 members in 33 countries, this growing network promotes a better understanding of water history to build a "new culture of water" and inspire people to adopt more forward-looking uses of modern technology applied to water governance.

KEY THEMES

< Fig. 1 The freshwater basin of Tapi Bhavadi: a lesser-known stepwell in the old city of Jodhpur, Rajasthan (Source: Bhawani Singh, 2021; Mehrangarh Museum Trust – Living Waters Museum, India).

The chemical formula H_2O is not "water."
H_2O is a liquid deprived of both
its cosmic sense and its "genius loci."
It's a formula that is opaque to dreams.
Ivan Illich (1992)

Introduction

The rich sedimentation of water history and of diverse hydraulic cultures inherited from the past has left fascinating testimonials of what we can think of as distinct "water worlds" – that is, unique socio-cultural practices and conceptions aimed not only at using and managing water, but also simultaneously enjoying and celebrating it. Indeed, symbolic and sacred values have always been associated with the precious liquid element worldwide (Bachelard 1942; Eliade 1948; Barthes 1957; Tölle-Kastenbein 1990; Teti 2003; Eulisse 2010; Strang 2023).

However, ancient water cultures inherited from countless generations have been too often obliterated by the paradigm of standardization and "development at all costs" that characterizes the consumer society. In the name of modernity and progress, rivers and aquifers have been poisoned with tons of plastic and pollutants that weigh most heavily on the poorest people. At the same time we can ask: in places where drinking water has become available in every house in unlimited quantities, who still perceives the value of the drop that comes out of the tap? In recent decades of fast development, water has been made increasingly "invisible" – that is, far from people's awareness and interests.

Need for a Paradigm Shift: The Diplomatic Turn

In the Anthropocene, while freshwater biodiversity is plummeting, the preservation of biological diversity and historical water heritage is threatened by general indifference and growing apathy. Consider the rhetoric of greenwashing that sees an increasing number of even virtuous companies reducing the minimum percentage of plastic in their products to better advertise themselves under the banner of "sustainable development" and the new fashionable "green painters" taking a selfie next to an electric car for the sole purpose of self-promotion in political elections. Meanwhile, there is an overall failure to take effective measures to resolve the growing problems of managing an increasingly polluted and scarce resource (Illich 1992; Franzin 2005; Holst-Warhaft and Steenhuis 2010; Eulisse 2010; Tickner et al. 2020; Pileri 2022). Today most people ignore – or do not know enough about – how the health of rivers, aquifers and aquatic ecosystems affects human lives and well-being. Humanity seems not only to no longer be directly involved in water management but also, broadly speaking, to have lost a perception of the natural cycle of water.

Perceptions and attitudes that feed indifference are the consequence of a consumer society that has obliterated water history and the rich semiotic structures of historical cultures strongly permeated by the awareness of a needed coexistence with water in all its manifestations. Indeed, the current global water crisis appears tied to a loss of ancestral imaginaries and values linked to the liquid element. This is a condition that makes multiple water-related heritages more vulnerable than ever (Pileri 2022; Strang 2023; Wantzen 2023; Eulisse, Vallerani, and Visentin 2023).

In this radical change of human awareness of the crucial value of water, as Michel Serres has pointed out (2018), the "new Nature" that is born from the hubris of the Anthropocene and that is leading to mass extinction of biological diver-

sity is inseparable from consequences for the health of people and future societies. For this reason, we need to collectively experiment with alternative ways of inhabiting the planet within a framework no longer based on the concept of "security" but on concepts of "vulnerability" and "mutual care": "a diplomatic turn towards Peace with the Earth provides such an opportunity" (Degeorges 2021, 4). A new partnership with the Earth is the post-environmental paradigm that needs to replace "the unsustainable and predatory paradigm of economic growth based on the ideology of performance and optimization" that characterizes present-day societies (Degeorges 2021, 4).

The predominant development paradigm of consumer societies assumes that efficient (and "sustainable") water management can take place only with major hydraulic infrastructures that devour energy and leave a huge ecological footprint. In this frame, contemporary challenges to more forward-looking water uses require a change from the current cultural paradigm of "domination over nature" to one of "ecosystem sustainability" of the territory and its resources. Such a paradigm shift is a long-term and demanding task that requires education, training and engagement (UNCCD 2005; Global Network of Water Museums 2019; Treviso Manifesto in Defense of Water 2021; Wantzen 2023).

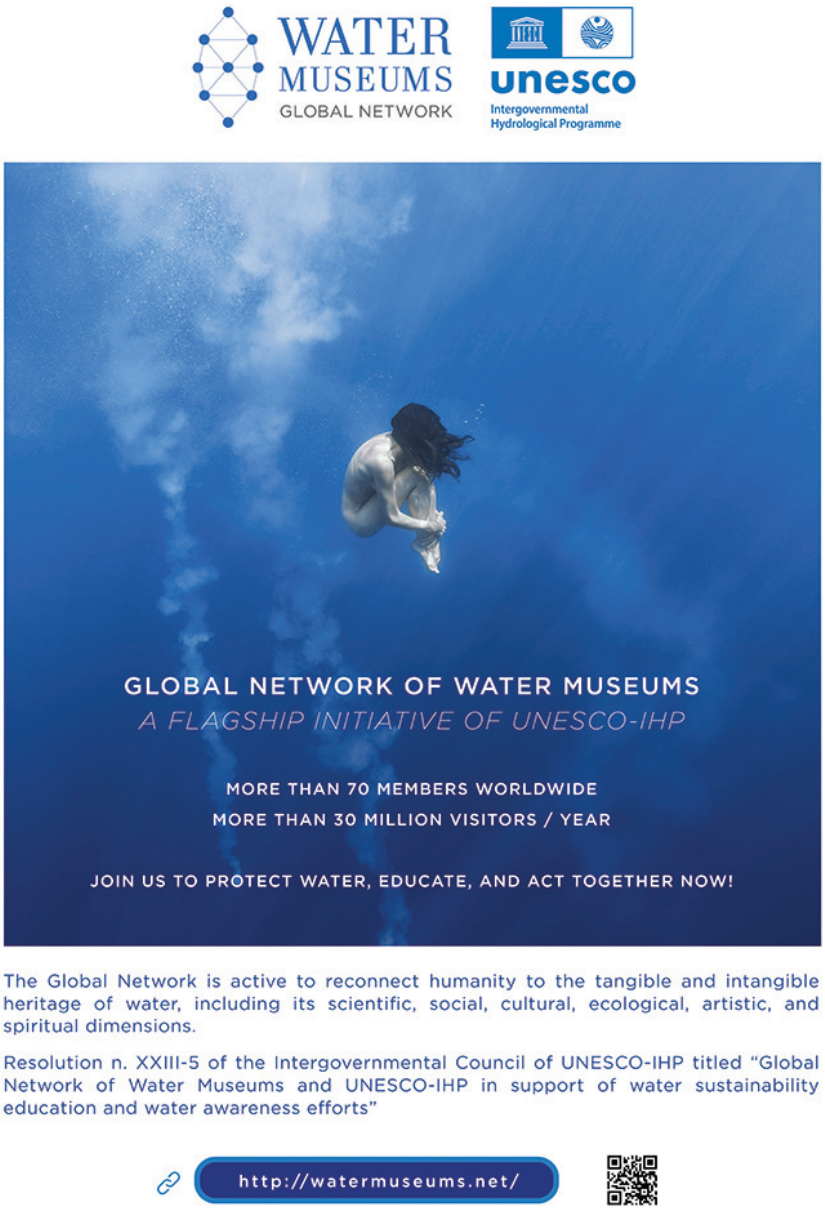
A closer look at historical water cultures offers a better understanding of the ancient ways of living in close relationship with water and its many manifestations. Although past generations only had basic empirical knowledge available and limited tools, we find that in many places our forerunners often managed water with more far-seeing vision when compared to the present day. Concerns about over-exploitation of common resources were shared in discussions and decisions that reflected learning by trial and error. Most efficient local solutions considered the limits imposed by nature, involved people directly in water governance and handed the resulting social practices down through the generations (UNCCD 2005).

For this reason, today it is crucial to know water history better and reconsider how past societies could manage scarcity in extreme environmental conditions by developing models of more forward-looking water management. Indeed, ancient water cultures reveal an essentially empirical character but simultaneously also holistic visions that incorporate intangible aspects and values associated with water to preserve it in the long run. This approach also led to natural coexistence with other species in diverse ecological contexts. In contrast, the consumer society thrives on a distorted knowledge of nature and pays little attention to its own footprint.

How Water Museums Can Stimulate Paradigm Change

In rediscovering ancient practices of human coexistence with the liquid element, what lesson can we apply to improving sustainability education and citizen awareness concerning the fragility of water? Water museums play an important role in this process, as has been stressed in a few declarations and in the Strategic Plan of the 9th Phase (2022–2029) of UNESCO's Intergovernmental Hydrological Programme (UNESCO-IHP 2022, 119).

In fact, museums can address water-related heritage of all kinds – whether natural, cultural, tangible or intangible. They can also foster key and fresh approaches to reconnect us with ancient practices and values of farsighted water management. Indeed, museums worldwide display outstanding features of water knowledge



^ Fig. 2 The poster of the founding Manifesto of the Global Network of Water Museums.

and heritage that can be vitally important in reconnecting individuals with water and in preserving the biological diversity of ecosystems.

This is a crucial contribution to the UN Sustainable Development Goals (SDGs), since in many parts of the world multiple water assets and heritage sites have been obliterated by the illusory availability of unlimited quantities of water – as implied by the functional ideology of consumer

societies. In this context, it is important to stress that more farsighted management of local water no longer requires only fundamental notions of hydrodynamics, technical management and efficient resource allocation to consumers. To find solutions to the challenges of water scarcity, policy makers must be sensitized to and properly trained about the need to also consider the ingenious visions and farsighted practices of past water management approaches. Concrete examples of these solutions were developed for the exhibition *Valuing Ancient Water Cultures* organized for the UN-Water Summit on Groundwater at UNESCO by the Global Network of Water Museums (2022). Ancient visions of managing water show how to benefit from low-cost and zero-emission practices that have simultaneously modeled waterscapes over the centuries. Such good practices and underlying models must be better combined with innovative technologies to protect freshwater ecosystems and face the impacts of climate change and water scarcity.

This perspective must be promoted further to better protect pristine waters, aquifers and water bodies – thus, preventing the further artificialization of riverbeds and enhancing freshwater ecosystem services. To reach these objectives, museums and visitors' centers – not to mention a growing number of exhibitions focusing on water vulnerability and involving several institutions, companies and artists – can inspire people to learn more and think about innovative solutions with long-term goals and with greater respect for non-human species that live in aquatic environments.

Changing people's minds and lifestyles is the mission of the Global Network of Water Museums (WAMU-NET), a network aimed at establishing a new relationship with our vital element (fig. 1). Indeed, while bringing renewed attention to ancient socio-cultural practices and perceptions related to water, the mission of WAMU-NET also focuses on present-day common behaviors, perceptions and attitudes involving water. In this perspective, the WAMU-NET Charter stresses the need to build a new "culture of water" – a culture that must take more account of our inherited "watery past," that is, the experiences and worldviews exhibited in water museums (Global Network of Water Museums 2019).

Museums can help transform individual behaviors, change paradigms and reestablish deeper connections with water. To do this, however, museums and related institutions must be better supported at all levels in order to promote new skills and pedagogical models. Education systems must respond to current water challenges by fostering fresh perceptions and awareness of values related to past liquid heritage.

In this sense, museums can be considered key drivers of the needed "diplomatic turn" in water governance and uses. They can inspire people, including the younger generation, with long-term visions and paradigms rooted in more farsighted wisdom linked to water. The more we look at ancient water knowledge, values and visions that gave rise to forward-looking management models as part of an educational process, the more it is possible to imagine more equitable and sustainable futures.

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Engaging with Water and Rivers from a Multispecies Justice Perspective

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Rivers are ecosystems indispensable for the survival of both humans and non-human species. Yet humans often disregard their importance and modify the existing socio-natural equilibrium of rivers in the pursuit of economic and political agendas. With a focus on new water justice movements, this article advocates a perspective that recognizes rivers as hydrosocial territories, actively and continuously co-created, co-inhabited, and transformed by a multiplicity of human and other-than-human beings. Such a perspective opens a path to a multispecies justice framework that involves rethinking the relations between human and non-human beings in the worlds we share as a medium for creating more socio-ecologically just and biodiverse water worlds.

KEY THEMES

< Fig.1 Beaver (Source: Unsplash License https://unsplash.com/photos/GZi8gjGV76g).

Rivers carry freshwater, an essential substance for life on Earth, across vast distances and diverse landscapes, but many rivers are currently endangered due to human activities and infrastructure, including dams and mega-dams, pollution, diversion and depletion. These threats originate from a dominant, technocratic and anthropocentric paradigm that defines water management and governance according to specific human worldviews and economic and political agendas. In response, new water justice movements (NWJMs) have been arising that strive to defend and re-enliven riverine hydrosocial territories (Boelens et al. 2022). As described by Boelens and colleagues, hydrosocial territorities are "the contested imaginary and socio-environmental materialization of a spatially bound multi-scalar network in which humans, water flows, ecological relations, hydraulic infrastructure, financial means, legal-administrative arrangements and cultural institutions and practices are interactively defined, aligned and mobilized through epistemological belief systems, political hierarchies and naturalizing discourses" (Boelens et al. 2016, 2).

NWJMs include Rights of Rivers campaigns, which have been spreading around the globe for the last decade and a half (O'Donnell and Talbot-Jones 2018; Kauffman and Martin 2018). Key cases include the Vilcabamba in Ecuador (Berros 2017), the Atrato in Colombia (Macpherson, Ospina and Ventura, 2020), the Whanganui in Aotearoa New Zealand (Rodgers 2017), the Ganges and Yamuna in India (Kinkaid 2019), and the Magpie or Muteshekau-shipu in Canada (Page and Pelizzon 2022). A network of international organizations has since drafted a Universal Declaration of Rights of Rivers acknowledging these bodies of water as living entities with inherent fundamental rights such as the right to flow, the right to perform essential functions within their ecosystems, the right to be free from pollution, and the right to regeneration and restoration.

Although pervaded by challenges that include contestation, internal power dynamics and processes of subjectification, these NWJMs have the potential to help restructure nature-society relations in watery worlds. Namely, they reflect an attempt to bring modern, Western legal systems into dialogue with other cultural modes of relationship with water (Laborde and Jackson 2022) and with different ontological understandings of rivers (Götz and Middleton 2020). Indeed, the construction of water as a natural substance abstracted from social, cultural, and religious contexts that is prevalent in mainstream water resources management is coming under increasing scrutiny (Anderson et al. 2019). In civil society, socio-environmental movements, and branches of academia, there has been a growing interest in understanding how water is also historical, cultural, and political (Anderson et al. 2019). The same happens with rivers, who are differently recognized as living beings, as ancestral kin and as multispecies communities. For Australian Aboriginal peoples and for the Maori tribes of Aotearoa New Zealand, for instance, rivers such as the Martuwarra or the Whanganui are understood (and have been engaged with historically) as sacred ancestors (RiverOfLife et al. 2020; Magallanes 2020).

These alternative modes of relationship encourage the acknowledgment of rivers as hydrosocial territories, actively and continuously co-created, co-inhabited and transformed by a multiplicity of humans and other-than-human beings, such as animals and plants. This awareness leads people to consider issues of water justice beyond the predominant human-centric perspective. Through a particular political ecology lens, water justice aims to challenge

^ Fig. 2 River trout (Source: Hunter Brumels via Unsplash).

power structures as they are manifested in and through water and to shed light on the "multiple layers of water injustices, ranging from the brutal, visible practices of water grabbing and pollution to the subtle powers and politics of misrecognition and exclusion" (Boelens, Perreault and Vos 2018, 2–3). These practices, powers and politics affect not only human communities but also many other beings who live in, with and around rivers. Exclusion and misrecognition may lead into canalizing, damming, and polluting rivers while disregarding the fact that rivers are the habitat of many different species whose lives entirely depend upon the socio-ecological integrity of their territory. Thus, impacting the river will ultimately impact all the species in the area. Exclusion and misrecognition may also involve overlooking the agency of beings who co-create these riverine territories, such as beavers, who are ecosystem engineers and whose dam-building activities can have significant impact on river biodiversity (Orazi et al. 2022). Further, both animal and plant species should be recognized for their role in river territories. Rivers can thus be understood as "territories-in-territory" (Hoogesteger et al. 2016), bringing together many different species, lifeways, knowledges and forms of agency. Therefore, analyzing river systems (and water worlds in general) through a multispecies justice perspective becomes fundamental.

Multispecies justice recasts the subject of justice beyond (only) humans and invites us to rethink relations between human and non-human beings in the worlds we share and co-create.

It is both a concept and an agenda for radical research, one which recognizes that a plurality of axes of identity (e.g., species, race, gender, class, age, ability, being) intersect and are interwoven in structures of inequality, injustice and oppression, but also, potentially of resistance and resilience (Tschakert et al. 2020). This recognition aligns with a political ecology perspective that views discussions around water (in)justices as necessarily comprising critical reflection about which and whose voices, histories, worldviews, knowledge systems, norms and practices are rendered visible or invisible (Zwarteveen and Boelens 2014).

Applying a multispecies justice framework to the defense, restoration and re-enlivening of rivers can help researchers, activists, local communities, environmental organizations and other actors to think about other relevant questions. These include: How are riverine hydrosocial territories co-constituted by a diversity of human and other-than-human beings, and consequently, how do processes of domestication, enclosure and degradation of the world's rivers (Boelens 2022) affect all these different communities? How are particular (human and non-human) subjects excluded from water governance processes? How might the recognition of other-than-human subjects and the upholding of their multiple forms of agency in the creation and preservation of these territories be a matter of multispecies justice and also be an important way to maintain or restore the socio-ecological integrity of rivers? Finally, one should be aware that enlarging the circle of subjects invited to the political decision-making table also leads to additional questions, such as: Who is doing the inviting? Who is being invited and who is not? Whose voices are we listening to and whose are we not? What tensions and potential contradictions exist between the perspectives of different subjects (e.g., a representative of an environmental organization, a spokesperson for a riverine animal species, a representative of the state, a member of a company)? Why?

Whereas non-human beings and their modes of relationship with the environment (namely water) and with each other are traditionally portrayed as being biological or ecological matters, I would argue that they are profoundly political and cultural as well. As Van Dooren, Kirksey and Münster (2016, 4) note, "Many entities, from geologic formations and rivers to glaciers, might themselves be thought to have distinct ways of life, histories, and patterns of becoming and entanglement, that is, ways of affecting and being affected." Important questions for multispecies justice would therefore also include: To what extent do water management and governance regimes acknowledge the historic relations between non-human beings that developed in (and that created) water worlds over thousands of years? To what extent does (in)tangible water heritage also implicate non-human lives, modes of knowing and of creating water worlds and modes of relating with each other? Is cultural heritage an only-human story (Van Dooren, Kirksey and Münster 2016) or a more-than-human one? As Henk van Schaik and Sir Diederik Six argue in another Blue Paper, contemporary water managers do not sufficiently acknowledge the value of thousands of years' worth of experience of different people and cultures regarding water (van Schaik and Six 2021). In line with that, I would add that they also do not recognize the value of thousands of years' worth of experience, lifeways, knowledge and agency of non-human beings with water and with each other in liquid territories such as rivers. To acknowledge these – the tangible and intangible heritage of both human and other-than-human beings in relation to water – can also be a matter of multispecies justice.

Finally, it might be argued that multispecies justice already exists in daily socio-cultural practices around the world. Examples include the restoration efforts that connect Nmé (sturgeon) and Anishinaabe communities in the US (Whyte 2017), the relationship between fishing communities and the fishes of the Magdalena River, Colombia (Boelens et al. 2021); and the biodiversity conservation zone that protects more than 900 varieties of native potato in the Andean region, which was created by Quechua peoples such as the Paru Paru, Chawaytiri, Sacaca, Pampallacta, Amaru and Kuyo Grande communities (Whyte 2020). In these different geographically and culturally situated cases, local communities have been historically involved in relations of reciprocity and kinship with different beings (such as fish and potatoes) and have developed practices – such as conservation and restoration efforts – to respond to threats to their common lives and to protect and uphold the existence and lifeways of both the human and the other-than-human beings who are involved in these relations.

For example, the fisherwomen and fishermen of the Magdalena River, Colombia, engage in interspecies relations every day. They claim to hear the fish sing and to be able to predict the weather according to what animals tell them (Boelens et al. 2021). Importantly, they establish ethical guidelines for fishing that seek to respect particular aspects of the lives of the fishes with whom their own lives are so intimately entangled. This could be understood as a form of multispecies justice. In another example, the Anishinaabe are actively involved in restoring Nmé (sturgeon) populations, not only because the sturgeon has historically been an important source of food for the communities and a species indicator for monitoring the environment, but also, because the Anishinaabe are involved in a cultural and spiritual relationship with the sturgeon that assigns them a specific responsibility to care for their fish kin (Whyte 2017). This could also be understood as a form of multispecies justice, where the well-being of one species is directly entangled with the well-being of another, and both humans and non-humans are interdependent.

These examples of hydrosociality in the Magdalena River in Colombia and in the Great Lakes region of North America show us how human and non-human systems and communities are profoundly entangled, and how the future of healthy, living rivers may be closely related to the upholding and protecting of the lives and lifeways of these diverse beings and communities. It is therefore of increasing importance to look at NWJMs around the world that are practising different, localized forms of multispecies justice, to learn from such practices and to exchange knowledge and experience in order to create more socio-ecologically just and biodiverse water worlds.

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Carlota Houart is a PhD researcher at Wageningen University & Research, the Netherlands, as part of the ERC-funded project "Riverhood: Living Rivers and New Water Justice Movements." Carlota's PhD project focuses on multispecies justice in riverine hydrosocial territories through a political ecology perspective. As part of her research, she is critically exploring how the voices, interests, and needs of other-than-human beings (such as animals, plants, and the rivers themselves) might be included in political decision-making and grassroots processes concerning river management and governance, alongside those of human communities. In other words, a central question of her research is how might multispecies justice contribute to new movements and strategies for the defense and restoration of rivers, and what challenges can this entail? As part of her research project, she is looking at the River Maas in the Netherlands and at the Piatúa River in Ecuador and will apply methods of multispecies ethnography to both cases. Carlota has a background in international relations and in peace, security, and development studies at the University of Coimbra, Portugal, where she also previously worked as a junior researcher at the Centre for Social Studies. Parallel to her personal interest in environmental activism, which has led her to collaborate with movements such as Extinction Rebellion and the Global Alliance for the Rights of Nature, her current research interests include political ecology, ecofeminism, Indigenous ontologies and knowledge systems, ethics in more-than-human research, and post-anthropocentric political theory more broadly.

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River Culture: Living with the River, Loving the River, Taking Care of the River

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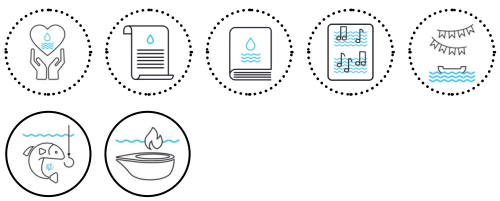
An unbelievably small portion of the water available on planet Earth, just 0.00015 per cent of it, runs in rivers (Garcia-Moreno et al. 2014). And yet, this is the most important water source, not only for humans, but also for animals, plants and entire ecosystems on all continents. The natural flow regime of rivers, including periods of floods and low flows, has set the pace for cultural activities and biological evolution since the earliest days. But, in assuming that water is a resource that can be exploited without limits, humanity and global life support systems are running into an existential crisis, recently worsened by climate change. This article presents the book publication River Culture – Life as a Dance to the Rhythm of the Waters, *which bears the name of a scientific concept that offers a way out of this crisis. Its innovative approach combines adaptive strategies developed by non-human biota with cultural practices resulting from human-nature interactions. The goal is to develop sustainable management options for river catchments (Wantzen 2022, 2023).*

KEY THEMES



< Fig.1 Traditional boat architecture is one expression of river culture (Source: Karl M. Wantzen, 2022, CC-BY).

