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

2022 (Vol. 1 No. 2)

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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 or 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.

For every article in Blue Papers, we assigned a number of relevant SDGs beside SDG6. Icons on the use and meaning of the types of water offer a further categorization. All case studies are categorized according to the Köppen-Geiger climate classification to indicate specific local challenges.

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

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

- Transcending the nature-culture divide
- Tangible and intangible aspects
- Integrated discourses and practices
- 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: As a mix technology contribution from the Portuguese, Dutch and British, the Mannar Fort has defended the ocean frontier for centuries for the European powers in Asia. It has also witnessed the devastating contemporary divisions and conflicts between Tamil and Singhalese people in Sri Lanka. The balance between the built heritage, water landscape, infrastructure, governance and various stakeholders would be the most challenging and yet crucial mission for the preservation of the fort (Source: Queenie Lin, 2019).

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Content

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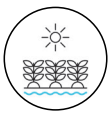
Capturing Water, Culture and Heritage through Icons: A First Attempt

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).

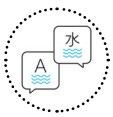
Place of Worship
Humans have created religious spaces for revering water and they may use water to express reverence for or connection with a spirit or deity. Structures such as churches and temples contain elements related to water, or can be part of the management of water resources.

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.

Water, Culture and Heritage Themes

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.

Leveraging the Past for Better Futures

Eddy Moors
IHE Delft Institute for Water Education

Water managers face many urgent challenges. Sea levels are rising, floods and droughts are increasing in frequency and intensity, while population growth and socio-economic transitions increase water demand.

These challenges cannot be resolved by technological innovation alone. To adapt to the changing requirements of water systems, we need to not only rethink institutions, laws and policies, but also to reflect on past cultures and the often-overlooked relationship between humans, water and ecosystems. We need to include the larger public and elevate their awareness of the value of water, spark more interest and foster engagement. Water challenges are also socio-cultural challenges: they are anchored in local practices, cultures and traditions.

To tackle these complex challenges, we need a better understanding of the interconnections between water, cultures and societies, over time and through space. Researchers and practitioners from multiple disciplines and approaches need to forge a shared approach that connects technological innovation with historical, anthropological, political and economic aspects.

This new journal, *Blue Papers*, aims to contribute by bringing together different disciplinary approaches and stakeholders around the theme of water, culture and heritage. It will shine light on local adaptations and global visions. It will demonstrate the value of traditional knowledge and of the involvement of marginalized groups to develop sustainable management of water.

In this way, *Blue Papers* aspires to foster cross-disciplinary connections that will help the world tackle the urgent water challenges we as humanity face today.

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Preface

Editorial Issue 2/2022: The Heritage of Water-Related Infrastructures and Governance

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

Humans have shaped water in all its forms and functions over time; they have controlled water through infrastructures, institutions and legislations. Many of the decisions made have benefited individuals, communities and nations; but many have also created new forms of injustice, making water the epicenter of societal issues and conflict from time past. Upstream and downstream communities have long been in conflict about the amount of water shared, its cleanliness or its use. Providing drinking water to some can mean cutting off others; creating dams to generate energy or store water may prevent fish from migrating. Building dikes can protect some people and put others in harm's way.

Institutions can protect and guide the functioning of water systems through laws and regulations. Innovations in technology, economic setup or political structure can lead to transformations of infrastructures and to an imbalance with the institutional system. As infrastructures grow beyond institutional boundaries (including national boundaries), planning control is often lacking. Once established, infrastructures and institutions can also delay change. Watersheds, for example, are often controlled by multiple institutions and therefore are not holistically regulated. Large-scale systems, moreover, often take away the agency of local groups and their access to water. Climate change intensifies the challenges presented by historical path dependencies. With momentum building to achieve goals and targets by 2030, we must carefully assess governing laws, policies and institutions with an eye to their role in solving (or impeding) today's water-related problems.

The second issue of *Blue Papers* focuses on relationships between infrastructure, governance systems and regulations. Authors from diverse disciplines and geographical backgrounds explore the multiple ways in which legislation and water rights relate to traditional water systems and local water cultures. The challenges of water management are also reflected in those of heritage governance. In the heritage field, the themes of nature and culture are separated, making it difficult to address the fields of water and heritage comprehensively. Given the interdependencies and conflicting interests of different stakeholders involved, we need a shared vision, (re)connecting water and heritage sectors so human and non-human actors can contribute to a sustainable tomorrow.

Jacqueline Vel, Tody Sasmitha Jiwa Utama, Hertasning Ichlas and Adriaan Bedner open up part I with reflections on the ways in which past legislation threatens traditional water management systems, such as the rice terraces in Indonesia. Questions of water rights are also at the heart of Rutgerd Boelens' "Riverhood" project, in which he explores the disenfranchisement of local water

cultures and proposes new forms of justice in water management. Karim Nawaz argues for the recognition of spate irrigation as a sustainable irrigation system and for including it in educational programs. Maria Estefania Gioia exposes the institutional divide in World Heritage discourses to show the rift created by the division between natural and cultural heritage. Chris Underwood discusses the need for proper management of underwater cultural heritage. Frans Wijsen concludes part I by showing how religious institutions can hinder, but also help sustainable heritage and water management.

The methodologies and case studies in part II present tested and working examples. Sara Ahmed and Sukrit Sen propose heritage as leverage for better governance to water, through virtual exhibitions and education about water objects and practices. Ana Maria Fernandez Maldonado, Marcin Dąbrowski, Kasia Piskorek and Wout van den Toorn Vrijthoff similarly propose an ecosystem approach, especially as a tool to create common ground and start multi-stakeholder negotiation and planning. Historical water systems can still be relevant, as illustrated by Catalina