Introduction

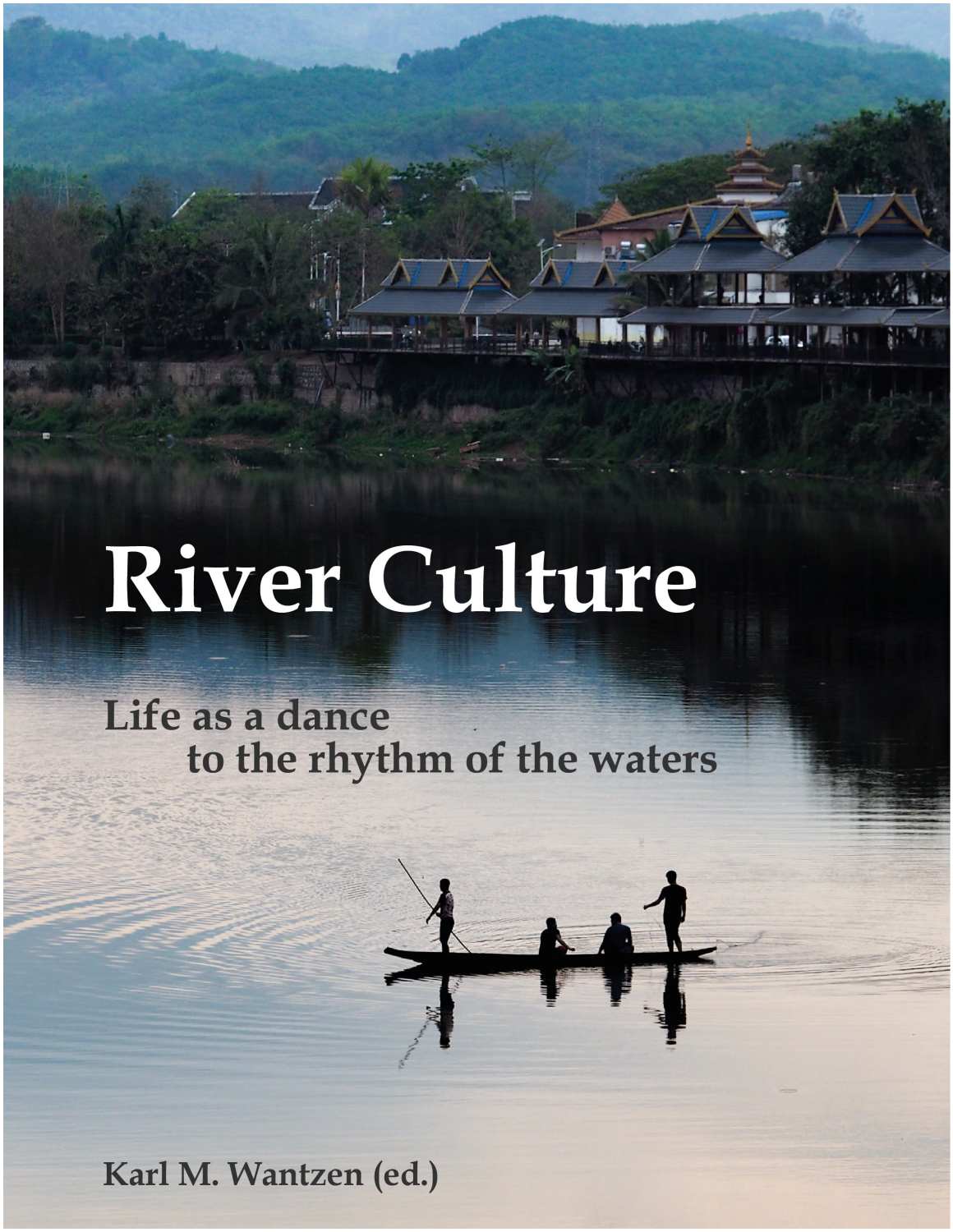
Rivers are both cradles of innovation and cultural conveyor belts. In a recent worldwide study, more than 120 scientists from different academic fields and 24 countries of origin jointly analyzed the biocultural diversity of rivers, the threats to this diversity, and examples and perspectives that can be helpful for overcoming the meltdown of biological and cultural diversity (fig. 2) (Wantzen 2023). *River Culture – Life as a Dance to the Rhythm of the Waters* presents socio-ecological portraits of twenty-eight rivers from four continents: six river case studies in Africa, seven in Asia, six in the Americas and nine in Europe. Five reviews explain sustainable concepts for riverscape management in the Anthropocene, two chapters deal with artists' perspectives on environmental communication and one with gender equality. *River Culture* delivers, for the first time, a synopsis of the diversity of cultural practices linked to rivers – from religious practices to architecture – and their historical development from ancient times to the postmodern era. Not only did the study envisage a list of elements of biological and cultural diversity, but also it investigated how these adaptive mechanisms (in the case of non-human biota) and the cultural practices (by humans) could be used to improve the management of riverine landscapes. The book has been designed to serve as a toolbox of examples, showing how river-related problems can be overcome, and how engaged societal groups have succeeded in implementing widespread solutions that contribute to the shared 2030 Agenda for Sustainable Development.

Surprising similarities were found between riverine contexts, despite huge geographical distances and cultural differences, such as the alternating "common use" of assets during high water periods and the "ownership of territories" during dry periods in floodplains in Africa and South America. Consideration of this alternating use form, originally driven by the rhythm of the waters, could stimulate ideas for tackling problems of poverty and resource overuse.

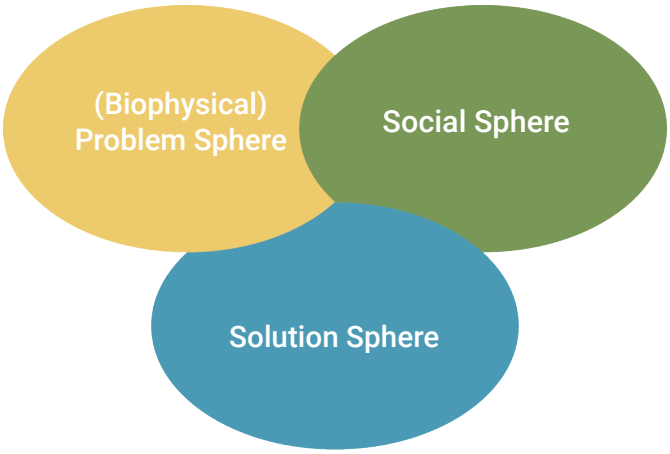
Global Similarities and Culture-Specific Patterns in Human-River Relationships

The authors of *River Culture* are campaigning for justice between upstream and downstream communities along rivers (especially in the case of dam construction and interbasin water transfer [Boelens et al. 2022]), as well as between humans and non-human species, stating: "Those who have a snout or a beak cannot complain when all the water becomes deviated for irrigation or energy production, but they also have a right to live." Moreover, the authors warn that most natural floodplain wetlands and practically all river deltas are vanishing as a result of the blocking of environmental flows of water and transport of sediments by dam construction. In the case of the Mekong, just 1 per cent of the original amount of sediment, before damming, reaches the sea. At the same time, migratory fish (including the most important species for inland fisheries) and other freshwater species are vanishing worldwide, and, along with them, the cultural activities connected to them. The authors of *River Culture* state that they recently observed an intergenerational disruption of cultural memories and they show how those memories can be revitalized and integrated into global actions, such as the UNESCO Global Network of Water Museums and the Intergovernmental Hydrological Programme (IHP).

The effects of biophysical deterioration and the concomitant meltdown of cultural diversity are remarkably similar worldwide; however, motivations – that is, why people begin to take action



^ Fig. 2 The book *River Culture – Life as a Dance to the Rhythm of the Waters* (Wantzen 2023) delivers a global study of human-river relationships (Source: Photo by Pia Parolin, 2023; cover design by Karl M. Wantzen, CC-BY-SA 3.0 IGO).



^ Fig. 3 Actions toward sustainability (e.g. river restoration projects) require matching the "problem-sphere" with the "social sphere" to result in efficient solutions (Source: Karl M. Wantzen, 2023).

to solve or mitigate the problem – show great intercultural variation and may involve both bottom-up and top-down approaches. For example, religious or educational motivations drive community-based conservation initiatives in India, while the River Chief System in China was implemented by the government to combat water pollution (Cao and Vazhayil 2023).

Current and Future Challenges to the Sustainable Management of Riverscapes

The greatest challenge involved in saving the ecological and social functions of rivers as life support systems for all continental biota, human and non-human, involves the transfer from well-established knowledge about urgently needed actions (detailed, for example, in the water-related SDGs) to successfully implemented (and not only planned) actions (Vörösmarty et al. 2018). The warnings about global tipping points are old news – especially when it comes to the essential freshwater ecosystems – but the global trends of further deterioration, e.g. building more dams, polluting water and overexploiting the remaining freshwater fauna, continue unchanged. For instance, in 2018, the global average of the Living Planet Index for freshwater was only 16 percent that of 1970. Facts and evidence alone do not suffice; rather, what is necessary are globally binding contracts and the issuing and reinforcing of laws. To find support for these measures, human-nature relationships (or in this case, human-riverscape relationships) need to be strengthened. However, these linkages are often bound to intangible cultural practices that were ignored by previous management policies.

The River Culture concept (Wantzen et al. 2016), with its innovative, double-sided approach of learning from selected biotic strategies and cultural practices (both of which have been tested for their capacities in sustainability) supports these initiatives to take action by adding new aspects. Recent global analyses of practical (and successful) applications, for example, in the context of urban hydrosystem restoration (Wantzen et al. 2019), the planning of

human-river encounter sites (Zingraff-Hamed et al. 2021), stream daylighting (Wantzen et al. 2021), river restoration (Wantzen et al. 2022), and the management of dedicated sites in riverscapes (Yousry et al. 2022), show how the "biophysical problem-sphere" and the "social sphere" need to be matched into a "solution sphere" to support and gain social acceptance of the needed project (fig. 3). In this context, it is important to note that the more complex the problem, the more intense the social adherence to natural processes and sustainability should be. Relatively simple projects, such as the establishment of wastewater treatment to overcome water pollution, are easily understood and readily supported by the concerned population. However, if complex restoration projects, such as dam removal, are not sufficiently incorporated in the perception and understanding of the community, they may provoke resistance, as recently seen in the case of the Sélune River in France, where after dam removal, a protest movement resulted in a checkmate situation in national dam removal policies.

Conclusion

River culture, that is, the combination of evolved (biological and cultural) practices that are adapted to the natural rhythms of water (also known as flood pulse or natural flow regime), provides a sustainable approach to riverscape management. The currently prevailing value systems, which only consider the river as a set of assets to be maximally exploited, is definitively unsustainable. Current tendencies to change this value system by acknowledging the water needs of ecosystems to function well (environmental flows, ecological flows), the rights of non-human species to live well (that is, not only to survive but also to evolve further), and the rights of First Nations as users of rivers, and so on, are currently gaining increasing importance, for example in global and political frameworks such as UNESCO's IHP IX, the European Water4all policies and the French OneWater research program. The critical question is whether this development can happen quickly enough to cope with the increasing speed of socio-environmental degradation and the decreasing resilience of multiple stressed ecosystems. Most often, human activities in favor of nature only arise after catastrophic events such as the 1986 Sandoz accident, which resulted in initiating the first serious international treaties intended to reduce water pollution in the Rhine catchment. But do we need life-threatening events (including irreversible damages to our life-support systems) to take action? With the *River Culture* approach, the natural, cultural and emotional connections to the river are in focus and it is recognized that people who love their rivers (again) will respect them, take care of them and prevent them from harm, as they would for another human being.

Despite the many unpleasant truths shown in the *River Culture* case studies, there are also positive signs. The publication presents various examples of participatory management and governmental programs facing the global river crisis. "In many societies, a katharsis moment has taken place, and the insight that we need to protect entire riverscapes better than before is gaining momentum," the River Culture authors conclude optimistically.

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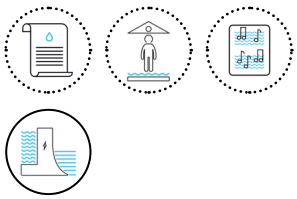
Water and Culture Policies: An Illustrative Case of Updated Collaborative Transformation Policies

Sylvia Amann
Inforelais

Water and culture have been closely linked to human beings since ancient times. These connections were often lost in the process of industrialization. New water culture policies and initiatives reflect new attempts at collaborative transformation. They provide a way to transcend the current crisis-management discourse and related narrow policy answers offered by policy makers in Europe. The EU foresight scenarios describe potential future developments. They can serve as a starting point for cross-sectoral cooperation and policy making that can help solve the current and upcoming challenges and make it possible to take advantage of opportunities. Collaborative ecosystems need to be brought forward by policy makers and leaders as well as staff in culture and water organizations. This can change the dominant practice of policy making, which is sectored in silos and often can't provide sustainable solutions. A set of interlinked initiatives provide a basis for integrated policy making and multi-stakeholder collaboration that can bring about positive change.

KEY THEMES



< Fig. 1 Changing water-related practices in cities: Miroir de l'Eau, Bordeaux (Source: Tony Hisgett, CC BY 2.0 , via Wikimedia Commons).

Introduction

The twenty-first century's major transitions have become increasingly apparent since the acute phase of the Covid-19 pandemic. In particular, the effects of the digital revolution and of climate change have become increasingly tangible and affect water and culture in ways that policy makers must address. Agribusiness practices pose additional danger to water resources. Agricultural heritage is not well protected as an intangible asset.

Major research on transformation scenarios was already being published before the pandemic. These publications also include the EU foresight work being carried out by the European Commission. However, this knowledge remained limited for a long time to exchanges among experts. The EU foresight scenario report (European Commission 2021a) refers to main disruptive elements, namely shifts in global order and demography, digital hyperconnectivity and technological transformation, climate change and other environmental challenges as well as pressure on democratic models of governance and values.

The pandemic and its major disruptions challenged most of the (cultural) policy makers. They demonstrated a lack of preparation concerning risk awareness and appropriate institutional settings and plans. This absence, and the types of policy responses implemented, underline an emergency and crisis-driven approach. A crisis-response focus entails, for example, the use of funds budgeted for culture or water policy objectives for emergency help rather than for structural changes.

The reconstruction of historic buildings after inundation in flood-prone places illustrates this. Future-oriented policies would focus on prevention and innovation, however, current policy often focuses on rebuilding. Both prevention and innovation require an in-depth understanding by decision makers about future risks and opportunities. Such an approach needs updated water and culture policies adapted to the specific requirements linked to the future scenarios ahead. Which types of policies and actions should be considered?

Transformative Frameworks for Active Water and Culture Policies

Culture and water policies aim to generate positive impacts on society and economy or to prevent damage to the population. A lack of reflection on future scenarios by policy makers, in organizations as well as by individuals, avoids generating the desired effects and risks harming the objective of a sustainable and just transition. Policy makers need to understand the underlying dynamic frameworks in which their action is expected in order to develop future policies that advance positive societal and economic developments.

These interrelations can be best illustrated with one of the key dynamic elements on Earth – water. Irrigation systems or (historic) port infrastructures address the dynamic nature of water as such and by the means of political frameworks. Investment in water-related infrastructures like dams aims at transforming these contexts in favor of the investors and in the best cases also of the population. Ignoring rising water levels due to the effects of climate change, for example, will cause undesired effects and require policy makers to focus on crisis intervention. These effects in turn can hinder the development of preventive measures. Crisis intervention is also likely to negatively impact investments in innovation to achieve an updated

^ Fig. 2 Cultural heritage and water: Jardin des Grands Explorateurs, Marco Polo et Cavelier de la Salle, Paris (Source: Sylvia Amann, 2022).

sustainable water (management) culture.

From a European point of view, future policy making should be based on the major EU scenarios. In the context of the European Union, the EU Joint Research Centre identified main scenarios of future action and all link to water and culture policies (European Commission 2017).

The first scenario imagines shifts in global order and demography, including a fundamental increase in the global population as well as a decline of 16 per cent of the available workforce in the EU. This would mean that scarce water resources globally will generate migratory movements and related intercultural challenges on the European continent.

According to the second scenario, climate change and other environmental challenges will impact the EU Member States and will have considerable further effects on biodiversity and food production. As a result, the strong impact of climate change on the water cycle will also cause water-related damages to historic coastal cities. These changes will affect opportunities for cultural tourism and creative industries.

The third scenario assumes that the pressure on democratic models is accelerating and that it challenges governance and values. Water and heritage commons are topics related to the stabilization of democratic models. An understanding that the whole population co-owns common water and cultural heritage, morally and financially, is far from universally shared. Its greater acceptance would contribute to more stable democratic models.

In the fourth scenario, digital transformations

^ Fig. 3 Arts-based communication on water-related challenges: Bruges Whale Sculpture (Source: Falk2, CC BY-SA 4.0, via Wikimedia Commons).

comprise hyperconnectivity as well as recent developments like the metaverse and artificial intelligence. These are also linked to cooling systems that require a continuous supply of water to ensure the use of the digital platforms by the creative economy as well as digital audiences.

Further reflections on these frameworks bring forward a critique of the current crisis-response approach and the necessity for a shift toward the notion of "permanent transformation." The context for water and culture policy makers is permanently changing, as a result, for example, of new types of water pollution involving medical goods during the pandemic and evolving use patterns of the Black Sea shores and beaches due to the war in Ukraine. These changes can be more or less disruptive. In the years 2020 to 2022, many policy makers focused on coping with immediate crises. At the same time, many policy makers lost sight of the need for a wider perspective based on permanent transformation.

Collaborative Water Culture Ecosystems

Policy makers need to be aware of transformation scenarios; they also need to embrace collaborative approaches due to the cross-sectoral nature of all future challenges. Addressing

connected problems with silo-type actions will not produce the required solutions. Water culture policies are excellent examples. Arts, culture and heritage have considerable potential to (re)connect people with the central role of water in human survival. Culture policy and water policy makers should design and implement forward-looking policy approaches together. However, this kind of collaboration is to a large extent not yet in place in Europe.

In analyzing a wide range of EU water scenarios and related policy papers, it becomes apparent that culture, arts and heritage concerns have not played a major role in defining or implementing sustainable future policies and actions. The EU foresight scenarios highlight the need for international ocean governance in a sustainable and peaceful manner (European Commission 2017). Nonetheless, this EU paper does not reflect further on the role of soft power, including sustainable international cultural relations. A new integrated approach to international relations could be applied to many situations, such as a coordinated attempt to manage heritage and water in international river delta systems.

The so-called Water Mission (European Commission 2022) in the EU research program "Horizon Europe" aims to encourage integrated approaches to addressing major future water-related challenges in the European Union. However, the documents describing the focus of the mission do not include the related positive and negative impacts of culture. (Un)sustainable (cultural) tourism is one example.

A study of structural risks published by the European Parliament (2020) fails to link non-tech innovations for water use to the considerable potential of arts and creative industries to influence water use patterns. Collaboration between policy makers and administration is needed and conversations need to take place that will establish better cross-sectoral links and to transcend policy-making silos.

A collaborative system needs a collaborative mindset based on horizontal partnerships as well as collaborative individuals, organizations and governance. However, these collaborative ecosystems are difficult to bring into practice. Vertical relations of power persist, generating uneven access to resources, knowledge and the power to make decisions. Water management companies and their relationship to local populations are an example of these complex relations of power.

Furthermore, potentially conflicting objectives related to water use like the generation of hydropower or the protection of sustainable agricultural practices near rivers are complex frameworks for potential sustainable horizontal partnerships. These are further accentuated by party politics that pervade many public administrations and create discouraging settings for those individuals interested in developing cross-sectoral initiatives. How can we remedy this unfavorable situation?

Potential Next Steps for Policy Makers and Stakeholders

Collaborative transformation policies – in the area of water and culture or other thematic fields – require, first, awareness of the need for cross-sectoral cooperation. Also, enhanced cross-sectoral collaboration is required to better understand how the different topics are linked and need consideration in policy making. Thematic interlinkages include the concepts of (water, heritage) commons and democracy and the cultural dimensions of migration flows caused by water scarcity. Systematic studies

^ Fig. 4 Current leisure cultures related to water: pool parties (Source: Club Skirts Dinah Shore Weekend, CC BY-SA 3.0 via Wikimedia Commons).

of the transversal nature of future scenarios related to water and culture are not yet taking place in the European Union. Such research would have the potential to increase the understanding of water and culture ecosystems and provide the necessary basis for science-based (policy) action.

In terms of the development of integrated water culture policies, common topics of interest include the reduction of plastic litter in oceans or the management of transnational river basins and related heritage practices. Furthermore, the links between non-urban practices in (agri) culture and the international cultural dimension of port cities merit the attention of both culture and water policy makers. Guiding values for common action need to be discussed and agreed upon between the two sectors. They might include a resolve to overcome touristification that infringes upon water and heritage commons. With such an approach, the social dimensions and the people's needs in terms of water and cultural heritage can be brought to the fore.

In addition, culture policy and water policy should be built on longer-term perspectives. Both aim at ensuring that these precious resources remain available for future generations. Cultural changes related to water-use patterns are needed as the current use of water reflects the dominating value systems in our societies. An illustrative example is the swimming pool culture in Europe promoted by the fashion industry as well as by the music industry that provides cool songs for the pool party.

The relationship between populations and the resource of water needs to adapt to changing conditions and to expected future water scenarios. The creative industries are one sector with considerable potential to generate new narratives for updated water-related lifestyles. These cultural changes are areas of urgent action. Furthermore, the understanding of the global and territory-specific dimensions of future water challenges need to be better addressed. This territorial perspective relates also to international cultural relations and decolonization. Additional linked topics include just transition (European Commission 2021b), sustainable development and global solidarity.

All those working in (public and private) organizations can be agents of positive change. This understanding is not yet sufficiently anchored in many institutions. New collaborative transformation policies are only feasible when operators are willing to and have the necessary skills to cooperate across silos. Policy makers should understand this crucial need and responsible for providing the required frameworks. For example, the European Commission (2019) requires "interservice consultations" – that is, directorate-generals of the European Commission must consult other directorate-generals on proposals with which they have an interest. On another policy level, the OECD supports stakeholders with a whole set of tools and good practice examples regarding mission-driven cross-sectoral innovation initiatives (Larue 2021).

These initiatives show a certain will to encourage cross-sectoral collaboration. However, considerable further innovation in policy making (settings) is needed. It is time to imagine updated practices. These collaborative practices should involve a wide range of strata of the (global) population. These cross-sectoral policies need stakeholders able to understand that major transformation scenarios of the twenty-first century can be only addressed together in a cross-sectoral, collaborative and sustainable manner.

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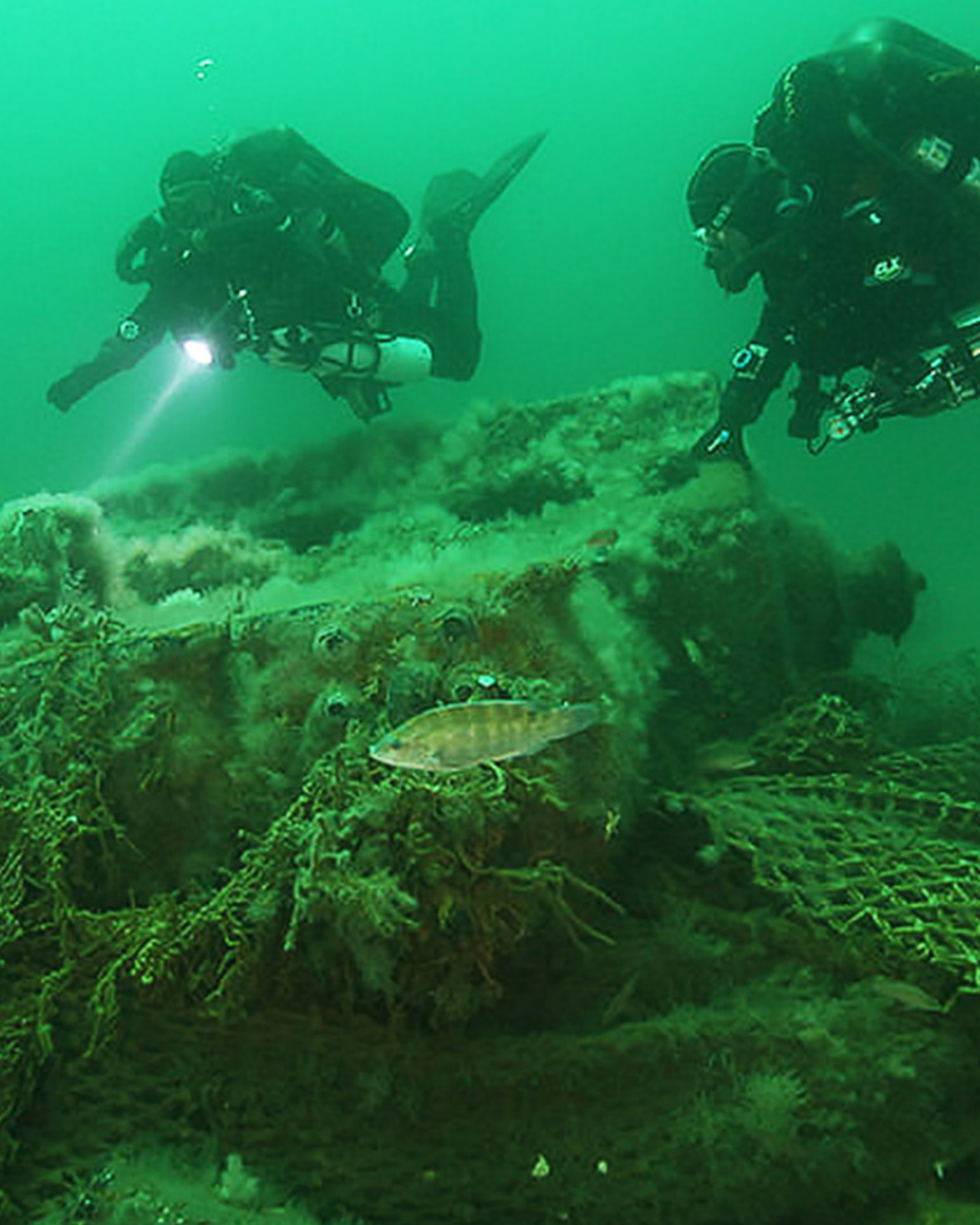

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Threats to Underwater Cultural Heritage from Existing and Future Human Activities

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Our ocean heritage (natural and cultural) is at risk from destructive human activities, including bottom trawling, deep seabed mining (DSM), and potentially polluting wrecks (PPWs). The stories of our societies and our ancestors are often connected with the ocean and captured on the seafloor as artifacts, shipwrecks and the remains of those lost or buried at sea. Previously, marine global heritage protection efforts have been largely focused on natural heritage. However, Underwater Cultural Heritage (UCH) is also ocean heritage and must be considered the same way. We must shine a light on UCH as heritage and insist that it be part of Marine Spatial Planning with integrated ocean and coastal management. Approaches include, but are not limited to, (1) Conducting baseline surveys to identify heritage that should be conserved and preserved for present and future generations; (2) Environmental assessments taking into account the impact of human activities on both natural and cultural heritage; (3) Measures to identify, avoid or minimize the adverse impacts; and (4) The application of a precautionary approach to trawling, DSM and salvage of PPWs, calling for a moratorium on these activities unless and until steps 1 – 3 have been accomplished, permits/other management controls are in place and significant natural and cultural sites have been designated as protected areas.

KEY THEMES

< Fig. 1 A diver examines debris left from fishing gear in the Stellwagen Bank Marine Sanctuary, a nationally protected area in the United States that allows trawling and fishing within its borders (Source: National Oceanic and Atmospheric Administration).

Bottom Trawling, Deep Seabed Mining and Potentially Polluting Wrecks: Current and Future Challenges

Every day, thousands of kilometers of the seabed are ploughed by trawlers, destroying both cultural and natural heritage. Since its first mention in an English 1376 parliamentary petition, trawling has been regarded as a catastrophically damaging practice with long-lasting negative consequences for seabed ecology and marine life (Roberts 2007). Although legislation that limits trawling can help biological communities rebound, the archaeological material lost can never be recovered (Brennan et al. 2015). Maritime archaeologists and marine ecologists need to communicate and work together with fishers and policy makers to find ways to limit harm. Shipwrecks are as much part of the marine landscape, and thus of importance to ecologists, as they are to the cultural, historical landscape (fig. 1).

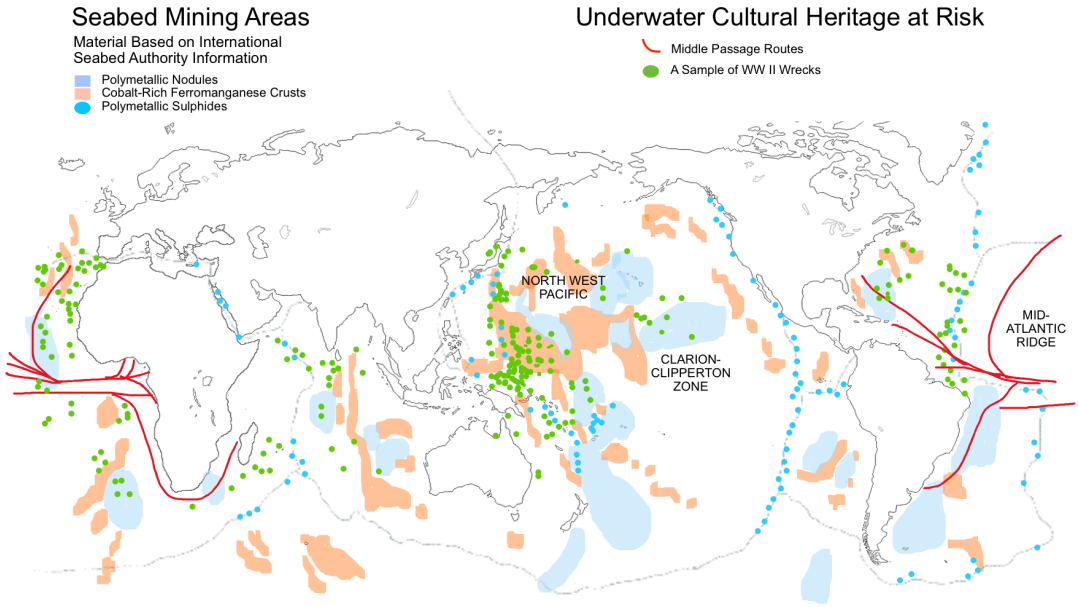
There are also future challenges facing UCH. Deep seabed mining operations (DSM) that interact with tangible UCH will destroy heritage by removing it from the seafloor and processing it through a machine before discharge (The Ocean Foundation, n.d.) (fig. 2). Current International Seabed Authority (ISA) exploration and exploitation draft regulations are not sufficiently protective of UCH. For example, the regulations do not require the real-time monitoring of operations and transmission of relevant data, which would enable identification of tangible UCH and the halting of destructive activities to protect the heritage.

DSM will also affect intangible cultural heritage. For example, noise from DSM has the potential to negatively impact local practices such as shark calling (a ritual connected with a sense of identity and community practiced in the Pacific where, on special occasions, men sing to attract sharks), as well as the migration of whales – which have cultural importance to many communities around the globe (Tilot et al. 2021). Concerns have also been raised about how DSM affects some cultures' awareness of their responsibility to the ocean or particular attention they pay to the deep ocean. Such conversations have not yet found a place in regulatory development at the ISA.

Additional threats to heritage, both natural and cultural, can come from the material itself. While the wrecks from the world wars are part of our cultural heritage, they pose a significant pollution threat to the marine environment as well as to fishing and other livelihoods that depend on a healthy ocean (fig. 3). Millions of gallons of oil lie underwater trapped in shipwrecks, particularly from wars though not all, and unexploded ordinances pose additional threats (Carter 2021). Unfortunately, while some oil leak origins are known, many come from unknown sources and will definitely cause future damage (National Atmospheric and Oceanic Administration 2012).

Current Legal Context

The 1982 United Nations Convention on Law of the Sea (LOSC) recognizes a broad (and arguably vague) duty to protect objects of a historical or cultural nature, which includes UCH, in articles 149 and 303. But it was not until the 2001 UNESCO Convention that sorely needed details were provided about how to implement this duty. At that convention, UNESCO established general principles, including a policy of considering in situ preservation as a first option for management, a ban on the application of the law of salvage and an Annex of scientific rules for research and conservation should re-



^ Fig. 2 Threats to UCH from seabed mining. A sample of the UCH at risk from the ISA's proposed seabed mining activities (Source: Image created by Charlotte Jarvis based on ISA Information, SPREP Pacific Wreck Database and Turner et al. 2020).

covery be deemed necessary or appropriate. UNESCO also recognized "the need to respond appropriately to the possible negative impact on underwater cultural heritage of legitimate activities that may incidentally affect it" and indicated State Parties are obligated to take that need into account in their control of activities such as trawling and mining (UNESCO 2002).

The control of trawling, mining and management of PPWs should integrate the duty to protect underwater cultural heritage under the 2001 Convention and LOSC articles 149 and 202(1) with the duty to protect the marine environment under article 192 of the LOSC and the management of resource exploitation under article 193. As UCH is already an integral part of the UN Decade of Ocean Science for Sustainable Development, it follows that the science of archaeology and conservation of UCH must be considered in the next steps for sustainable development of our ocean heritage – particularly in regard to trawling, DSM and PPWs. Considering the potential serious and irreversible harm that can come from the activities, precautionary action is paramount.

Conclusion: Additional Approaches and Opportunities

In line with the legal framework, there are measures that should be taken to protect UCH properly:

1. Science-based decision making must be subject to baseline surveys that identify the ocean heritage (natural and cultural) that may be adversely affected by harmful activities. This can be best accomplished through Marine Spatial

^ Fig. 3 A diver examines the USS Macaw, a World War II submarine rescue ship that sank in Midway Atoll. Such vessels present UCH preservation issues as they are both cultural and natural heritage that should be protected but also potentially polluting wrecks (Source: Brett Seymour, Exploring the Sunken Heritage of Midway Atoll Expedition and National Atmospheric and Oceanic Administration).

Planning Surveys, including consideration that UCH may need to be set aside as a marine protected area, such as with RMS Titanic.

2. Environmental Impact Assessment (EIA) processes need to be standardized in a way that includes UCH as an integral part of the marine environment. If properly conducted, EIAs can be of great help to the application of the Precautionary Principle since their objective is to gather the maximum possible information on the activity, while assessing the impacts and risks related to that project and find mitigation solutions.

3. A precautionary global moratorium is needed on DSM until the surveys, environmental and cultural assessments have been conducted, and when needed, marine protected areas have been established.

The lack of awareness about threats to UCH outside its own field highlights the need for more education and outreach to policy makers, stakeholders, governments, the public and other scientific professionals. For example, ministries of culture, archaeological programs, or other programs focused on UCH may benefit from being made aware of, and invited into, discussions around DSM, including the drafting of regulations, standards and guidelines occurring at ISA meetings. Additionally, The Ocean Foundation (n.d.) and the Lloyd's Register Foundation, Heritage and Education Centre

are co-sponsoring three volumes highlighting present and future risks to UCH including trawling, potentially polluting wrecks and DSM. The series is intended to further the goals of the UN Decade of Ocean Science for Sustainability and to highlight the importance of ocean heritage – both natural and cultural.

Since the natural and cultural heritage of our world is often intertwined, we need to protect both, as has been recognized since the 1972 World Heritage Convention. For example, in the US, Papahānaumokuākea Marine National Monument became the first mixed natural and cultural UNESCO World Heritage Site in the US and other sites can follow suit to ensure adequate protection of ocean heritage (Papahānaumokuākea 2020). It is time to take the considerations that started in the terrestrial environment and extend them to the territorial sea and continental shelf as well as the area under the high seas (UNESCO 2020).

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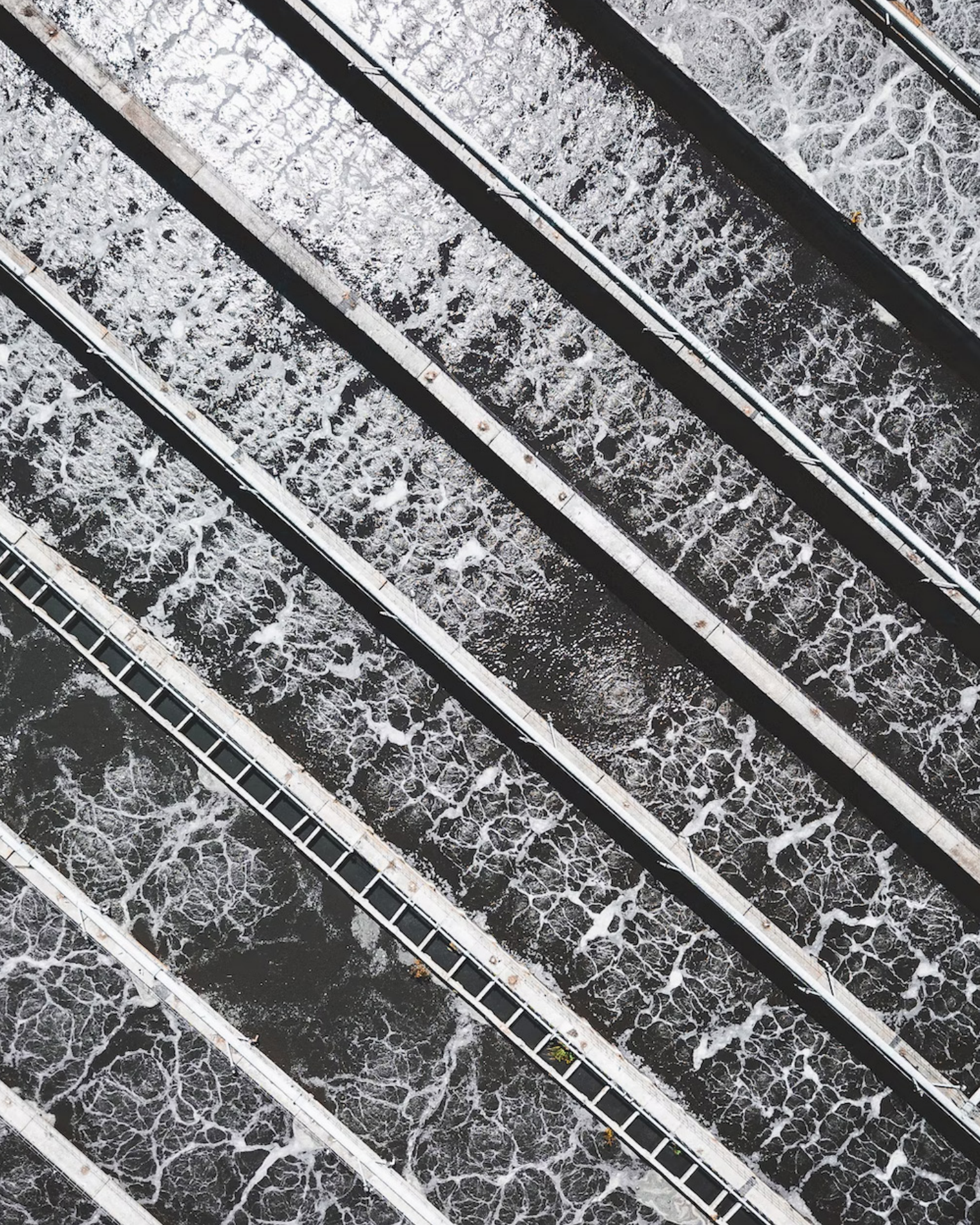

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Intersection of Heritage, Water, and the Work of the ICOMOS Sustainable Development Goals Working Group

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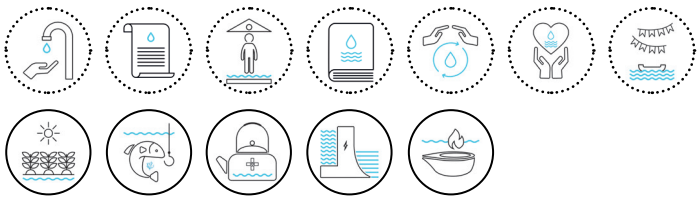
ICOMOS Heritage & Gender Equality Task Team and ISC Water and Heritage

The Sustainable Development Goals Working Group (SDGWG) of the International Council on Monuments and Sites (ICOMOS) advocates for heritage by publishing reports, attending conferences and engaging in networking. The SDGWG is particularly interested in how water, heritage and sustainable development intersect. Various aspects of this intersection are demonstrated by three case studies of underwater cultural heritage: a study of submarine cables and pipelines, the traditional floating garden system of chinampas in Mexico City, and the indigenous water tanks of kulams and gender-associated stepwells in India. This paper examines the current state of protection and advocacy, while also discussing the challenges faced by water heritage. While significant challenges remain, the SDGWG is developing solutions to ongoing and sometimes overlooked problems.

KEY THEMES



< Fig. 1 Oxidation ponds (Source: Ivan Badura, 2018; via Unsplash).

Introduction: The Sustainable Development Goals Working Group as an Interdisciplinary Task Force

The integral connection between water, land and civilizations has been well studied by scholars. The successful management of water resources has shaped many heritage sites around coastal areas rivers and freshwater sources and examples of ingenious irrigation systems adapted to local water conditions can be found around the world. The International Council on Monuments and Sites (ICOMOS) is a non-governmental organization committed to furthering the conservation, protection, use and enhancement of the world's cultural heritage. Since its establishment in 1965, members of ICOMOS have worked to protect various types of heritage, including water heritage, and have developed approaches for the conservation of sites. They also aim to encourage the cultural, social and economic development of communities, while limiting any detrimental environmental impact of heritage, promoting peace and advocating for strategic partnerships with stakeholders and practitioners.

Prior to the establishment of the UN Sustainable Development Goals (SDGs) in 2015, ICOMOS had already advocated for the positive integration of culture and cultural heritage in urban development plans and policies as a way of enhancing the sustainability of urban areas (ICOMOS 2021). As early as 2011, ICOMOS recognized the need for culture and cultural heritage to be acknowledged in sustainable development efforts, as reflected in a Resolution at the 17th General Assembly of ICOMOS (ICOMOS 2021a). In 2014 ICOMOS established the Sustainable Development Goals Working Group (SDGWG) as an interdisciplinary task force to coordinate the response and implementation by ICOMOS of the United Nations 2030 Agenda. ICOMOS is continuing to promote the role of heritage in sustainable development.

The SDGWG promotes the existing and potential contribution of heritage practices to multiple SDGs, aside from the dedicated target identified for heritage – Target 11.4, "strengthening efforts to protect and safeguard the world's cultural and natural heritage." The working group collaborates with other scientific bodies within ICOMOS to find meaningful connections between water, heritage and sustainable development. With the International Committee on Underwater Cultural Heritage (ICUCH) (ICUCH, n.d.), it produced "The Future of Our Pasts: Cultural Heritage in a Sustainable Ocean," which was presented at the UN Ocean Conference in July 2022 (ICOMOS 2022). This statement illustrated ways in which heritage contributes to the success of the Decade of Ocean Science for Sustainable Development. During the UNESCO World Conference on Cultural Policy and Sustainable Development in September 2022, the SDGWG worked with ICOMOS Mexico and looked at the practical challenges of the floating cultural landscape of the Chinampas in Mexico City in relation to changing food and water consumption patterns and climate change. Most recently, the SDGWG has worked with the International Scientific Committee on Water Heritage (ISC Water and Heritage, n.d.) to create a series of side events for the UN Water Conference in March 2023. These events are intended to promote the valuable contribution of water heritage and to link its role to the success of the SDGs.

In 2021 the SDGWG developed a policy guide (ICOMOS 2021a) identifying the role of heritage in contributing to each SDG. The guide highlights the role of water-based heritage practices, involving both freshwater and salt water, to help achieve the SDGs. It encourages heritage

actors to "Harness the potential of heritage in providing viable strategies for the sustainable management of water resources that support the availability of fresh water and sanitation for all" and to "Harness the potential of heritage to protect bio-cultural diversity and ensure the sustainable use of the oceans, seas and marine resources." The policy guide also provides several examples of water heritage projects that support the SDGs, such as the irrigation methods of the terraced landscape of the Honghe Rice Terraces in China; the qanat water channels at the Pahlavan-Pour World Heritage Site in Iran; spate irrigation systems found in Pakistan, Yemen, North Africa and East Africa; and the underwater heritage of stone tidal weirs, which can be found in many parts of the globe.

The following examples further demonstrate how the important relationship between water and heritage links to many dimensions of the SDGs. These examples have been selected to reflect a variety of heritage forms and highlight different dimensions of sustainable development.

Underwater Cultural Heritage as Resource and Cultural Connection

All 17 SDGs are closely connected to heritage and culture (ICOMOS 2021b) and they can also be connected to water. Underwater cultural heritage is, in many instances, tangible and intangible evidence of the past development of communities and has the potential to provide answers to current and future challenges.

If cultural heritage, according to UNESCO, is the "cultural legacy which we receive from the past, which we live in the present and which we will pass on to future generations" (UNESCO, n.d.), submarine cables and pipelines can be considered cultural heritage. In fact, the first submarine cable was used in the 1850s. Today, thousands of kilometers of submarine cables lie on or under the seabed carrying telephone calls and internet data (only 1 per cent of telecommunications are established via satellite) (Perez-Alvaro 2013). Consequently, submarine cables are closely related to many SDGs now because of their importance to economic growth, industry innovation and infrastructure (SDG 9) and to reducing inequality around the world (SDG 5 and 10). They can be indispensable to the well-being of people who live far from friends and family and depend on the internet to maintain connections.

Pipelines are another example of water-related cultural heritage. Humans have always needed to control the movement of water. Ancient Rome and Greece are examples of societies with well-developed plumbing systems and the basis for today's networks of pipes, which supply cities and towns with water (Carter 2007). Nowadays, the gas and oil used by modern economies are transported by old and new pipelines under water across oceans and are key for most of the SDGs: good health from heated homes (SDG 3), quality education in temperature-controlled schools (SDG 4), affordable energy (SDG 7) and economic growth for industry and infrastructure (SDG 8). They may not be part of a sustainable system in the long term, and it will be necessary to re-evaluate them in the future, but at the moment gas and oil pipelines remain necessary for many people around the world. Submarine cables and pipelines were not only solutions to problems that communities faced in the past and examples of what were once technological advances, but they can provide examples of solutions for present-day problems.

^ Fig. 2 Technical visit to chinampas of Xochimilco, Mexico City, Mexico (Source: Bretony Colville).

Fresh Water and the Rights of Indigenous Communities

Within the boundaries of modern Mexico City, there is a traditional permaculture landscape composed of chinampas that is still in use today (fig. 2). The area is listed as part of the World Heritage Site of the Historic Center of Mexico City and Xochimilco. An extremely productive agricultural landscape, chinampa farming is a traditional practice that dates to as early as 1256 CE (Reed 1966). During the Spanish conquest of Tenochtitlán, Bernal Díaz del Castillo, a Spanish conquistador, documented that most of the produce in a market that supported approximately 60,000 people came from the floating gardens of the chinampas (Reed 1966). Now the landscape has been severely reduced, with only 18 per cent of its original extension remaining in 1986, however it is still being actively cultivated, studied and conserved (Pozo 2022).

The traditional chinampa system involves a delicate balance of land and water. The system is being threatened by urban growth, overuse

^ Fig. 3 Chinampas canals clogged with invasive waterlilies (Source: Bretony Colville).

of water resulting in soil subsidence, invasion of introduced species, and harmful chemicals. These threats are common problems around the world, however, the *chinamperos* the traditional practitioners, are using a combination of traditional and modern techniques to combat them. The natural filtering system produced by the unique construction methods help maintain the quality of the water, while the introduced species are being controlled and used as green fertilizer. The lessons learned at this site could possibly be used to improve conditions at other locations, such as Ifugao in the Philippines, known for its rice terraces, some of which have also been listed as a World Heritage Site.

In 2022 the SDGWG and the Mexican National ICOMOS Committee organized a technical visit to the chinampas. Through this event, connections were made between the academics working with the local community in Mexico and academics working in Ifugao. Local Mexican government officials also attended the event, and further meetings were organized to discuss the threats faced by the site in more detail (fig. 3). The traditional knowledge and building

^ Fig. 4 ***Perungulam vaykaal*** (water channel) along the Thamirabarani river basin (Source: Saranya Dharshini).

systems are integral to the conservation of the chinampas, as well as to what is hoped will be the recovery of more of the islands.

Human-Made Water Sources and Gendered Spaces

In many cultures, water is associated with traditions and rituals that are integral to a particular way of life. India is a country where rivers and water bodies are considered to be holy and often reverently named after goddesses. Water architecture and management in India have a long history and historic water bodies such as kulams (water storage) and stepwells exemplify civic life and sustainability.

The kulams of the Thamirabarani river basin were developed over centuries beginning in the Pandya period (fourth century BCE to fourteenth century CE) (Subbarayalu 2014; Mohanakrishnan 2001). An indigenous water system, kulam is a component of a larger water network that assures water equity and conservation (fig. 4). While the water system is still in use, it is gradually being ousted. Without heritage status and protection, the future of the kulams looks bleak (fig. 5). "Fostering Resilience: Focus on the Intersection of Cultural Landscape, Climate Change, and Gender," presented during the ICOMOS International Scientific Committee

^ Fig. 5 Condition of the Perungulam Kulam (water storage) during the pre-monsoon months (Source: Saranya Dharshini).

on Cultural Landscape dialogue series, raised awareness about the lack of heritage protection and slow eradication of historic water bodies (Dharshini 2021).

In the case of the stepwells of western India, even though some of the stepwells are protected as heritage sites, they are not in use. Their historic links to gendered spaces and women's patronage has also been overlooked (fig. 6). Built for communal use, women's sponsorship was crucial to the development of stepwells, particularly in western India, where the climate is hot, semiarid and erratic in terms of rainfall. Since the eleventh century CE, women not only sponsored and developed the stepwells, but they also provided inspiration for the design aesthetics, drawing on women's tales of bravery, valor and love. The artistic and architectural language of these stepwells emphasizes the value of feminine spaces, female patronage and the place of gender in water history (Dharshini 2020). Creation of feminine spaces were necessary in a period where it was customary for a woman to leave her family and friends after marriage to become part of her husband's family. Around the world, women and girls are usually responsible for fetching water, a tradition tied to gendered spaces (UN-Water 2023). Stepwells provided women with a private space to congregate with other women in a public realm (Jain-Neubauer 2016). "The Role of Women in

^ Fig. 6: Dada Harir ni Vav (stepwell) in Ahmedabad (Source: Saranya Dharshini).

Subterranean Waterscapes of India," presented and published as part of 2019 ICOMOS Water as Heritage international conference proceedings, reflected on the need for inclusivity and diversity in narratives of water history to encourage equity in gender representation and participation.

Even today in most countries, domestic water is considered a responsibility of women, however fewer than fifty countries have laws or policies that particularly mention women's participation in water management (UN-Water 2021). The Heritage and Gender Equality task team of ICOMOS, a joint effort of the SDGWG and the Rights-Based Approaches Working Group, envisions that water heritage sites and traditional practices can play an important role in women's empowerment by emphasizing gender narratives and providing an inclusive participation platform at all levels of decision making. The task team realizes that some traditional heritage practices can be viewed as discriminatory and could potentially reduce gender parity and equity, therefore, it is essential to realize a balance in the nature of traditional gender roles and the need for gender equality in water heritage to ensure equal opportunity and accessibility for sustainable use.

Conclusion

ICOMOS' mandate is to promote the conservation and protection of monuments, buildings and sites; however, the membership has

a much wider impact on culture and heritage. As part of this larger organization, the SDGWG coordinates the ICOMOS response to the SDGs and exploring how culture and heritage can be a driving force to what comes after the completion of the UN 2030 Agenda. The work includes mapping various ways water heritage contributes to achieving SDGs 6 and 14 and it supports other specialist groups within ICOMOS to showcase how various types of heritage enable the achievement of the global sustainable development agenda.

There are two avenues that the SDGWG uses to achieve its goals: formal engagement and advocacy guided by UN Agenda 2030, and informal networking between members and sharing case studies of how heritage practically contributes to the sustainable development of communities. Both avenues rely on and are enhanced by the other. For example, at events such as the High-Level Political Forum, members of the SDGWG engage with other professionals and stakeholders in a way that increases their own knowledge but also widens professional networks that may not have otherwise developed. The case study of the Mexican chinampas is a recent example of the type of cross-fertilization that formal and informal networking and advocacy can provide.

There are also limitations to what the SDGWG can do. Its advocacy must fit within wider international policy frameworks, such as the UNESCO World Heritage Convention, and its actions are currently confined within the agenda set by the SDGs. While advocating for greater awareness of certain issues, such as often overlooked water heritage like submarine cables, the working group is not a governance organization and can only advise on and work with policies that are defined and approved by political entities and states. Another limiting factor is the lack of heritage-based indicators for the two water SDGs. Without relevant data that the indicators provide, it is hard to develop evidence-based advice and education. This is shown in the example of the stepwells, where stronger indicators are needed to support efforts to promote both clean water and equal rights for people of all genders.

While there are still significant challenges being faced by water heritage, the SDGWG is developing solutions to ongoing problems. The SDGWG will continue to draw attention to the important intersection of water, heritage and sustainable development.

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PART II Methodologies and Case Studies

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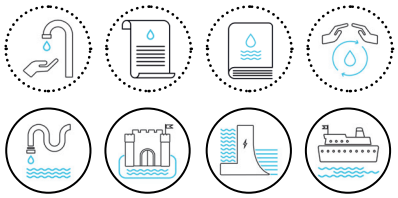
Interview with Kunlé Adeyemi | African Water Cities: Embedding Local Knowledge for Sustainable Coexistence between Humanity and the Environment

Interview with Kunlé Adeyemi, founder of NLÉ
by Carlien Donkor and Matteo D'Agostino

This interview highlights the extensive research project African Water Cities by architectural studio NLÉ, which explores intersections of rapid urbanization and climate change in the African context. NLÉ proposes new strategies for addressing water, culture and heritage management in Africa as Sub-Saharan Africa experiences the second-fastest rates of urbanization and population growth in the world. The discussion also addresses whether and how these strategies fit within the scope of the UN SDGs.

KEY THEMES



< Fig. 1 Traditional building systems in Makoko, Lagos (Source: NLÉ, 2011, CC BY-NC-ND 4.0).

Introduction

INTERVIEWER | Carlien Donkor: Thank you for agreeing to this interview. I'd first like to ask you about the African Water Cities project and, in particular, about the project's central concept and strategies.

INTERVIEWEE | Kunlé Adeyemi, founder and principal, NLÉ: African Water Cities is a body of work that began in 2011, while we were researching affordable housing and trying to tackle the challenges of providing inclusive dwellings in rapidly developing regions and cities like Lagos, Nigeria. We noticed that we were not only dealing with issues of rapid growth in African cities but that many cities, particularly coastal and waterfront cities, increasingly face challenges of flooding exacerbated by climate change. The African Water Cities project looks at the intersection of cities and water in African contexts, considering that many cities and communities are already adapting to these issues.
At the same time, we realized that there was a huge knowledge gap in the information necessary to inform strategies for urban adaptation. The project fills that gap by identifying and providing knowledge about major cities all over the continent. Only after this can we begin to address the issues of adaptation and mitigation in rapidly urbanizing cities dealing with climate-related challenges.

Matteo D'Agostino: Could you tell us a little bit more about what these knowledge gaps are?

Kunlé Adeyemi: For instance, on the African continent, we don't recognize the specificity of communities and their traditional adaptation strategies. We don't acknowledge the characteristics of our cities positioned on the waterfront. There is little attention paid to the implications of current urban development practices. We don't understand where we are positioned economically or how our resources can be deployed to solve some of our challenges. All these aspects have huge implications for the future of the continent, yet this information is not readily available, and this isn't because it doesn't exist.

Carlien Donkor: Why is that and how does your specific case matter for the question of water, culture and heritage?

Kunlé Adeyemi: In our research, we realize that the challenges of adaptation and climate adaptation have already been addressed by some of the Indigenous communities that exist in various parts of the world and particularly on the African continent. These are insights coming from communities that have survived for hundreds of years, building on and around water. They have developed a culture of coexisting with water instead of fighting it. That is in itself a very unique culture that should not be undone or forgotten but preserved to inspire current and future solutions (fig. 1).

Carlien Donkor: I'd like to know which cities or which countries have you looked at so far?

Kunlé Adeyemi: We have studied Nigeria, Tanzania, Côte d'Ivoire and Cape Verde. In the last seven to eight years, I have been researching with various institutions, particularly in the US, for instance, the universities of Cornell, Harvard, Columbia and Princeton. With their students, we go into cities in various countries and collaborate with the local organizations there, doing groundwork and field research to understand what is going on.

Carlien Donkor: Can you give us more insights about the research process and methodologies, from data collection to proposal making?

Kunlé Adeyemi: To analyze our research, we have developed a methodology of research which we call "DESIMER," an acronym for "Demographics, Economics, Socio-Politics, Infrastructure, Morphology, Environment and Resources." All of these factors influence development, so this is not only about design, but it is really about understanding the issues that guide design.

Matteo D'Agostino: It is a very interesting approach because it integrates different dimensions. Would you be willing to share a little bit more about this?

Kunlé Adeyemi: One of the major things we learned when we began the African Water Cities project is that, as architects and planners, we have to consider that a range of factors influence development and these exist beyond disciplinary boundaries. "DESIMER" analyzes both human development and environmental indexes. "Demographics" tell us the characteristics of the population in terms of size, ethnicity and customs. "Economics" is also important. The project will not work if it does not have some economical structure that makes it viable, both long- and short-term. "Socio-politics" considers the history and background of the people. "Environmental" aspects include morphology (the shape and topography of the place), climatic and extreme weather patterns; and finally the local "Resources" available. It is crucial to first have a deep understanding of these factors. Design then becomes a tool to bring all these issues together through physical manifestation in the built environment. We utilize a broader approach to solving a problem or better still, understand a problem before even thinking of a solution.

Carlien Donkor: Are you actively involving different stakeholders during your research and the design process?

Kunlé Adeyemi: Yes. Always. It is very important because when dealing with projects concerning a large urban development, there are multiple stakeholders that must be involved. Our project is supported by the UN agencies, from the office of the UN Deputy Secretary-General herself to get support from UNDP, UNHabitat and UNEP. We also have various representatives from the communities in areas where we think we can intervene. So, we're really developing a model in which all stakeholders have to be involved, from consent to support. Only in this way will it be a stable and sustainable model. In the current phase, we are also looking at how to scale up this model, adapting it to various regions.

Carlien Donkor: Have there been important similarities or differences you've encountered within the different African contexts that you have already researched? Would you say that your solution is tailored to fit within the different contexts, but they have certain similarities as well?

Kunlé Adeyemi: For sure, they share a lot in common but every country, every city is unique. The main similarity between most of the cities that we have identified is that they are characterized by the impact and challenge of the issues of flooding as a result of an increase in rainfall, sea-level rise in some cases, and extreme seasonal weather events. These are all exacerbated by climate change. The common threats are due to their geographical locations, within a specific climatic belt that spans from West to East Africa. They are also cities that are growing rapidly. On the other hand, every city has its unique resources, unique social and political contexts and environmental conditions beside different water bodies. Be it coasts, riv-

^ Fig. 2 Makoko Floating School, Lagos (Source: NLÉ, 2013, CC BY-NC-ND 4.0).

ers, lakes, lagoons or floodplains. There are several differences. We try to highlight this and consider how these "uniquenesses" can drive competitive advantage in each of the cities.

Our Water Cities concept is a solution for how to build and live around water. However, there are also more general solutions we consider for building African Water Cities (AWCs). Resilient, nature-based solutions provide a smart way of building that is very inclusive and tailored to the means and needs of local inhabitants, their local environments and resources. We then provide contextualized solutions and frameworks rather than introducing new or foreign technologies that are alien to the environment (fig. 2).

Africa and Beyond

Carlien Donkor: Could you elaborate on the impact you are trying to make in Africa and beyond the African Water Cities project?

Kunlé Adeyemi: I think we bring knowledge and awareness to people about the importance and urgency of adaptation and mitigation, whilst also offering insightful solutions. We are currently working on a book titled *African Water Cities*, which will be published this year. Then there is also the physical intervention, let's say, an architectural body of work, where we have developed innovative solutions to help build on and around water, while preserving local culture.

^ Fig. 3 African Water Cities – MoMA Uneven Growth (Source: NLÉ, 2014, CC BY-NC-ND 4.0).

Floating systems are one of many building solutions that we believe would be part of a larger ecosystem of how to live and build around water, while preserving local culture. The Makoko floating system is one example in Makoko, Lagos. We are working on a proposal that focuses on (re)developing the community itself, which combines an inventory of different solutions from architecture to wastewater management and sanitation (fig. 3).

Water and Heritage Management

Carlien Donkor: In your opinion, what are the current and future challenges for water and heritage management within the African context?

Kunlé Adeyemi: I think the issue of clean water is one that we can go deep into. There are many concerns around scarcity, but we are also dealing with what is, ironically, an abundance of water in areas where we discuss flooding. Rather than water supply in terms of clean water, I focus on water as a physical, urban resource and its impact on the urban environment. We reframe these challenges as an opportunity to lear. Indigenous communities scattered all over the continent are already adapting. Their insights hold the DNA for how we can (re)develop our cities to become "net zero." Indeed, some of these communities are net zero already in that they consume fewer emissions than they produce. When we look at the effects of climate change and the degree of loss and damages it is causing, the amount of infrastructure that would be required to create flood defences everywhere is just unimaginable. That is just not the approach that we believe will be viable in the long term as we face the impacts of climate change for many decades to come. So instead of fighting it, we want to learn to live with it and that really goes back to learning from our own "local heritage."

Carlien Donkor: Do you think water and heritage management should be more integrated?

^ Fig. 4 Opening of Makoko Floating School (Source: NLÉ, 2013, CC BY-NC-ND 4.0).

Kunlé Adeyemi: In my opinion, they need to be. It is a very unusual proposition for many people when you say, "let's build on and around water." Yet this already happens in Venice and Florence, Amsterdam, and cities such as Chicago. Whilst they have their challenges, these are historic "water cities" that developed essentially being covered by water and waterways. However, on the African continent, we don't integrate water into our urban fabric. There is a huge disconnection to water heritage, I would say.

Carlien Donkor: In your opinion, why is this the case?
Kunlé Adeyemi: I think there are a number of things. One is that the culture of development that we have adopted over hundreds of years has been land-based. We learned to cultivate land and within a short period, further cultivated the creation of additional land over water through reclamation. This is very capital intensive and makes it unaffordable for the average person to purchase land, yet we have not shifted our focus toward living around our waterways, although it's part of our history. The coat of arms for Lagos is a symbol of the city that contains fishermen on boats and tells the story of a city living around water. The expertise and occupation of the first settlers of Lagos was fishing (fig. 4).

Water has always been part of African heritage. Seventy per cent of all major cities and capitals on the African continent are on waterfronts. So, water is an essential ingredient in the recipe of African cities. We turned our backs to this but with the impacts of climate change, we are forced to confront this and innovate in terms of insurance that it is part of survival as a human race.

Matteo D'Agostino: You mentioned the question of the sustainability of certain solutions,

^ Fig. 5 Traditional bamboo dwelling, Makoko (Source: NLÉ, 2013, CC BY-NC-ND 4.0).

such as building large flood protection systems in Africa. In many Western countries, these concrete structures are often seen as a solution, while, for you, they are not ideal in the long run. Why are you of this view?

Kunlé Adeyemi: This refers back to our "DESIMER" research method. Multibillion-dollar shoreline protection infrastructures that manage water levels in Rotterdam or Amsterdam are appropriate for the Netherlands. This doesn't imply that we can immediately copy and paste them within the African context. It is arguable that people would do the research and tell you, yeah, of course, it's possible, but that doesn't mean that it's the best solution for us. We have our own materials: bamboo and timber, earth and laterite (fig. 5). Why don't we foreground these resources in our own future cities? There are solutions everywhere. The infrastructure possibilities are there, but there is a knowledge gap in what we can do with "our own resources, for our own problems, to create our own solutions."

Contextualizing African Water Cities in the UN SDGs

Carlien Donkor: How is the AWCs project in alignment with the UN SDGs?

Kunlé Adeyemi: SDG 11 "sustainable cities" is directly connected with what we do, and we are keen on achieving it through nature-based solutions. From that, of course, issues of affordability, clean energy, economic growth – whether it's SDG 7, SDG 8 or SDG 9 – are very important. We're learning from communities who built so much out of so little. That's where our foun-

^ Fig. 6 Makoko Floating Platform, Lagos (Source: NLÉ, 2012).

dation is from. So, if we can learn to do what they've done and innovate such solutions then we're already reducing some of those inequalities (SDG 4). The solutions geared toward SDG 6 are, of course, an essential part of any healthy city. Our project is in cities that have an abundance of water due to excess rainfall and flooding. Part of our infrastructural solution is to provide an adequate supply of clean water to the communities and people living there through various rainwater harvesting filtration systems. The impact on climate is the overarching element in this (SDG 13).

Carlien Donkor: In mentioning the knowledge gap, I wanted to ask, is it perhaps due to a lack of education?

Kunlé Adeyemi: Absolutely. Thanks for bringing that up. Indeed, education is a way of filling that knowledge gap and part of that commitment is to set up the African Water City Center at the University of Lagos in Nigeria, where we are already educating students, some of which are doing internships and exchange programs in various organizations, getting valuable expertise on development projects and architecture around water.

Carlien Donkor: Are you also thinking about informal education activities? For instance, targeting people who are not English-proficient?

Kunlé Adeyemi: First of all, seeing is believing, and people respond to what they see. They change their perspective once they experience something. And what we have been able to do is to take action, which in our field of work is key. Ten years ago, we had an idea and we just built it. We said, "Look, we're going to see how

^ Fig. 7 MFS IV – Mansa Floating Hub – Cultural Platform, Mindelo (Source: NLÉ, 2021).

it works, how it feels, we're going to learn from it." And it had a lot of impact on people just because they saw something different. I think that demonstrating something through innovation, and not just through formal education in the classroom, is vital. Involving people in the process of learning, understanding and challenging their current views, moves it one step further (fig. 6).

Conclusion

Matteo D'Agostino: Could you give us some takeaway points from your approach, looking at the future challenges in the African context?
Kunlé Adeyemi: First of all, I would say innovation is essential for a truly authentic and sustainable solution for Africa. And that means taking some risks such as "using what we have to get what we want." In that process, we can improve on what we have. Many African cities can still be described as young, so if we do make mistakes, this is the time to make them. But the worst mistake would be simply trying to be something other than what we are. Understanding the abundance and characteristics of our local resources and deploying them through the economy of means is necessary for our sustainable development. Now, there's a lot of scientific documentation when it comes to policies, finance and even health. But one of the main challenges that we're tackling as people in the building sector is just how these factors

relate to the built environment. We continue to promote diversity and the coexistence between people and the environment. That's what we really stand for (fig. 7).

What is the future of the African city, rapidly growing and affected by climate change? African cities lack certain things, but offer an abundance of resources. So, how can we learn and turn existing challenges into opportunities? What are the potential directions we can anticipate for ensuring that we are ahead of this curve?

Acknowledgment
This interview was peer-reviewed. It was prepared, conducted, and edited for length and clarity by members of the editorial team of the UNESCO Chair Water, Ports and Historic Cities: Carola Hein, Carlien Donkor and Matteo D'Agostino.

Kunlé Adeyemi is an architect, professor and development strategist whose works are internationally recognized for originality and innovation. He is the founder and principal of NLÉ – an architecture, design and urbanism practice founded in 2010. Kunlé's notable works include "Makoko Floating System (MFS™)" – a groundbreaking, prefabricated, building solution for developments on water – deployed in five countries across three continents, with the latest iteration Mansa Floating Hub in Sao Vicente, Cape Verde. This acclaimed project is part of NLÉ's extensive body of work and new venture – Water Cities® Group and the African Water Cities Centre – focused on the intersections of rapid urbanization and climate change. Alongside his professional practice with multiple prestigious awards, Adeyemi is an international speaker and one of UNDP's Africa in Development Supergroup members. He is currently an adjunct visiting professor at the University of Lagos, following appointments in various institutions including the universities of Harvard, Princeton, Cornell and Columbia.

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Toward a World Inventory of Water-Related Museums, Heritage Assets and Values to Promote Sustainability Education

Eriberto Eulisse
Global Network of Water Museums

Two resolutions of UNESCO-IHP (2018 and 2021) have highlighted the importance of fostering water sustainability education through networked water museums and developing a world inventory (WIN) of these institutions. To achieve this goal, the Global Network of Water Museums has developed a methodology to initiate a worldwide census of water museums, interpretation centers and water-related heritage values. The benefits of adopting a common methodology are clear. By using a transnational toolkit it will be possible to highlight the large variety of valuable aquatic heritages and the paradigmatic models of human coexistence with water environments worldwide. All institutions involved in implementing the WIN at the regional and national level will be empowered to communicate and target the SDGs and provide inspiration through the use of holistic approaches and good practices inherited from our "watery past" to better plan future resilience.

KEY THEMES

< Fig. 1 The ingenious system of wells and seeping galleries *galerìas filtrantes* in the Tehuacan Valley is an ancient solution to climate change and is based on indigenous hydro-technologies (Source: Raúl H. Garciadiego, Water Museum "Agua Para Siempre!," Puebla, Mexico).

Introduction

In recent decades statements, studies and documents of the Intergovernmental Hydrological Programme (IHP) of UNESCO have helped to define the importance of preserving, protecting and strengthening the functionality of rivers and aquatic ecosystems to ensure quality of life for humans and non-human species. The 2018 Resolution of UNESCO-IHP n.XXIII-5 emphasized the need to strengthen educational activities that promote more sustainable uses of water.[1] This resolution also paved the way to acknowledging the role and function of a worldwide network of museums aimed at fostering water sustainability education and awareness.

The Global Network of Water Museums (WAMU-NET) was established in 2019 to spread greater awareness of the value of water and promote more forward-looking management models, drawing inspiration from the rich "watery past" of humankind – that is, inherited historical heritages, practices and cultures of managing water. Indeed, in the Anthropocene, an era full of water challenges, museums provide an important means of educating people about water and re-connecting individuals to water. Museums can help change harmful behaviors and attitudes related to water and can promote tangible improvements of the critical conditions created by poor management of aquifers, rivers and freshwater ecosystems.

Today, as stressed by the WAMU-NET Charter (2019), a "new culture of water" is needed more than ever.[2] In the Anthropocene there is a crucial need for a paradigm shift aimed at fostering new perceptions and behaviors toward water and its management in the long term. Museums can inspire individuals to embrace new possible solutions for a balanced coexistence with water in all its manifestations. But how can museums effectively help accelerate this paradigm change in the face of the prevailing ideology of "development at all costs" that is typical of the consumer society?

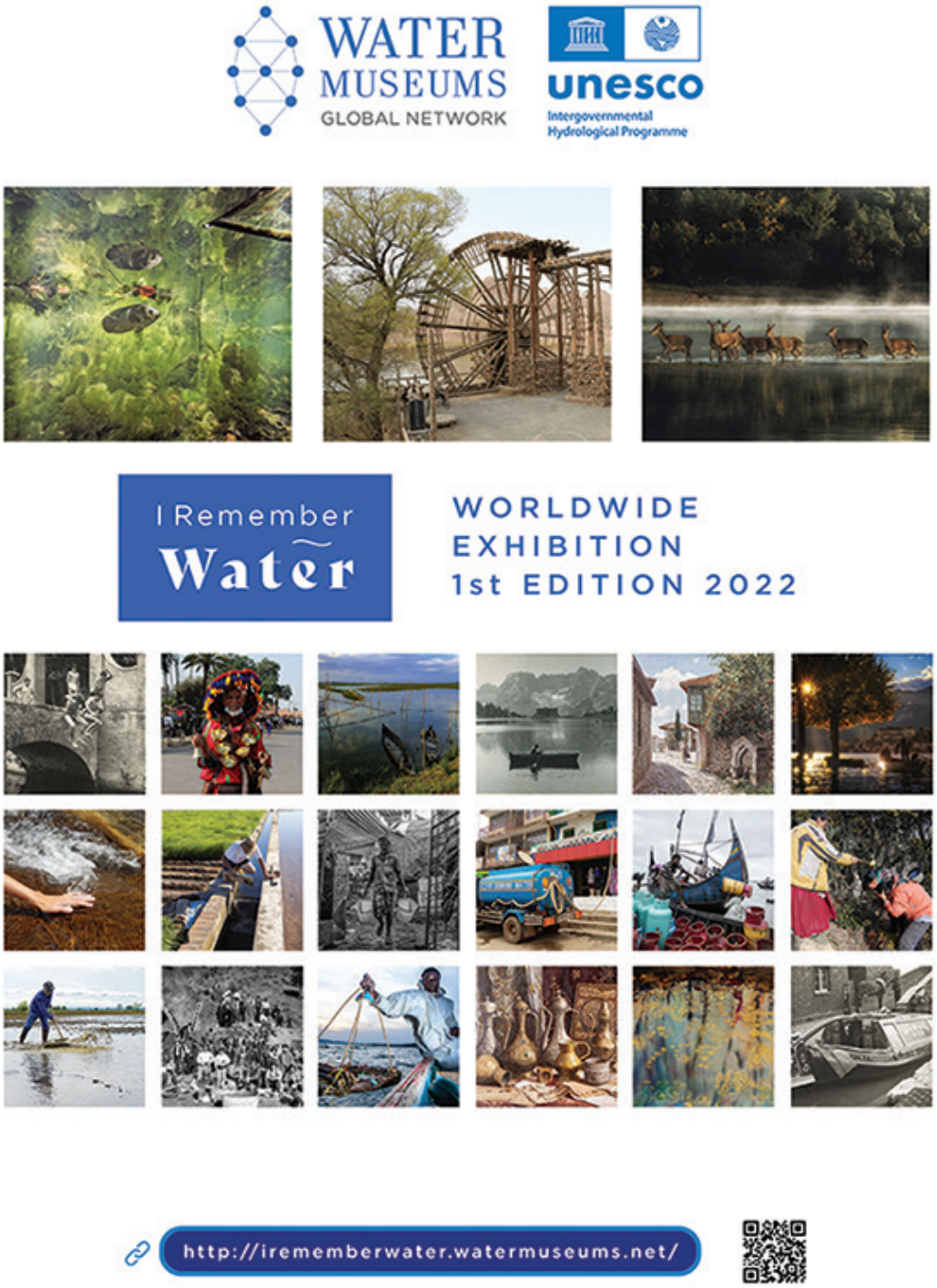
Water museums stimulate people of all ages to think about innovative ways of managing water and protecting water-related heritage for the future – with solutions that draw on modern hydraulic technology but also on ancient management practices and knowledge. Offering daily educational activities for thousands of young people, many museums around the world are working to promote a paradigm shift, that is, a radical change in the way of considering not only the very causes of problems, but also possible solutions involving more judicious use of water.

However, in today's context it is important to build a new culture of water not only based on the teaching of basic scientific knowledge and water history, but also supported by non-formal education geared toward reestablishing deeper emotional connections with this vital fluid. An educational approach that recognizes the importance of perception and emotion in reestablishing a meaningful connection with water has been gradually incorporated into scientific literature. Some approaches focus on water-related cultural and heritage values (Strang 2023) or the "emotional geographies" or the "sense of place" of riverine communities (Vallerani 2018), and others on fresh "human-river encounters" (Wantzen 2023). Whatever the focus it is essen-

1. Resolution n. XXIII-5 of UNESCO-IHP, https://www.watermuseums.net/assets/Uploads/footer-links/RESOLUTION-XXIII-5-Global-Network-Water-Museums-EN-final.pdf.

2. Charter of WAMU-NET, https://www.watermuseums.net/contacts/.

^ Fig. 2 Poster of the youth contest and award "The Water We Want".



^ Fig. 3 Poster of the itinerant exhibition "I Remember Water".

tial to promote holistic educational approaches aimed at inspiring new perceptions and attitudes toward water.

New Approaches to Promoting Water Values and Historical Management Practices

As of 1 January 2023, WAMU-NET counts more than 80 water museums and institutions in 33 different countries. These members collectively host an average number of approximately 40 million visitors per year (ante COVID).[3] All together – networked – the affiliated water museums reveal considerable potential to inspire people to adopt more forward-looking water practices.

Among the different activities developed by WAMU-NET and aimed at raising awareness about more farsighted water uses, consider the youth contest and award *The Water We Want* and the exhibitions *I Remember Water* and *Valuing Ancient Water Cultures* (descriptions are available on the WAMU-NET website). "The Water We Want" is an annual competition that aims to involve young people in expressing ideas and visions about the importance of water for life through drawings, pictures, videos and other media (fig. 1). The competition was launched in 2020 with a social media campaign that included 22 professional videos and mini-videos. In 2023, the fourth edition is underway.

The exhibition *I Remember Water* aims to collect significant memories worldwide that recall past water practices and significant heritage sites (fig. 2). The goal is to reflect on pathways that can lead to more just and sustainable futures. Water memories – whether they are tangible or intangible, sensory or emotional, short-term or long-term – are fundamental to our existence as individuals and as collective societies. From the ornate public fountains and household taps that in the last century provided free water to citizens in growing urban settlements to people's emotional relationships with water, the images exhibited on this new digital platform illustrate the rich diversity and the striking affinities in humans' connections with water and in unique heritages across the world.

The exhibition *Valuing Ancient Water Cultures* was organized at UNESCO's headquarters in Paris as an official side event of the UN-Water Summit on Groundwater (fig. 3). Through case studies from Asia, Africa, Europe and Latin America, the exhibition showed how museums can raise awareness of water vulnerability, "making the invisible visible," and inspiring people and professionals with innovative ideas and approaches for simultaneously promoting sustainable eco-tourism and planning better resilience to climate change impacts. For example, the exhibition proved how the involvement of local communities in monitoring groundwater quality and quantity is a crucial prerequisite for sustainable water use in line with the Sustainable Development Goals (SDGs). The exhibition demonstrated how traditional knowledge passed down through generations over a long history of struggle and coexistence with water can reshape contemporary thinking on water and heritage across the world.

Toward a World Inventory of Water Museums, Interpretation Centers and Heritage Values

In 2021 the Intergovernmental Council of UNE-

3. This figure is calculated from the yearly number of visitors of 80 water museums affiliated with WAMU-NET, considering data available in 2019, before the COVID-19 pandemic.

WATER MUSEUMS GLOBAL NETWORK

unesco Intergovernmental Hydrological Programme

Valuing Ancient Water Cultures

© 2022 Raki Films - from the documentary series 'Children of Water' by Joy Penroz & Sylvain Grain.

An Inspiring Source of Innovations for Sustainable Groundwater Management

Learning from past practices and knowledge to make the invisible visible: from Indian stepwells to Omani *aflaj*, Moroccan *khettaras*, Algerian oases, Chilean *socavones*, Mexican *tecuates*, and Mediterranean cisterns and wells

^ Fig. 4 Poster for the itinerant exhibition *Valuing Ancient Water Cultures*.

^ Fig. 5 The World Inventory (WIN) campaign of water museums and interpretation centers will be promoted under the auspices of the IHP Resolution n.7-XXIII.

Phase	Implementation Step
Phase 1	1st step: 1.1 - Remote survey of existing water museums, interpretation centers and collections through a predefined taxonomy, or classification system, made of six categories (*)
	2nd step: 1.2 - Questionnaire for collecting quantitative and qualitative data about museums and institutions already mapped in the 1st step
Phase 2	1st step: 2.1 - Remote survey of future (potential) water museums, interpretation and visitor centers related to cultural landscapes (waterscapes), including ancestral hydro-technologies, community-based practices, intangible heritage, traditional and indigenous knowledge and citizens' observatories
	2nd step: 2.2 - Remote survey of the potential contributions of ancient water management practices and cultures to achieve the SDGs (climate change adaptation strategies and good practices to manage scarce water resources in arid regions)

(*) The six categories of classification are grouped into three main typologies to facilitate the systematic classification and the comparison of data:

a) Type 1: Existing institutions
   1. MUCD - Museums, Collections and Documentation Centers
   2. IDEM – Interpretation and Visitors' Centres, Digital Museums, Eco-Museums, Community-based Museums, Extended Museums

b) Type 2: Potential/Future institutions
   3. WASH - Waterscapes (Cultural Landscapes), Sites, and Water-Related Heritage Assets
   4. ANTE - Ancestral Hydro-Technologies, Community-Based Practices, and Citizens' Observatories
   5. INTL - Intangible Heritage and the Heritage of "Living Waters"

c) Type 3: Contributions to achieve the UN SDGs
   6. GOOD – Good practices to manage resilience and scarce water resources and solutions that can potentially contribute to climate adaptation

^ Table 1. The two phases, four steps of implementation, and six categories of classification proposed to implement the world inventory (WIN) of water museums and interpretation centers.

SCO-IHP stressed the opportunity of making a comprehensive inventory of water-related museums, interpretation centers, and heritage values worldwide (as of March 2023 the resolution was available on the WAMU-NET website). To start making the census, a specific methodology was developed and officially presented in March 2022 at the 9th World Water Forum in Dakar, Senegal. A transnational toolkit was elaborated to provide a tested methodology and stimulate the production of outline inventories at the regional and national level. As of March 2023, it is freely available on the WAMU-NET website.

Thanks to this practical toolkit, guidance is provided not only to identify existing "water museums" in specific regions, but also to look for new potential museums, including visitor centers, eco-museums and - according to the definition of Jalla (2017) and Folga-Januszewska (2017) – "extended museums." Indeed, by adopting a broad definition of water museums it is possible to list in the WIN not only physical buildings and collections, but also interpretation centers, digital museums, community-based museums, social practices and heritage values. The heritage of "living waters" and the landscape of wa-

ter, or waterscapes, are also considered in WIN for their potential to stimulate the creation of new museums and visitors' centers (fig. 4).[4]

Two pilot case studies in Italy and the Netherlands (focusing on the Po Delta and the Rhine Delta region) provide practical examples on how to implement the methodology and realize inventories at the regional level using a predefined set of classification categories for the remote analysis of existing water museums (Phase 1 of implementation). These categories allow for the simultaneous identification of new museums or interpretation centers to be created - which are the focus of Phase 2 of the investigation.[12]

The methodology proposed by the transnational toolkit provides support for conducting the census in two different phases and four steps. Each phase includes two steps, as shown in table 1.

By adopting the proposed toolkit to identify both existing and potential water museums in different regions worldwide, research institutions and National IHP Committees can better target and communicate the SDGs in connection with two resolutions of UNESCO-IHP. In addition, they will be stimulated to highlight paradigmatic models of human coexistence with water, promote related values, facilitate access to heritage sites and foster new human-river encounters. Educational activities on water sustainability will be strengthened and new holistic approaches promoted to plan better resilience.

In carrying out WIN, it will be possible to encourage younger and older generations to learn about different paradigms of water uses and management through time and become better acquainted with the ancient values associated with this precious life-giving element. This approach will simultaneously also support the right to water for other living species. Thus, by integrating the practical experiences of our predecessors into educational processes, we can think about innovative models for more forward-looking water uses and lay the foundations for a better world.

Acknowledgment
This contribution was peer-reviewed. It was edited by members of the editorial team of the UNESCO Chair Water, Ports and Historic Cities: Carola Hein and Matteo D'Agostino.

4. The project that inspired this approach was developed through the research carried out on the historical waterways of Venice's hinterland (Eulisse, Vallerani and Visentin 2023).

5. Pilot inventories were developed in cooperation with the UNESCO Chair "Water, Ports and Historic Cities" of TU Delft, ICOMOS NL and the UNESCO Chair "Water, Heritage, and Sustainable Development" of Ca' Foscari, Venice University.

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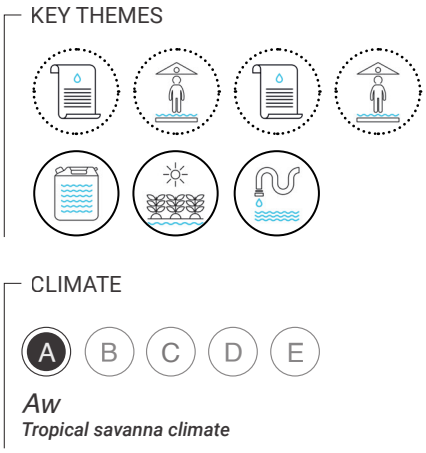
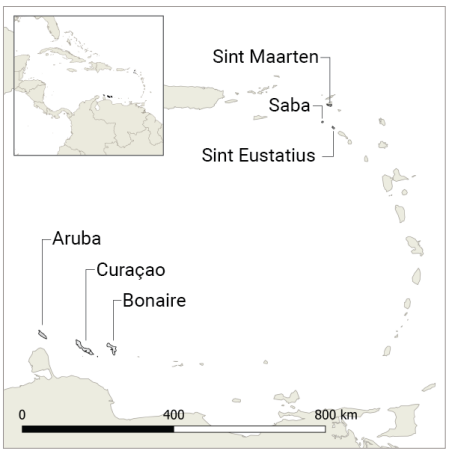
Thirsty Islands and Water Inequality: The Impact of Colonial Practices on Freshwater Challenges in the Dutch Caribbean

Suzanne Loen
LILA Living Landscapes

Small Island Developing States (SIDS) and Territories in the Dutch Caribbean face unique water challenges related to climate change. With fragile ecosystems and surrounded by rising sea levels and limited natural resources, island communities are increasingly faced with the reality of life with extreme drought and floods. While Caribbean SIDS in general have limited freshwater resources and limited water-retaining capacity due to natural characteristics, it is undeniable that unsustainable actions, practices and attitudes under colonial rule, such as deforestation and "property-thinking," have contributed to present-day environmental degradation, freshwater resource management problems and water inequality. In the Netherlands, there are ongoing discussions about reparative justice compensation for the impact of Dutch colonial imperialism. In this light, it is worth considering whether reparative justice for the former colonial territories could take the form of eco- and heritage-system reparations and substantial investments in nature- and heritage-based solutions.





< Fig. 1 An almost dry streambed of a *rooi* in Curaçao. The *rooien* are the hydrological and ecological backbone of the island. They only carry water after sufficient rainfall and are therefore easily overlooked and destroyed during spatial developments and land use change (Source: John Dohmen, 2017. CC BY-NC).

The Current State of Water

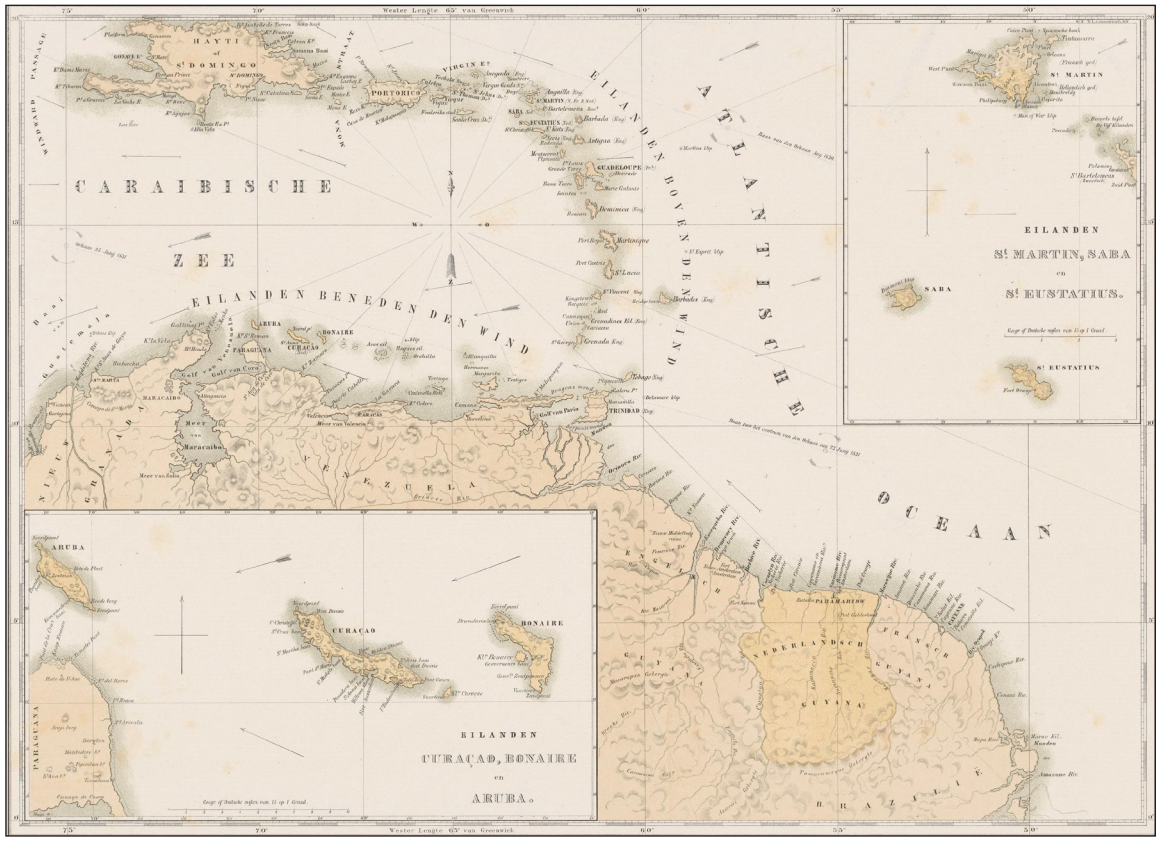
The Dutch Caribbean Small Islands States (SIDS) and Territories are part of the Lesser Antilles, an island "arc" between Puerto Rico and Venezuela. Within the Kingdom of the Netherlands, Curaçao, Aruba and Sint-Maarten (CAS islands) are autonomous countries, while Bonaire, St. Eustatius and Saba (BES islands) are special municipalities. The impact of the climate crisis on these former colonial territories of the Netherlands involves increasingly extreme weather patterns and rising sea levels, felt directly and intensely. Located east of Puerto Rico, the islands of Saba, St. Maarten and St. Eustatius (S islands) are located within the hurricane belt. At the periphery of the hurricane belt, located off the coast of Venezuela, Aruba, Bonaire and Curaçao constitute the ABC islands group (fig. 2). While the islands show a variety of geographical and hydrological circumstances, their semi-arid climates are characterized by long periods of drought and spells of strong storms increasingly causing economic and social disruption and devastation. Because of the natural soil characteristics and topsoil degradation, with limited freshwater resources and water-retaining capacity, there is little room to store rainwater to alleviate water stress and prevent the natural environment from desiccation in periods of extreme drought. Drinking water in the Dutch Caribbean is generally produced from seawater through reverse osmosis, an energy-demanding process that drives up the price of water. Today, many Dutch Caribbean citizens depend on tourism for their livelihoods. Tourism is a water-intensive industry that puts an extra strain on natural resources and the insular freshwater supply (Heartsill-Scalley 2012).

The Climate Crisis and Water Inequality

Freshwater systems in the Caribbean are in a state of crisis (Heartsill-Scalley 2012), amplified by the impact of climate change. In the Netherlands, the Dutch government has put climate adaptation and mitigation firmly on the agenda. However, the impact of the climate crisis on the Dutch Caribbean is under-researched. Hence, policies and programs for the BES islands to respond to the climate crisis are lacking. The urgent need for the Dutch government to address this issue was underlined in a recent study, "The Impacts of Climate Change on Bonaire" (Koks et al. 2022), in which the researchers estimated that a fifth of the island of Bonaire will be permanently inundated by 2050. Mangrove decay, declining shorelines, floods and inundation will also amplify the strained insular freshwater supply due to salination. The price of drinking water on St. Eustatius is already seven times higher than in the Netherlands, a price which about half the island population cannot afford. Without access to piped water, people are forced to rely on private rainwater cisterns. Due to longer periods of drought and increasingly erratic rain patterns, these domestic systems do little to alleviate water insecurity. This is in stark contrast to the Netherlands where almost 100 per cent of households have access to piped water.

The Historical Exploitation of Natural Resources

In general, small island ecosystems are more vulnerable to the impact of climate change and natural disasters than those on larger land masses. However, the negative impact of (over) exploitation of natural resources and land use changes during colonial rule have affected island ecology and freshwater recharge capacity. The Dutch colonial empire treated their foreign territories mainly as extraction colonies. In Curaçao, the Spanish and Dutch occupation marked the beginning and acceleration of large-scale deforestation (primarily for dyewood).



^ Fig. 2 Map of the islands of the Dutch Caribbean, formerly known as Nederlandse Antillen (1860–1862) (Source: Rijksmuseum, 2022. CC0 1.0, via Wikimedia Commons).

The introduction of grazing cattle deterred the regrowth of green cover and led to the degradation of the topsoil. This negatively affected the water-retaining capacity of the soil, while the decreasing size of the mangrove belt led to an increase in salt intrusion in coastal freshwater sources. Freshwater scarcity however did not prevent water from becoming a commodity on commercially operated water plantations (*waterplantages*) of Curaçao (fig. 3) (Loen 2019). Here, water was extracted from the soil to sell, for example, to passing cargo ships. To increase the water yield, large dams were built downstream in the streambeds of *rooien* (ephemeral streams also known as guts, ghuts or gullies) (fig. 1). This led to erosion, the silting of the soil and increased the risk of dam breaches. During the oil era (ca. 1920~1950), the Curaçao oil refinery industry took over many water plantations to extract water for their industrial processes, often at the expense of nature, agriculture, people and livestock.

"Property-Thinking"

Throughout history, the scarcity of freshwater in what are now the Dutch Caribbean islands has been a source of conflict and tension – whether between Indigenous people and invading enti-

^ Fig. 3 Watermills on a water plantation in Curaçao, ca. 1900–1920 (Source: Soublette et Fils, 2020. Public domain, via Wikimedia Commons).

ties, rural and urban populations, landowners and enslaved people or commercial and public interests. "Property-thinking" – the transfer (or confiscation) of public goods, such as water and land, to colonial capitalist governing entities – was a cornerstone of the Dutch colonial empire. Informal (marginalized) stakeholders such as Indigenous and (formerly) enslaved islanders had no voice in the management of land, water or natural resources on which they depended for their livelihoods. According to Bhattacharyya (2019) colonial "property-thinking" resulted in the loss of social, cultural, economic, legal and spiritual ownership for Indigenous and marginalized communities and continues to shape our living environments often with devastating ecological consequences. The large-scale deforestation as well as the way in which the government accommodated the transfer of water plantations to Curaçao's oil industry and commodification of water without consideration for those who depended on the water and land for their livelihood are scenarios of "property-thinking." The legacy of "property-thinking" in the postcolonial era is reflected in the backlog and shortcomings of public (water) infrastructure and services, planning policies and the extent of environmental degradation.

The Erasure of Traditional Culture and Knowledge Systems

Dutch society is still coming to terms with the crimes committed against Indigenous people, enslaved people and their descendants under colonial rule. With the tragic erasure or (cultural) genocide of the Indigenous people and oppression of the enslaved came the loss of local traditional ecological knowledge systems (TEKS). Little is known about the traces and legacy of TEKS on material and immaterial (water) heritage, let alone their potential value to build resilience against the impact of the climate crisis. A study of freshwater management in St. Eustatius notes the existence of enslaved workers who specialized in rainwater harvesting and water management systems, of which no written records have been found (Van Keulen 2018). The subjugated and marginalized position of both Indigenous and Afro-Caribbean people has no doubt contributed to the lack of attention to and appreciation for traditional freshwater management systems.

Discussion: Ecological and Heritage Systems Reparations?

To say Dutch Caribbean SIDS are facing water challenges is an understatement. Ecosystems, people and their livelihoods face the acute threat of a water crisis amplified by the impact of climate change. It is undeniable that past actions, practices and attitudes under corporate colonial rule, including the over-exploitation of natural resources and "property thinking," have contributed to present-day environmental degradation, freshwater resource management problems and geographical water inequalities. Huge investments are needed to transform infrastructures and institutions to reduce inequality (SDG 9, 10, 16). However, to build sustainable settlements and improve access to clean water and sanitation (SDG 6, 11), innovation and optimization alone are not the answer. In order to tap into the potential of ecosystem services and holistic nature- and heritage-based solutions, it is essential to restore terrestrial and aquatic ecosystems (SDG 13, 14, 15).

On 19 December 2022, the Dutch prime minister offered formal apologies on behalf of the government to former colonies in the Caribbean for its involvement in the transatlantic slave trade. There have long been discussions about reparative justice through financial compensation for the former colonies and with the recent apologies by the minister, discussions have revived. In light of increasing climatic and water inequalities amplified by the climate crisis, it is worth considering whether reparative justice for the former colonial territories could take the form of eco- and heritage-system reparations and investments in nature- and heritage-based solutions.

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Looking Back Paves our Way Forward: The Delta City of Amsterdam

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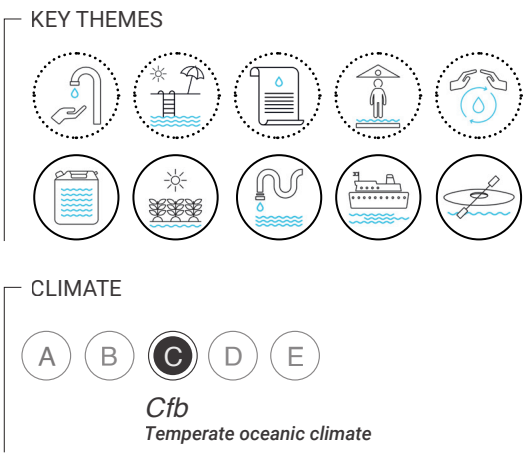
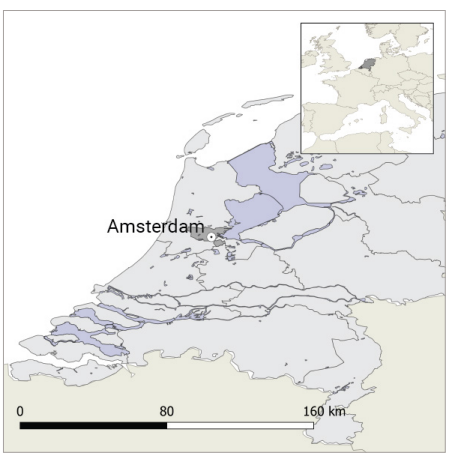
As one of the most famous delta cities in the world, Amsterdam exemplifies how decisions and narratives from the past can be the driving force for present-day actions and more effective design principles for future city planning. Water management in Amsterdam has often been, and frequently still is, reactive in response to water hazards, flooding, droughts, pollution and disease. While contemporary pressures urge water managers to redesign the living environment in harmony with changing water cycles, the centuries-long history of water awareness, cumulative knowledge and long-term spatial planning has led to gradual improvement throughout Amsterdam. Many solutions are still relevant today and are essential in decision making as we design a new climate-resilient future and deal with challenges such as sea-level rise and demographic change. Despite residing below sea level, the people of the delta city of Amsterdam exhibit a profound sense of confidence and security against flooding. Moreover, the material and immaterial dimensions of the water network serve as a tangible reminder of our ancestors' deltaic identity, highlighting their contributions to our current living environment. Therefore, the water system plays a vital role in preserving Amsterdam's urban landscapes, cultural heritage and historical significance, which also helps strengthen this delta city's future water management and urban planning.





< Fig. 1 The Amstel Locks (1673) protected the Amstel River's upstream areas, which are important for food production, from poor water quality by flushing water. The locks still play an important role in Amsterdam water management (Source: Albert Jan Perier).

The Delta City of Amsterdam and its Water Management Challenges

Amsterdam, the capital city of the Netherlands, has been strongly influenced by water for more than 700 years. From a settlement at the edge of the Amstel River, it has become a city with over 800,000 inhabitants, built on, in and with water (van Leeuwen and Sjerps 2015). Amsterdam's connection with water is ubiquitous and even the city's name is a direct reference to its origin. A levee – dam – built on the intersection of the Amstel River and former Zuiderzee created space for a trading center. The established canals are artificial multi-purpose extensions of the Amstel, combining protection, transport of trading goods and groundwater drainage with an essential connection to the catchment of Amstelland. Investments in flood risk management, water quality and robust water infrastructure turned Amsterdam into an attractive, economically healthy and safe city (IWA 2016; Koop et al. 2017).

People shape, reshape and adapt urban spaces to sustain human life and its living environment. Today, natural water systems are increasingly impacted by human factors in ways that affect water availability and quality (Khatri and Tyagi 2015). Pressures on water systems create challenges for cities related to housing, drinking water, solid waste, drainage, wastewater, groundwater and surface water. For cities to remain livable, adequate water management is an essential and continuous task. To meet its future challenges, the Amsterdam region invests constantly in developing and maintaining its water system. Sustainable investment decisions for water management demand consideration of historic developments that proved valuable for the regional water board and the City of Amsterdam. Therefore, the development and the preservation of a solid knowledge base regarding the water system and environment is a critical priority in the decision making process and contributes to the legitimacy of water governance in the region.

The world-famous water system of Amsterdam earned its legacy over the course of six centuries in response to crises by balancing opportunism, entrepreneurial spirit and societal pressures. Praised as unique, history shows how water management in Amsterdam has often been, and frequently still is, reactive in response to water hazards, flooding, droughts, pollution and disease. Moreover, to this date essential steps in good decision making still require efforts to raise awareness of water issues (Peters et al. 2021). Politicians and water managers have a centuries-long track record developing a variety of solutions to prevent disasters. Enhanced knowledge and long-term spatial planning have led to gradual improvement throughout Amsterdam, and many of the solutions are still relevant. In terms of prospects for the Amsterdam of the future, they involve both hindrances and inspiration. Contemporary pressures urge water managers to reconsider and redesign the living environment in harmony with changing water cycles. Practitioners and society at large are confronted with the monumental opportunity and challenge of addressing sea-level rise and demographic change to invent a climate-resilient future.

A typical delta city faces four challenges: transmission of hinterland runoff, high water levels outside the city (high tides), water quality issues connected to wastewater production, and the city's spatial planning together with its water infrastructure design to manage rainfall and groundwater. These are among the challenges Amsterdam has faced in the Dutch delta within the city territory and its adjacent areas inland and along the shore. The city was designed

^ Fig. 2 Field level, Amsterdam. The city center has been artificially elevated to above average sea level (NAP). The city is protected against flooding by a dike with an altitude of +2 mNAP (in brown). IJ was part of the tidal area until 1872 (when the Oranje Locks closed). Zuiderzee, east of the Oranje Locks, became IJsselmeer in 1932 (Source: Wessel de Meijere, Waternet. Data: ESRI Nederland).

considering the water geography of its surroundings and constrained by fluctuating water levels in both the catchment area and in its connection to the sea.

Past: Decisions that Shaped the Natural Environment in the Process of Developing a Delta City

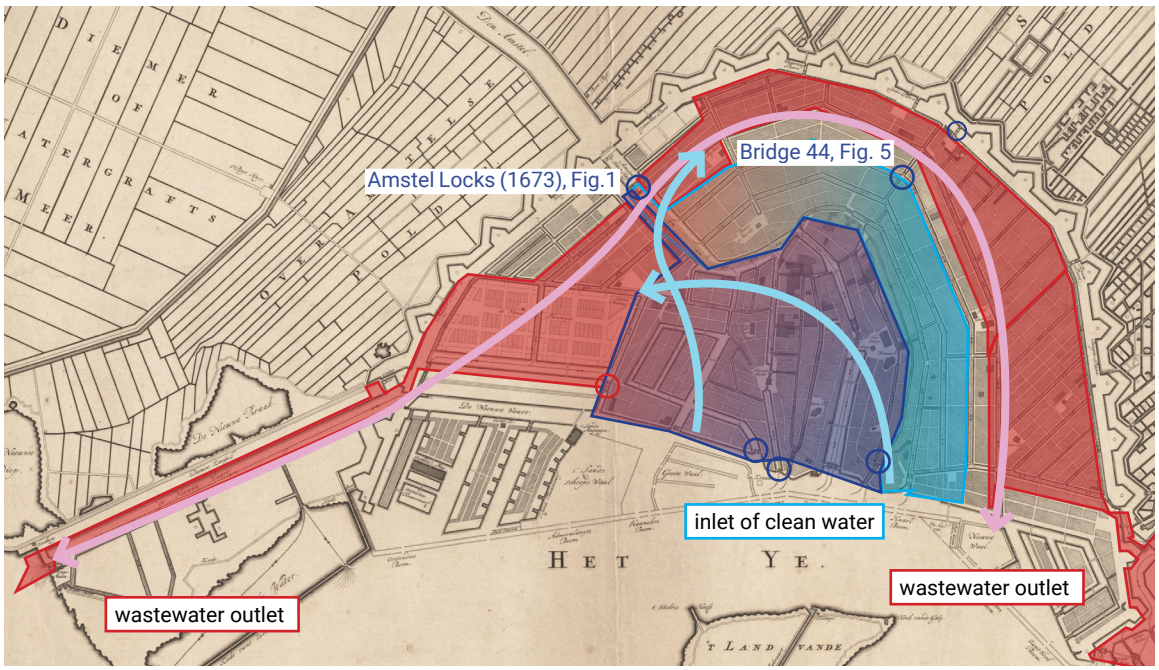
Before the original settlement that became Amsterdam, the sea intruded into the central part of the delta (1170). Protection against flooding was crucial and sea dikes were built. The sea dike has been reinforced over time in line with the highest flood level. After the big flood of 4 November 1675, the highest tide in Zuiderzee prior to the twentieth century, the level of the sea dike protecting Amsterdam from the sea was 9 feet, 5 inches, which is, following Amsterdam metrics, around 2.6 meters above sea level. Managing the tidal variability through the Oranje Locks (Orangesluizen) in 1872 reduced the risk of flooding in Amsterdam. In 1932 the distance of the city to the sea was further increased due to the construction of the Afsluitdijk. The Afsluitdijk is a sea-dividing levee that changed a brackish lagoon (Zuiderzee) into a freshwater lake (IJsselmeer). The IJsselmeer is now of great importance for the freshwater supply of the Northern Netherlands. In the future, regarding sea-level rise, the lake might have an important function connecting the Rhine to the North Sea.

Within the Netherlands, flood risk protection in urban areas is not solely dependent on the construction of levees. Another important measure is to increase field levels. It is common delta practice to raise the land, bringing in sand or other substrate materials before construction. In addition, elevated entrances to domestic housing will also mitigate flood risk. Basically, before urban development, Amster-

^ Fig. 3 1767 map Nieuwe Ambagtsheerlykheden der Stad Amsterdam waarin ook de Groote Ring van Amstelland. The area indicated in blue is the catchment directly connecting to the Amsterdam canals (Source: Historisch archief van Waterschap Amstel, Gooi en Vecht, NL-AsdWAGV_010140).

dam structurally raised land using soil, so that the city center is an artificial high point in the landscape. Outside the dike, in the tidal waters, street levels were raised up to 2.0m above sea level. In the protected area near the city center, street levels are typically raised between 0.5m and 1.0m above sea level (fig. 2).

Another layer of protection was added by the city's decision to restrict the discharge of the Amstel River draining into Amsterdam by managing the size of the catchment area. The city extended its influence over adjacent territories by acquiring new land while actively participating in local regional water authorities in the Amsterdam hinterlands. After a century of struggle and a decision from Holy Roman Emperor Charles V in 1525, it finally became clear which areas would be allowed to drain via Amsterdam (Zwaan 1984). The 1767 map in figure 3 shows the perimeter of the Amsterdam catchment in blue. The sinking peat land south of Amsterdam is divided into so-called polder areas, which are intentionally kept dry by pumping the rainfall surplus to a primary channel system known as the *boezem*. The Amstel River and city canals are part of the boezem designed for transporting rainfall surplus to the Zuiderzee. The Dutch name for this transport system is *boezem*, because it reflects the movement of the human chest in breathing. The periodic increases in water level, naturally occurring through small water level variations "breathe" rainfall surplus into the sea. However, after finishing the development of the port of Amsterdam, the installed Oranje Locks closed the – until then – permanent open connection between the Zuiderzee and the IJ in 1872. Since then, the initially steam-driven pumping stations complemented the natural flow at low tide in the sea and regulated the transport of catchment water to the Zuiderzee, with exceptions in 1942, 1975 and 2005.



^ Fig. 4 Flushing scheme in the second half of the seventeenth century until 1872. The blue arrows indicate the clean inlet water, and the red arrows indicate wastewater-enriched outflow. Locations of fig.1 and 5 are indicated. (Source: Map: Stadsarchief Amsterdam, KOKA00125000001).

The most significant impact from closing the Oranje Locks was the change in intensity of tidal variability and its inlet location, which directly affected the water volume available for flushing. It effectively prevented the system from flushing clean the Amsterdam canals with the required volume of water (Fig. 4). This prompted a streak of water quality issues and public turmoil and eventually the necessity of a proper sewage system became apparent. Water managers and city officials decided to build a sewer, transporting wastewater to the Zuiderzee. After a century of discharging untreated Amsterdam effluents, wastewater treatment started after 1982, dramatically improving the IJsselmeer's water quality. It took over 115 years, until 1987, to finish the sewerage system in the older city quarters. Nowadays, the water quality in Amsterdam canals has significantly improved and is even suitable for swimming.

Present: The Pressures that Drive Actions in Perspective

Due to the earlier adjustments to the water system, the city is located in a large polder. Water levels in the polder areas tend to rise due to limited pumping capacity. Which is why the increased risk of heavy rainfall forced Amsterdam to expand its storage capacity. In urban areas, blue and green solutions offer water-storage capacity on rooftops and gardens, in the public spaces of parks, and underneath streets. The lowest sections of polders act as natural floodplains. Floodplains are an important flood risk protection measure in spatial planning as water drains with the fewest obstacles. Floodplains nowadays also double as recreational space.

The present-day discussion is characterized by a sense of urgency about expanding pumping

capacity to transport water outside the city area, namely to the North Sea and the Markermeer and IJsselmeer lakes. The primary channel system comprising the IJ and Amsterdam canals developed as a typical transport system, that is, a system helping to discharge water from the low-lying areas. The area around Amsterdam has been designed and developed in such a way that the water levels cannot fluctuate strongly, therefore the water level must remain stable and excess water is pumped out.

There are also many tangible and intangible developments and pressures in the delta. The Dutch population is rapidly growing, demanding fresh water and seeking leisure on and along the canals, resulting in an overall exacerbation of pressures on the Amsterdam water system. The fact that Amsterdam is already a densely populated area also presents immense challenges for spatial development. Fortunately, a new national law, the Environment and Planning Act (Omgevingswet), will supply us with legal instruments for enforcing environmental values and principles, leaving the regional water authorities better equipped for their tasks. The impending law establishes quality requirements and values for many types of activities that affect assets like water and soil. These environmental values are designed to be adaptive to changing environments and societal needs in the future. Examining these values in relation to the past, including detrimental decisions that often irreversibly shaped the Amsterdam landscape, could offer new solutions to problems of the present and future. That process of reflection is in the spirit of the new law.

The delta region of Amsterdam faces significant pressures, leading to dynamic spatial developments and prompt governance actions that have shaped a distinctive environmentally conscious identity and behavior among the city's citizens. Additionally, the heightened awareness has induced societal unease, leading to demands for engagement and cooperation between governments and the people of Amsterdam to improve decision making. Citizens' concerns regarding their living environment have resonated with policymakers and institutions, which similarly prioritize ecological considerations, nature-based solutions, and water quality. Despite residing below sea level, the people of the delta city of Amsterdam exhibit a profound sense of confidence and security against flooding.

Water is regarded as the delta city's crown jewel. Less visible are the democratically elected water authority boards and their taxation system, which are crucial in maintaining and developing the intricate water network in urban landscapes. This comprehensive water system encompasses many physical structures, including canals, sluices, locks, quays, ports, water-related buildings and hidden infrastructures. Moreover, this network's tangible and intangible dimensions serve as a reminder of our ancestors' deltaic identity, highlighting their contributions to our current living environment. The water system will play a vital role in preserving the cultural and historical significance of Amsterdam's urban landscapes.

Future: Design Principles for Water Management in Amsterdam

The decisions of the past and the narratives we develop about them in the present in connection to citizens, or in a broader sense society, provide frameworks and insight for future water management and urban planning. Best practices and mistakes offer principles. The following principles are important to consider when shaping water management in the future:

^ Fig. 5 Bridge 44, Leidsegracht, where the platforms show traces of a lost function: closing doors were operated to force flow in the flushing scheme between 1663 and 1872 (Source: Stadsarchief Amsterdam, B00000024728).

1. Amsterdam should maintain an open water system to prioritize natural water movement connecting the catchment to the sea. The heritage of the water system formed in the past, integrated with the surrounding environment, forms a sound foundation for future functioning. Minimizing obstructions in the water, such as floating parks and houses, also maintains water quality and supports the system's active role in the ecosystem.

2. We need to develop adaptive strategies, such as increasing pumping capacity and backup systems, to address future sea-level rise. The *boezem* is a transport system and the space for storage is limited. We need to incorporate and extend water storage within the urban environment, utilizing rooftops, gardens, streets and parks. Polder areas can form floodplains. Continued and enforced collaboration with neighboring catchments is crucial for effective water management.

3. We need to ensure the open character of the IJmeer, which is important for the freshwater supply of the Northern Netherlands. Refrain from further development and consequent reduction in freshwater storage. In addition, it may be necessary in the future to be able to discharge more of the water from the Rhine via Ijmeer/Ijsselmeer as sea-level rise limits the ca-

pacity for outflow of the Rotterdam area.
4. We need to design water management systems that prioritize the governance, knowledge and heritage of Amsterdam. Strategies should aim to ensure the sustainability of the water system while balancing the cultural and economic significance of the city. Prioritize stakeholder engagement and cooperation among different institutions, including those responsible for heritage preservation, to ensure that spatial and water planning respects the city's unique cultural and historical characteristics.

5. Design strategies are needed to retain and store precipitation in polders and cities to ensure gradual drainage during heavy rainfall and to provide water during drought.

6. We need to improve water management systems in Amsterdam to enhance the protection of the city and its hinterland from floods resulting from rising sea levels. We should prioritize the conservation and functionality of existing dikes and heritage structures by ensuring that they are maintained and strengthened to withstand future challenges. Strategies should focus on enhancing the ability of existing dikes to protect the city and its inhabitants against dynamic water levels in IJ/Noordzeekanaal and beyond.

7. Water management systems need to be designed to prioritize elevated field levels in new construction and infrastructure. Given the threat of flooding and changes in ground level, it is essential to raise the field levels of urban areas to limit potential damage caused by flooding.

8. There is a need to reconsider Amsterdam's water management systems to prioritize cooperation and the balance between saltwater intrusion and freshwater use. Development of the harbor has historically disrupted water management, and sea-level rise will put additional pressure on this balance. Therefore, improving cooperation and coordination is crucial to ensure the sustainability of water management in the face of future challenges.

9. We need to design water management systems to obligate a priority for water quality and ecology. It is important to reduce pressure on the water system and waste management to ensure and improve water quality. If, in any case, reducing pressure on the water system is not in the capacity of the regional water board or municipalities, we should focus on more local reduction of pressures to improve water quality.

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Water Cooperation and Ideology in Local Communities

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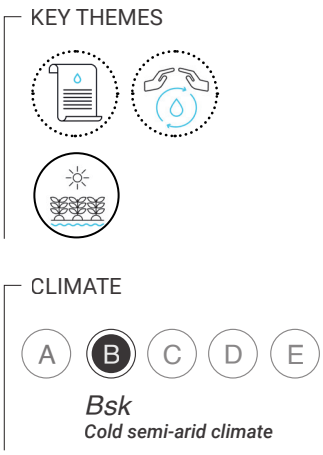
This article addresses how ideology affects local water governance, focusing on a groundwater basin in central Iran. It offers a case study of a symbiotic relationship between upstream and downstream communities, allowing a sustainable form of water governance. The cooler weather, better pastures and greater amount of precipitation of the basin upstream drew nomadic communities, whose economy was not dependent on irrigation. Downstream, fertile soil and warm weather favored agriculture with a high demand for water that was supplied by the groundwater transferred from the basin upstream. The exchange of livestock products and agricultural goods between the basin's upstream and downstream areas systematically tied their economic systems. However, Iran's 1979 revolution brought a hybrid leftist-Islamist ideology that unbalanced this traditional relationship through the reorganization of geographical space. The upstream communities were encouraged to cultivate their pastures, which led to a boom in the number of irrigation wells. The downstream villages were persuaded to adopt a new cropping pattern that turned most of their water-efficient vineyards into apricot orchards with high water demands. Therefore, an abrupt increase in water demand in the basin upstream and downstream thwarted the cooperation between the two areas and drove the basin into "the tragedy of the unmanaged commons."



< Fig. 1 Tube wells compete within the Abarkooh basin resulting in an annual drop of 80 cm in groundwater level (Source: Majid Labbaf Khaneiki and Abdullah Saif Al-Ghafri, 2018).

Introduction

In the arid Middle East, inclusive, safe, resilient and sustainable human settlements – as stipulated by SDG 11 – are far beyond reach without integrated water governance. Managerial, hydrological and socio-economic measures constitute the three fundamental dimensions of integrated water governance, which should be considered in any attempt to integrate monitoring and preservation systems, hydraulic technologies and infrastructures and economic incentives for water resources management (Lin 2012). As a case study, this paper examines the Abarkooh basin in central Iran (fig. 2), which exemplifies the conditions conducive to integrated water governance in the case of shared groundwater resources. This article is mostly based on data gathered firsthand through a Delphi study and nine unstructured interviews with local practitioners and experts during a field visit to the region in 2018.

Abarkooh is located in Yazd Province, some 150 kilometers southwest of the city of Yazd, and bordering Fars Province. Abarkooh has an arid and warm climate with an average annual precipitation of 146 millimeters (Kiani et al. 2016, 22). Given the topographical, geological and hydrological situation of the basin, the aqui fer of Abarkooh is replenished by rainfall that takes place mostly in the basin upslope in Fars Province; both regions share the same aquifer.

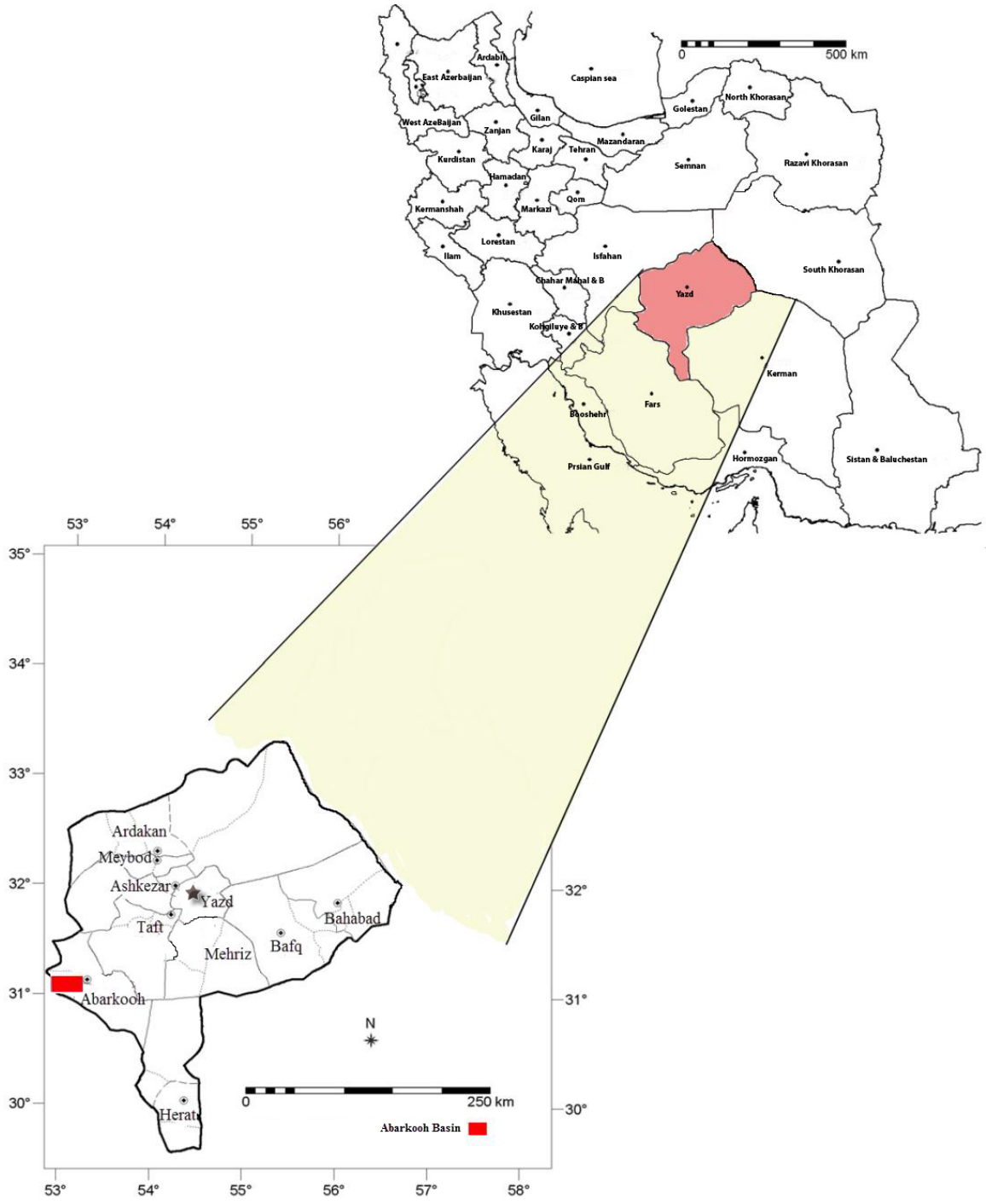
This article examines a traditional socio-economic mechanism that once regulated the utilization of the shared aquifer by various communities across the basin. This mechanism kept a balance between groundwater as a common pool resource and the demand of beneficiary communities, a balance that ensured sustainability in the basin for centuries (Ostrom 1990). The article also explores what happened to that historical balance between the local communities and their shared aquifer after Iran's 1979 revolution ushered in a new dominant ideology.

Geographical Diversity and the Distribution of Livelihoods

Geological and climatologic evidence suggests that the Abarkooh basin enjoyed a moister climate during the early Holocene, latest phase of the Quaternary (Kiani et al. 2016, 23), and its soil and water resources were favorable enough to draw some human populations. However, historical climate changes led to water scarcity and an uneven distribution of water resources across the basin (Labbaf Khaneiki et al. 2022).

Arable soil was abundant in the basin downstream where water was at a premium, and by contrast, the upstream was rich in water but short of arable soil. Over the course of history, the basin upstream drew various groups of nomadic communities with a pastoral economy. Some communities, such as the Gorji and Parandi tribes, were displaced and forced to migrate to this basin for political and military reasons (Kheyr Andish 2016, 125), while others like the Qashqayi, Arab, Marandi and Baseri tribes voluntarily chose this basin as their summer resort (Labbaf Khaneiki et al. 2022, 141).

Those involved in animal husbandry preferred the basin upstream where relatively high precipitation gave rise to green pastures, whereas the farming communities settled in the basin downstream whose fertile soil and warm climate favored agriculture, albeit with the help of irrigation. Downstream communities could solve the problem of water shortage by transferring water from the upstream, where the economy did not require much water. There were many qanats – a traditional water-mining technique that



^ Fig. 2 Abarkooh basin in the province of Yazd (Source: Majid Labbaf Khaneiki and Abdullah Saif Al-Ghafri 2022).

^ Fig. 3 The ruins of a grape syrup workshop in the basin downstream (Source: Majid Labbaf Khaneiki and Abdullah Saif Al-Ghafri 2018).

consists of a number of wells and a subterranean tunnel to drain groundwater out – stretching from the basin upstream to downstream to irrigate the farmlands. Different levels of water demand in the basin upstream and downstream were complementary.

In the basin upstream and downstream, two different economic systems divided geographical space such that a sustainable current of goods and capital circulated among all communities. Neither the upstream nor downstream communities were self-sufficient, since environmental limitations ruled out the possibility of producing all required products within one territory. The upstream livestock breeders mostly produced dairy products, shoes, carpet, wool, fur and fleece, with surplus exported to the downstream villages. In return, the downstream farmers provided the upstream with agricultural products. The mechanism of the upstream economy left most of the shared water for the downstream farmers who metabolized it into agricultural products. Thus, a considerable portion of the upstream water share was returned in the form of agricultural products. This economic interdependence ensured hydro-social justice and minimized the possibility of competition and tension between the two communities over their shared water resources.

Modes of Production and the Revolution

In the basin downstream, soil was suitable for vineyards where grapes were produced that could be turned into storable products like raisins and syrup. At a time when modern trans-

portation was not accessible in the region, raisins and syrup were among the foodstuffs that could be exported to other regions. More than 80 per cent of the grapes were used to produce a thick honey-like syrup that could bring the farmers a considerable income. Moreover, the syrup production process entailed a high level of cooperation, which contributed to the social cohesion of local communities.

Every five or six vineyards made up a cultivation unit that enjoyed a shared syrup workshop (fig. 3). At harvest time, the farmers rushed to pick the grapes as quickly as possible, before they rotted on branches. At the same time, they had to gather a great deal of firewood to be used in the production process, and all those laborious tasks needed to be completed in a short period of time. Therefore, all the farmers sharing the same syrup workshop collectively carried out the stages of the production process, regardless of the vineyards' ownership. They cooperated in gathering the harvest, crushing the grapes and then boiling the liquid down into a durable syrup called "shire." The resultant syrup was not only exported to the basin upstream, but also to other regions as far as Yazd, Isfahan and Shiraz.

In the basin downstream, the most widely planted variety of grapes was locally called *mesqālī* and mostly used for syrup production as mentioned, but after 1961, it gave way to another variety named *shāhānī*. The latter soon became popular in the basin downstream where water was in short supply, since its water demand was even lower. Unlike *mesqālī* grapes, the *shāhānī* variety did not lend itself to syrup production, and accordingly the farmers had to sell their harvest as fresh grapes. This disadvantage did not detract from the growing popularity of the *shāhānī* category, because the advent of modern transportation and road networks had changed socio-economic conditions to the extent that the farmers had access to the markets of remote provinces and could send their fresh products there. Given that the *shāhānī* variety enjoyed a lower water demand compared to *mesqālī*, farmers managed to expand the area of their vineyards without requiring more water, which brought them advantages. *Shāhānī* grapes were ideal for winemaking, which took place in several factories across Iran. Most of the harvest was transported to the provinces of Fars and Isfahan where wine factories were always thirsty for this variety of grapes.

In the wake of the Islamic revolution in 1979, a legal ban was placed on the production, transaction and consumption of alcoholic drinks including wine, and the farmers lost that lucrative market for their fresh grapes. It was almost impossible for the farmers to return to their traditional syrup production, due to a fundamental change in people's tastes and market trends during the preceding years. Also, in the formative years of the Islamic Republic of Iran, farmers were encouraged to change their cropping pattern in the basin, both downstream and upstream. In 1981 Javad Hesami introduced apricot saplings to the basin, leading to most of the vineyards becoming apricot orchards, which demand about four times more water than *shāhānī* grapes. The vineyards were irrigated once every thirty days, whereas the apricot orchards had to be watered once every eight days. The Islamic government tended to sedentarize the upstream nomads and encouraged them to turn their pastures into orchards by giving them free rein to dig tube wells and pump up the shared groundwater. However, the porous soil with its low water-holding capacity proved to be a limitation that made the basin upstream unsuitable for agriculture. Therefore, the government facilitated the use of motorized vehicles and machineries to modify the upstream soil, by transferring a huge amount of fertile soil

^ Fig. 4 The qanat of Cheshme Chāhak in the basin downstream, which dried up after groundwater overexploitation in the basin upstream (Source: Majid Labbaf Khaneiki and Abdullah Saif Al-Ghafri 2018).

from the basin downstream. In 2016, K. Roshan, an upstream farmer, transported 30,400 tons of soil from the basin downstream to improve only 20 hectares of his orchards.

The expansion of orchards in the basin upstream unbalanced the organic equation in which the upstream nomadic livelihood had permitted the release of groundwater toward the agrarian areas downstream. Cooperation gave way to competition reflected in a large number of tube wells mushrooming across the basin (fig. 1). As a result, the groundwater level annually falls an average of 80 cm, and the shared aquifer loses 36 million cubic meters of its water storage each year (Mortazavizadeh et al. 2013). A new study shows that the Abarkooh basin is plunging into "the tragedy of the commons" (in which incentives for individuals — when unmanaged — will ultimately be harmful to the collective [Hardin 1968]), where even the ground is sinking between 30 to 70 cm per year (Sherafat et al. 2020). This dramatic land subsidence is attributable to groundwater over-pumping, which has emptied the porous sediments of their water content (fig. 4) (Fallahpoor and Barzegari 2022).

Conclusion

This case study shows how ideology can affect

traditional water cooperation between a basin's upstream and downstream areas. After 1979, the new revolutionary government treated the Abarkooh upstream communities as the less advantaged deprived of their equal right to the shared groundwater. Thus, their pastures were turned into orchards dotted with hundreds of tube wells that greedily sucked up the shared aquifer. On the other hand, the downstream farmers were encouraged to change their cropping pattern, since winemaking was outlawed, and grape cultivation as their primary activity fell by the wayside. Apricot cultivation was introduced to the basin downstream, and apricots required much more water than grapes. Therefore, the basin upstream and downstream vied for a large share of the limited groundwater, and what had been cooperative communities became fierce competitors. As a result, the shared aquifer dramatically depleted, hundreds of qanats ran dry (fig. 4), the ground subsided and social tension continues to mount.

Ideological metanarratives do not always take into account geographical diversity that underlies inter-territorial cooperation among local communities. In the Abarkooh example, a religious ideology managed to homogenize different livelihoods whose sustainable consumption and production were anchored in their difference. Although it would be impossible for Abarkooh to return to the same traditional modes of production, SDGs 12 and 16 can still be achieved by diversifying economic activities based on different geographical capacities in the basin upstream and downstream. Competition over water will end only when interdependent production systems with different levels of water demand are re-introduced to the basin. In the basin upstream, production that demands little water and that uses raw materials from the downstream agricultural units can revive a sustainable pattern similar to the same traditional setting where water was fairly divided among different livelihoods.

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Revitalizing Istanbul's Water Heritage: The Valens Aqueduct

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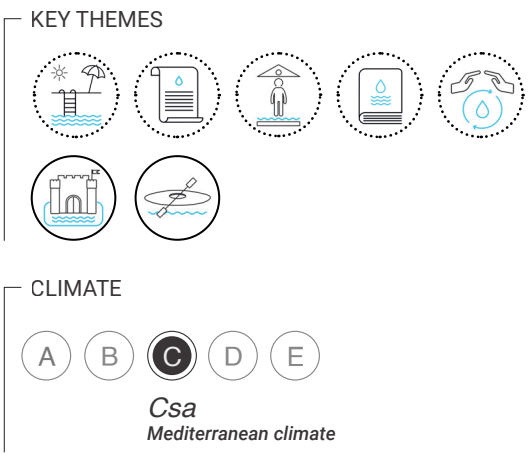
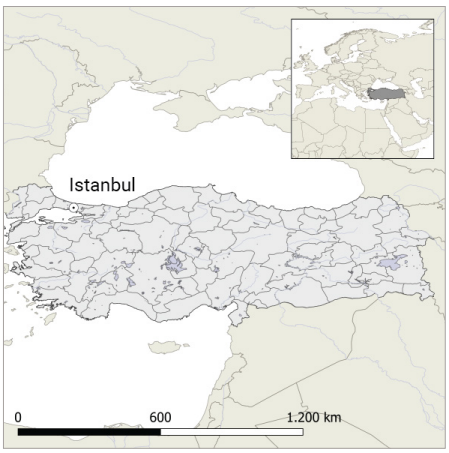
The ancient Valens Aqueduct in the metropolis of Istanbul, Türkiye, has the potential to raise public awareness of historical water management as well as of current and future water supply challenges. This monument stands as a highly visible remnant of what was once the longest water supply line of the Roman world. Although recognized and preserved as a heritage object testifying to its multi-layered history, it has lost its original function and its relationship to water management. We present a program that aims to develop solutions for revitalizing its tangible and intangible values as a prime example of water supply, management and culture through the ages. In this way, this heritage object can regain a connection with water, and water can become an engine for sustainable development.

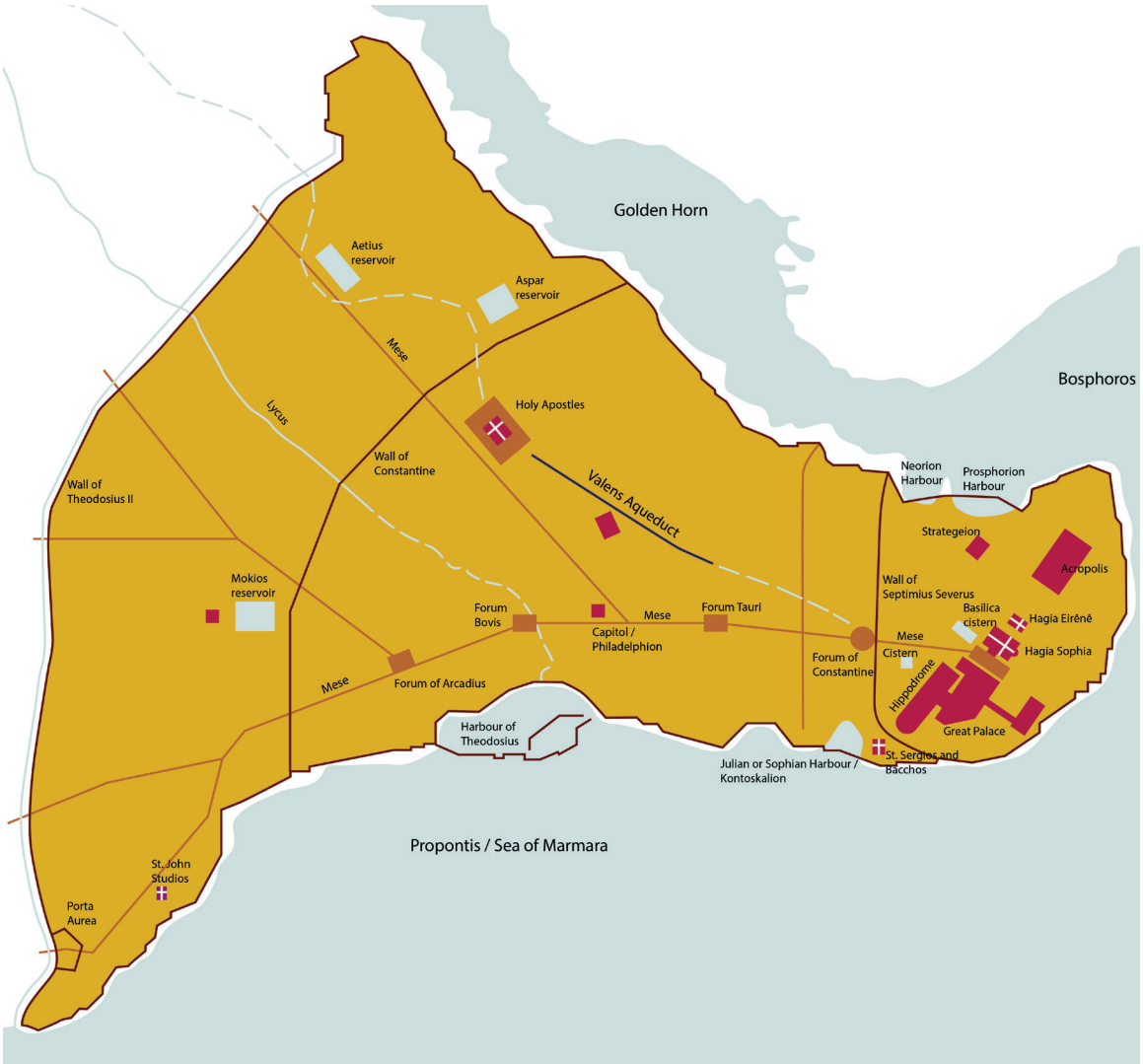




< Fig.1 The Valens Aqueduct (Bozdoğan Kemeri) in Istanbul (Source: Mariëtte Verhoeven, 2022, CC BY-NC-ND 4.0).

Introduction

The presence and accessibility of freshwater was the most critical condition for settlement in the peninsula that Roman Emperor Constantine chose as the site for his new capital, Constantinople, in 324 (fig. 2). Although politically and commercially strategic, the location was a poor choice from the point of view of water supply since it lacked freshwater. In 373, the city was provided with a long-distance water supply line (Crow et al. 2008), named after the emperor to whom the construction is attributed: Valens. The Valens line consisted of a system of channels, bridges and tunnels that carried water through the landscape from Thrace, 185 km away. The line was extended in the fifth century to 250 km in a straight line, but the complete



^ Fig. 2 Plan of Constantinople in Late Antiquity (Source: Studio Hartebeest, 2021, adapted).

system was calculated to be at least 426 km in total (Ward et al. 2017).

Throughout its history, management of the Valens line had to be adapted to changing conditions, including droughts, hostile attacks and fluctuating population numbers. In the year 626, a large Avar army besieged Constantinople and the Valens line was cut, not to be restored until the year 766. From the twelfth century onwards, the long-distance water supply line largely fell out of use. However, the section now known as the Valens Aqueduct (Bozdoğan Kemeri), the 971-meter-long arched aqueduct bridge between the third and fourth hills of the historical city, was in use (primarily for urban gardening) until the fall of Byzantine Constantinople in 1453. After 1453, part of the old Byzantine system, including the Valens Aqueduct, was revitalized and restored by the Ottoman Sultan Mehmet II (Çeçen 1996, 33–4). An inscription on the monument mentions a further restoration around 1700. The aqueduct was depicted numerous times on Ottoman period city panoramas and was the subject of early photographers. Since the 1940s, the long-defunct aqueduct has had traffic speeding under its arches along the Atatürk Boulevard. Restoration work on the Valens Aqueduct started in 2018 on behalf of the Istanbul Water and Sewerage Administration (ISKI).

Current Situation

The Valens Aqueduct stretches over an area with a dense and varied urban fabric consisting of historical monuments, workplaces, restaurants, residences, parks, parking areas and one of the main thoroughfares of the historic peninsula (fig. 1). The aqueduct is listed as a national monument, and its surrounding area is registered as an "Urban Conservation Site." In addition to its national significance, the Valens Aqueduct is within the boundaries of the "Historic Areas of Istanbul" UNESCO World Heritage Site.

The Valens Aqueduct is under a complex heritage management and governance scheme. Due to the area's national and international protection status, there are conservation master plans regulating the monument's preservation under the responsibility of the Ministry of Culture and Tourism. As a historic water structure, the Valens Aqueduct is legally owned by ISKI.

Despite its universal significance, the aqueduct is facing several threats, including air pollution, ongoing urbanization and uncontrolled use of the aqueduct by citizens. Houses, cafes and shops have been built partly in and against the monument, putting the integrity of the monument at risk (fig. 3).

Since 2018, ISKI has been carrying out restoration work, focusing primarily on structural and material problems. The masonry is being thoroughly cleaned and the joints are being renewed and strengthened (fig. 4). The restoration plan also proposes installing a platform to allow walking over or alongside the aqueduct at different heights. It is not clear to what extent this plan articulates the original function of the aqueduct and its connection to water management.

Challenges and Initiatives

Every day in Istanbul, an estimated 16 million people need to be supplied with freshwater. The metropolis brings 50 percent of its water from other provinces because its own reservoirs are drying up (İlhan 2021). Consumers are hardly aware of the efforts made in water manage-

^ Fig. 3 Interior of the Valens Café (Source: Mariëtte Verhoeven, 2022, CC BY-NC-ND 4.0).

ment because the modern water supply system is largely invisible while the visible remains of the historical system are no longer in use for hydrological purposes.

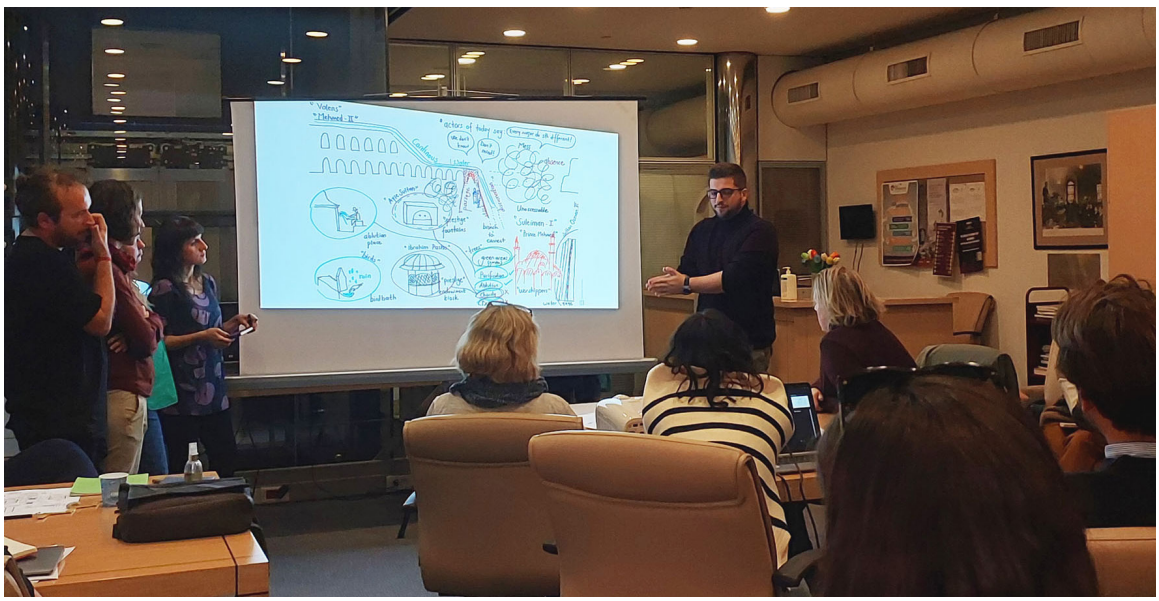
The Valens Aqueduct, an imposing structure in the heart of Istanbul, representing centuries of multi-layered history of urban water supply, is seen as an ideal showcase to tackle the challenges of developing a greater awareness of the precious value of water, and to restore the relationship between water and heritage. In 2021, under the umbrella of the Urban Heritage Lab of the Netherlands Institute in Turkey (NIT), where we collaborate with academic, public and private partners from Türkiye and the Netherlands, we started seeking public opinion by conducting an online public survey about the Valens Aqueduct. Although limited in scope and reach, it clearly indicated that many residents of Istanbul know the Valens Aqueduct and are aware of its original function. They see the monument as part of their history and strongly feel that it should be preserved, even though it no longer serves a hydrological function. Yet actual public engagement – notions of ownership by the community and a more in-depth or personal understanding of the heritage values of the aqueduct and of the historical water system that it was part of – is limited.

We decided to focus on actions and initiatives connected especially with SDG 4 (Quality Education) in order to: (1) increase knowledge and public awareness of the tangible and intangible values of Istanbul's water heritage, and (2) educate (future) heritage experts, planners and designers on how to integrate heritage in contemporary urban design.

To explore sustainable solutions for increasing knowledge and public engagement, representatives of Dutch and Turkish heritage organizations, NGOs and the creative industry met in September 2022 in Istanbul for a workshop. Two approaches emerged from the brainstorming session: a technological one and a more physical one. With the use of digital technologies, we want to develop a walking route app, which uses texts, images and videos to guide the user along the Valens Aqueduct and related heritage, providing not only insight into its multi-layered history but also contemporary testimonies. A more physical engagement could be established by using the Valens Aqueduct as a stage and backdrop for a Water Festival on World Water Day, with culture and art activities around the theme of water in past, present and future. These activities should be developed in collaboration with the local community so that they can come up with their own solutions for sustainable urban water supply and consumption issues, thereby connecting SDG 17 (Partnership for the Goals) with SDG 11 (Sustainable Cities and Communities).

An interdisciplinary academic course for graduate students and junior professionals from the Netherlands and Turkey ran from September to December 2022. This course, Water Heritage for Sustainable Cities, familiarized participants from a range of disciplinary backgrounds – architecture, urban planning, heritage studies, history, arts – with perspectives on water and heritage, especially those related to contemporary water challenges in a context of climate change and urban development. In a research-by-design exercise, participants learned to work in an interdisciplinary team to design proposals for the revitalization of the Valens Aqueduct (fig. 5). These proposals included reversible interventions in the urban fabric, art installations, educational programs, heritage walks, water harvesting systems and local community activities. The results will be published in 2023 and shared with stakeholders and the public.

^ Fig. 4 Restoration work on the Valens Aqueduct (Source: Mariëtte Verhoeven, 2022, CC BY-NC-ND 4.0).



^ Fig. 5 Adiscussion in the Water Heritage for Sustainable Cities course, October 2022 (Source: Netherlands Institute in Turkey, 2022, CC BY-NC-ND 4.0).

Conclusion

The biggest challenge for any plan to revitalize the Valens Aqueduct is to convince the relevant stakeholders in heritage and water management to preserve and protect the aqueduct not only as a historic relic but to employ it to restore the relationship between heritage and water. ISKI could, for example, through one of the proposed initiatives for the Valens Aqueduct, educate the public about its current efforts devoted to water management and supply in a sustainable future.

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The Erie Canalway: Stewardship and Multivalent Significance of Historic Waterways

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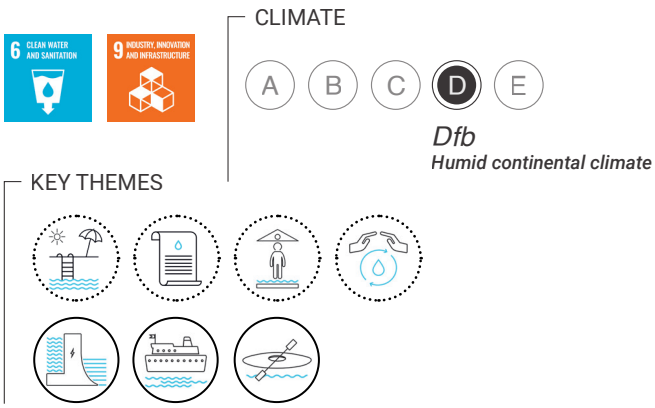
United States National Committee of the International Council on Monuments and Sites (World Heritage USA) Water and Heritage

Once North America's longest constructed transportation system, the Erie Canalway has been in continuous operation for nearly 200 years (ASCE 2022; Goodstadt et al. 2020). The Canalway transformed New York City into the nation's chief port and helped New York State (NYS) become a commercial, industrial and financial center (Library of Congress, n.d.; Hay 2014). Beyond moving people and goods, the Canalway carried ideas, innovations and social movements; it connected Europe, the US Eastern seaboard and the US interior; it has been credited with facilitating settlement efforts, advancing democracy and strengthening national identity (Goodstadt et al. 2020; Hay 2014). The system of the Erie Canalway is a National Historic Landmark and is listed on the NY State and National Registers of Historic Places; it is a National Historic Civil Engineering Landmark and is part of the Erie Canalway National Heritage Corridor. The Canalway contributes to SDG 9 (Industry, Innovation, Infrastructure) through its resilience over two centuries and its repurposing from transportation infrastructure to a historic, cultural and recreational corridor. Its innovation captures the paradigm shift of water engineering for transport to water management in terms of ecology and culture. The Canalway also illustrates some of the challenges associated with SDG 6 (Water and Sanitation), especially in regard to water-related ecosystems.



< Fig.1 Active recreation trails along the Erie Canal are a destination for cyclists (Source: Courtesy of Robert Tilley, 2022).

Introduction

The Erie Canalway was once a model for future canals in the US. When it opened in 1825, the Canalway was 363 miles long and was subsequently modified and incorporated into New York State's 450-mile canal system, which included navigational channels, locks, lift bridges, dams, powerhouses and maintenance structures, as illustrated by fig.2.

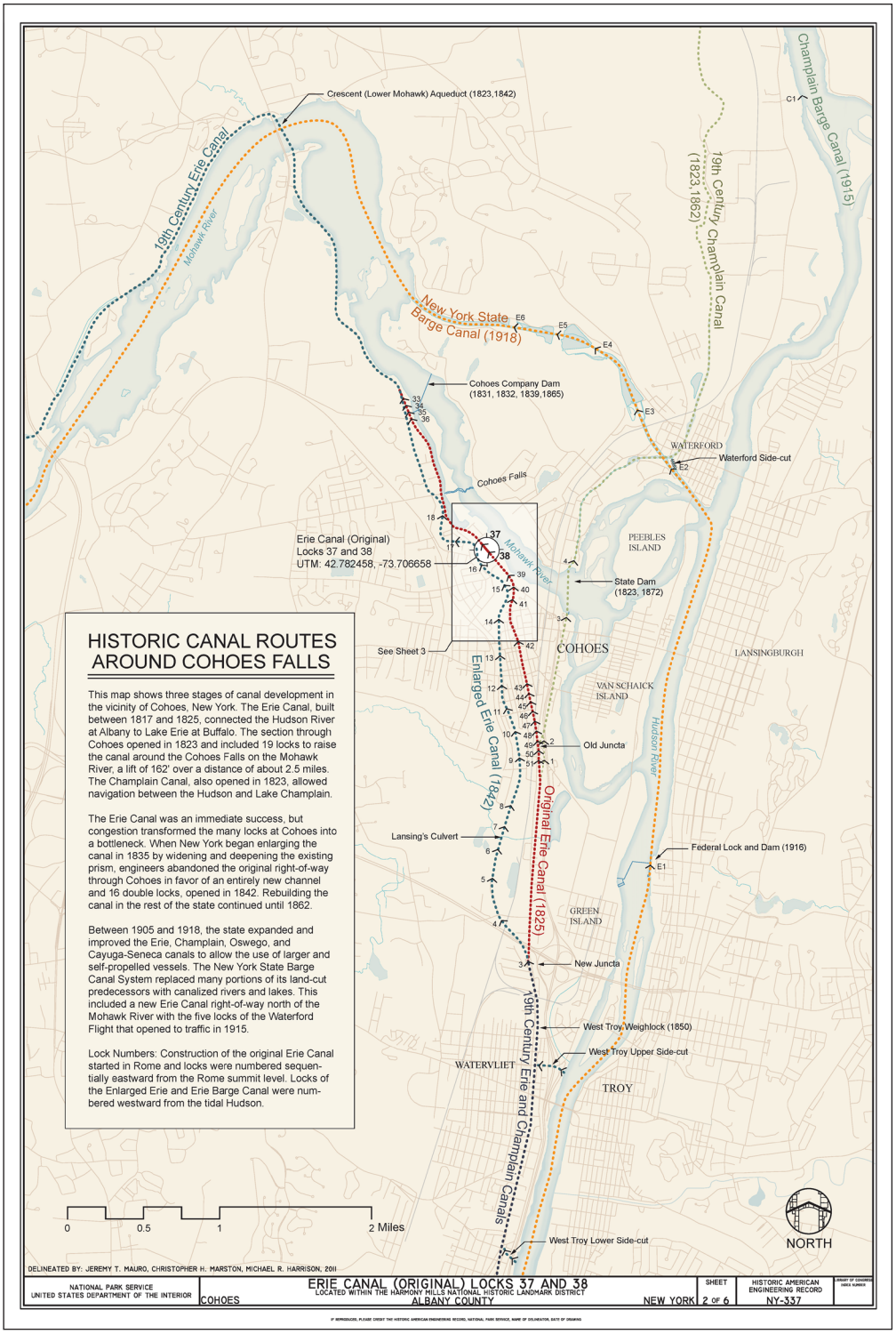
The Canalway facilitated transport of grains, European manufactured goods from the ports and lumber between the big lakes and the East Coast. Major New York State cities – from the Great Lakes to the Hudson River – are located along the trade route established by the Erie Canalway (e.g., Buffalo; Rochester; Syracuse; Utica; Albany; New York City). Builders oriented canal towns toward the Canalway; architecture including school buildings, churches, opera houses, main street and industrial buildings reflected prosperity from 1825 until the end of the nineteenth century, as seen in fig. 3 (Hay 2014; Tobin 2017).

A route for westbound and predominantly European immigrants and cargo, the Canalway opened the country west of the Appalachian Mountains and offered a cheap and safe way to carry produce to market. During the Civil War, the Canalway transported food, supplies and social ideas between the Northeast and the Midwest, facilitating the Federal war effort. Pivotal social movements such as abolition, women's rights and religious revivalism took place along the Canalway. Historic published travel accounts bear witness to how the Canalway captured the public imagination and inspired popular music, prints, children's books and postcards (Hay 2014).

As railroads became the dominant mode of transport and shipping, the Canalway traffic declined (Library of Congress, n.d.). The system deteriorated when the New York State Thruway bypassed canal communities, diminishing its commercial influence (Preservation League of NYS 2022). Contemporary challenges include enhancing regional economic development and preserving cultural value regionally, nationally and globally. Repurposing the historic corridor to meet contemporary transportation, recreational and cultural heritage needs is a premier example of combining historic water management with contemporary ecological and cultural water practices, sustainable development and public education.

Current Approaches to Preserving and Managing Water Heritage

In December 2000, the US Congress passed the Erie Canalway National Heritage Corridor (ECNHC) Act. The Act designated the Canalway's natural resources, the New York State Canal System and the communities along the Canalway a National Heritage Area. The legislation acknowledges the value the Canalway played in local, regional and national growth and its value as a historic, cultural, recreational, educational and natural resource. The Act designated the ECNHC Commission as the primary management entity for the implementation of the Erie Canalway Preservation and Management Plan (ECPMP), which included stakeholder inputs, key strategies and guidance for implementation (New York State 2010; Erie Canalway National Heritage Corridor 2006). Water managers continue their involvement through active maintenance to provide consistent draft for water transportation vessels (New York State Canal Corporation, n.d.). Water management has further expanded to include environmental stewardship with regard to stormwater pollution and



^ Fig. 2 Erie Canal (Original), Locks 37 and 38, 84 North Mohawk Street, Cohoes, Albany County, NY, Historic American Engineering Record (Source: Courtesy Library of Congress, no known restrictions on publication, documentation compiled after 1968).

^ Fig. 3 Erie Canal at Salina Street, Syracuse, Detroit Publishing Company, c. 1900 (Source: Courtesy of the Library of Congress, no known restrictions on publication)

invasive species (New York State Canal Corporation, n.d.). The Plan's key goals include:

- expressing and consistently protecting the Corridor's historic and distinctive sense of place; applying the highest standards of environmental quality to the Corridor's natural resources;
- achieving maximum scope and diversity for the Corridor's recreation opportunities, in harmony with the protection of heritage resources;
- encouraging current and future generations to value and support preservation of the Corridor's heritage;
- advancing balanced and self-sustaining economic growth and heritage development along the Corridor and;
- promoting the Corridor as a "must do" travel experience for regional, national and international visitors.

Formerly linking markets, the Canalway now connects natural, cultural, recreational and historic resources. Heritage and recreational tourism have flourished, attracting enthusiasts of history, culture, fishing, swimming, boating, bicycling and hiking (fig.1).

The Erie Canal Museum, National Heritage Corridor and Canal Corporation educate the public about the Canalway's history and significance. The Erie Canal Museum features permanent exhibits, temporary themed exhibits, educational programs, and virtual and in-person field trips (Erie Canal Museum 2023).

The ECPMP emphasizes the natural, historic, cultural and recreational resources of the canal system and its impact on the economy and quality of life because of public and private investments. Direct investments in the ECNHC include funds from the National Park

Service (NPS), NPS Heritage Partnership Program (HPP) and other non-NPS federal agencies (e.g., Department of Transportation; Department of Housing and Urban Development). Funding during 2002–2017 included non-federal Match Funds (61 per cent), NPS/HPP (25 per cent), other NPS funds (12 per cent) and Non-NPS federal funds (1.5 per cent) (Erie Canalway National Heritage Corridor 2023).

Current and Future Challenges to this Water System

The stewardship of a canalway requires collaboration between elected officials and government agencies, private enterprise and nonprofit entities. The Canalway's existence is a testament to the success of its management; however, with rapidly changing climate patterns, globalization and development pressures, the Canalway faces unprecedented challenges. Beyond politics and funding, significant challenges to sustainable stewardship include invasive species (vegetative and aquatic), water pollution, environmental degradation of adjacent lands and supporting regional economies.

Environmental and ecological impacts from the physical (hard-edge) barrier the Canalway creates are becoming apparent. From its inception, the Canalway's construction divided three critical wetland ecosystems, separated them from their native water sources, disrupted natural hydrology and reduced essential nutrients, thereby reducing their effectiveness within the framework of resilient storm water management (Navarro 2020). These ecological challenges and the Canalway's linear nature have facilitated the migration of invasive species (e.g., Round Goby fish; Water Chestnut plant) economically impacting the area with expensive prevention, treatment and removal requirements and decreasing property values (Navarro 2020).

The Canalway threads through large cities and small villages where nonpoint source stormwater pollution accumulates and transports to sensitive areas, the result of the expansion of impervious surfaces draining to the Canalway through connected waterways. While the need to reconnect specific waterbodies exists, others require isolation to minimize pollution.

Growing demand for improved access and increased outdoor recreation for kayakers, boaters and cyclists utilizing the Canalway as a "regional linear park" requires attention. The challenge is to re-integrate the Canalway into towns after its separation from construction of busy roadways. Improving access can help foster a growing economy centered around recreational tourism along the Canalway.

The greatest obstacles to addressing these challenges are effective stakeholder management and cooperation. Most of the solutions require periodically restricting access to (or through) parts of the Canalway. Adjacent landowners, the recreation sector and other canal-dependent economies may experience direct, negative impacts (Preservation League of New York State 2022).

Conclusion and Future Approaches

For nearly two centuries, the Canalway has faced and adapted to substantial challenges: transformations in cargo shipping and travel, governmental policy shifts, hydrology-related engineering problems, extreme weather events and changing societal attitudes toward the natural world, many of which continue to shape the present management of the Canalway and

affect local and regional interpretations of previous uses. Challenges offer opportunities for embracing tensions embedded in supporting active uses of historic waterways to meet contemporary demands while acknowledging and engaging with multiple cultural narratives around water and heritage corridors.

Lessons from interpretative and adaptive use of historic canalways can be applied to other waterways, including aqueducts and river reaches. They may also be applied to other heritage corridors inscribed on the landscape, including historic roads, railways and international borders.

Unique qualities of historic waterways, with their complex intertwined values regarding nature and culture, provide a shared creative space to encourage collaboration across academic disciplines, stakeholder groups and political affiliations. This approach will prove critically important in the future. The evolution of uses across generations combined with public involvement will be instructive in addressing new challenges for the Erie Canalway to maintain the functionality and ongoing contemporary relevance of this heritage corridor. With globalization, swings in international transportation, increasing redevelopment pressures, ecological effects from aggressive nonnative species, regional environmental stresses and climate change, the collective "lived experiences" embodied by the Canalway represent a legacy of resilience to guide adaptive management of the Canalway and serve as insightful models for historically informed stakeholder engagement for other heritage transects.

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Rebuilding Port Infrastructure Heritage in Jeddah, Saudi Arabia

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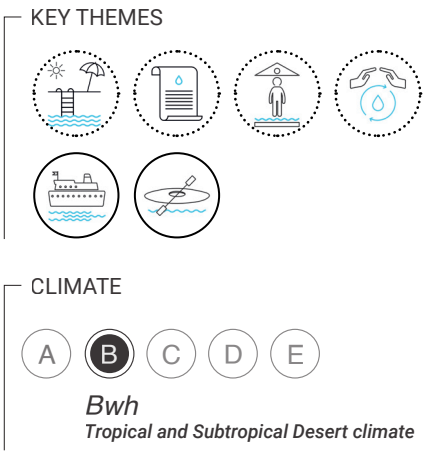
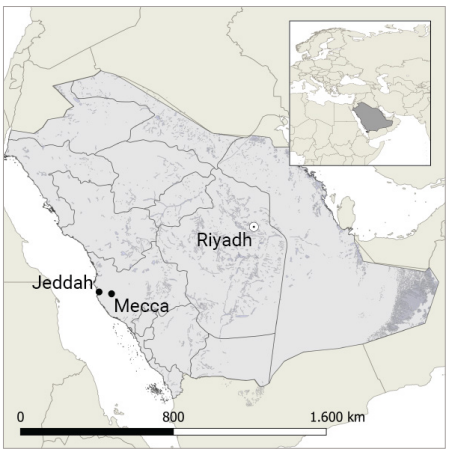
Transforming port infrastructure to meet the increasing demands of urbanization and modernization has been a contentious topic for decades, with push and pull between preserving historic structures and addressing sustainability, economic feasibility and tourism (Babalis 2018). This article takes an interdisciplinary view of these debates by exploring how restoring port infrastructure heritage can align key pillars of sustainable development: a strong local economy, water and sanitation, and social and cultural identity. An ongoing restoration project in Jeddah, Saudi Arabia, serves as a case study of integrative approaches and strategic objectives implemented by project developers and government stakeholders. The project addresses the challenge of rebuilding sustainable and resilient port infrastructure while still preserving heritage and making room for modern urban developments. The approach presented potentially creates new arenas for water and heritage management in spaces that have experienced rapid urban change and commercial exploitation in ways that have affected historic port infrastructure and human well-being.





< Fig. 1 Jeddah Al Balad docks, Bab Al Bunt docks, 1930s (Source: Jeddah Historical District, 2022).

Introduction

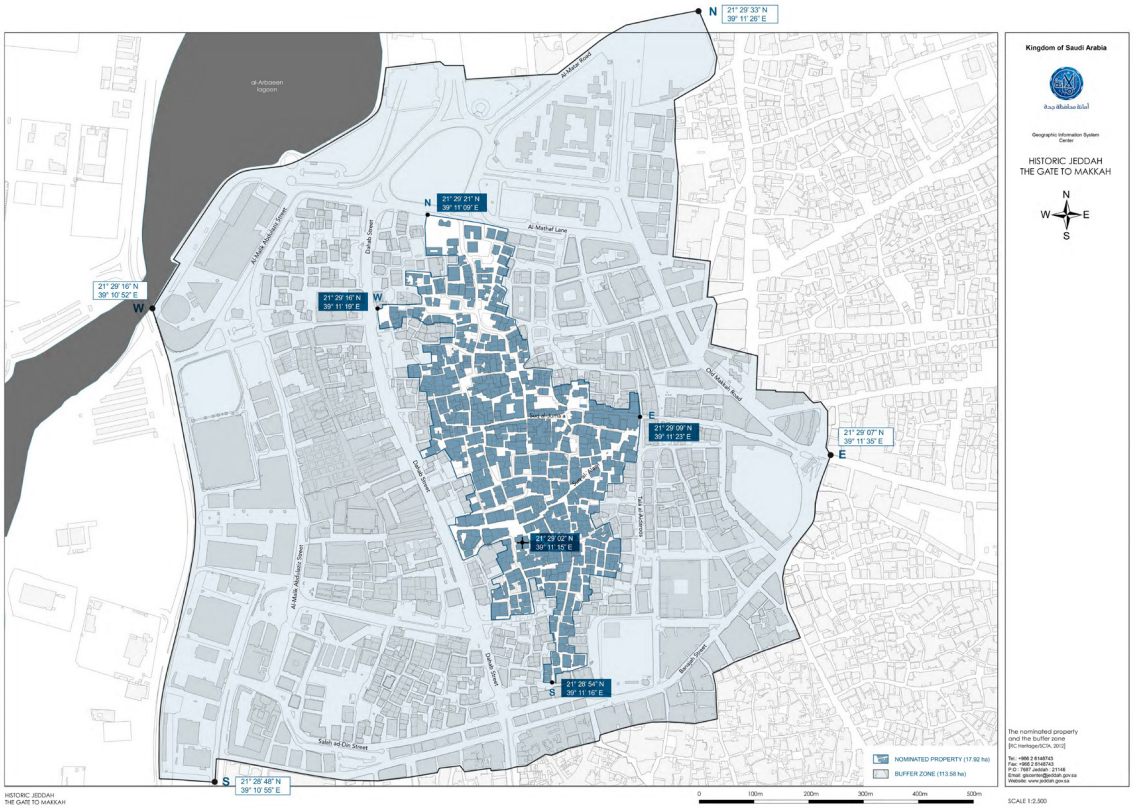
Port infrastructures such as docks, wharfs, piers, lagoons and harbors are a distinct form of built space, one where the urban environment is encapsulated by maritime history, economy and cultural identity (Hein, Luning and van de Laar 2021). This is especially the case for Jeddah, given its location between the two holiest cities in Islam, Mecca and Medina, making Jeddah the gate of entry for millions of Muslim pilgrims since its declaration as the "Gateway to Mecca" by the Muslim Caliphate Uthman bin Affan in 647 AD (UNESCO 2014). Its position on the eastern coast of the Red Sea, one of the world's oldest and most navigated waterways, has also made Jeddah an ancient coastal hub of mercantile trade and cultural interaction between East and West (Nyazi and Sağıroğlu 2018). This role has influenced the city's design and livelihood – from the Red Sea coral stone used to build the distinctive architecture, to the ties between Red Sea port activity and the region's market economy (UNESCO 2014; fig. 1). This led to the city's recognition by UNESCO as a World Heritage Site in 2014. However, the tumultuous growth of the Saudi oil industry in the 1970s brought massive and unprecedented change to the urban environments of the Saudi Kingdom, where the role of Jeddah as a port city ushered the commercial expansion of its port beyond the historical coastline through landfill. This distanced the old town from the sea, bringing structural damage and poor water sanitation to the district and the adjacent Al Arbaeen Lagoon in a way that has negatively impacted the lives of district residents.

Current Approaches and Challenges in the Preservation and Management of the Jeddah Historical District

Over 30 years after the city's expansion, the Saudi Vision 2030 seeks to revitalize heritage sites and grow tourism sectors (Vision 2030 2016). The Ministry of Culture (2018) and Jeddah Historic District (JHD), which were both established in 2018, plan to remove 600,000 cubic meters of Jeddah's landfill from the historic waterfront and lagoon of Al Balad, thus starting to revert the Al Balad coastline to its original historic state and reconnect it with the Red Sea. The master plan also includes the detoxification and restoration of the Al Arbaeen Lagoon, which remains a part of the Al Balad waterfront area (fig. 1). Concurrently, JHD has been leading the restoration and preservation of the Al Balad district, along with the zone and its buffer zone since its nomination as a heritage site. This includes 1 km^2 of the historic city core as existing urban fabric and over 450 heritage structures built in the traditional Red Sea architecture style, of which 60–70 had already been restored by JHD by 2022.

According to JHD's strategy, development and design officials, the project will be implemented in two distinct stages, utilizing multidisciplinary strategies from urban planning, water management and heritage assessment to achieve their goals of sustainable development. The first stage involves dredging 600,000 m^3 of landfill standing between Al Balad and the Red Sea. This area of land was added during the rapid urban growth of the city, at a time when the original port infrastructure had not been protected heritage space. This landfill area had never been used. The second stage will be to open up the Al Arbaeen Lagoon and seabed to water flow, which has been clogged due to being pushed further inland after the landfill, causing ad hoc sewage discharge and toxic buildup.

The priority is to minimize disruption to current residents of Al Balad during the restoration and regeneration; efforts to reduce traffic within the



^ Fig. 2 Map of the UNESCO Zone and Buffer Zone of Historic Jeddah, Al Balad (Source: UNESCO, 2014).

historic area are underway so that people who live and work in Al Balad continue to be able to do so. According to JHD, public engagement officials will maintain direct communication with residents throughout stages of development via "Quality of Life" outreach programs and by assessing resident needs for housing support during the construction and restoration of their homes and neighborhood.

To determine which areas of the historic coastline should be restored and rebuilt, the project team evaluated the cultural value of the site using heritagization assessment methods (Sjöholm 2016). Heritagization is the process in which objects, places and practices are labeled as cultural heritage with values affixed to them, and thus are meant to be treated accordingly. JHD identified the significant historic infrastructures to restore as heritage after employing local historians, heritage scholars, and community leaders to assess the coastline and city infrastructure. The new coastline will start at the base of the Al Bunt building, which was built in the late nineteenth century as a waterside dock for incoming pilgrims, traders and travelers entering Jeddah (fig. 1). This dock building still stands and will be restored and memorialized as the Red Sea Museum: a museum of the history of Red Sea navigation, religion, trade and marine life (fig. 3).

The museum is set to open in 2024 and will feature ethnographic and contemporary works of

^ Fig. 3 Bab Al Bunt, Jeddah Al Balad in 2023 (Source: Danna Albanyan, 2023, CC BY-NC-ND 4.0).

art, archival and scientific collections, as well as audiovisual accounts of the Red Sea, its ports and Jeddah. JHD has defined the museum as an anchor project to begin reconnecting Al Balad residents with the sea once more. Al Bunt was the beginning of the East-West route from the sea to the holy cities of Mecca and Medina, and re-establishing this dock infrastructure will reinforce significant historic roads and ancient networks, including the Spice Route and the Silk Road. These networks hold significant cultural and religious importance to the country, and according to JHD, mending these historic networks reveals the story and timeline of human settlements and can be an important driver for area revitalization.

Some of the major challenges identified by JHD officials are socio-economic in nature, such as creating incentives to revive Al Balad economically and ensure that it remains commercially active, thus increasing population density and making it self-supporting after years of urban sprawl and construction. This effort also includes preserving and promoting heritage spaces for tourism purposes, developing commercial and hospitality sectors, and creating jobs within the area for locals. Another challenge is reducing environmental deterioration in the neighborhood. Building sewage treatment plants and water irrigation networks is difficult within and around the historic core of Al Balad given the limitations of preserving Al Balad's

historic core. JHD will be looking for ways to minimize car traffic around the historic center while still enabling access to work. Current strategies include a permit system that discourages traffic and encourages peripheral parking away from the center and conducting local surveys and opening communication channels between stakeholders and residents.

Conclusion and Future Prospects

The Jeddah Al Balad waterfront and lagoon project provides an ideal testing ground to study not only the impact of rapid and unmitigated urbanization on historic port infrastructure, but also the initiated multidisciplinary mitigation measures to avoid further damage to local heritage infrastructure, water quality, the local economy and well-being. The solution to the challenge of regenerating a port district involves reconnecting old water networks and heritage infrastructures. After acknowledging the importance and embeddedness of port infrastructure in the Al Balad district, the JHD and Ministry of Culture plan to focus primarily on pursuing sustainable development and urban revitalization in line with UNESCO's SDGs by 2030. This will, of course, necessitate the continuation of current management efforts, collaboration among government agencies and effective cooperation with stakeholders and community members.

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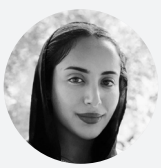

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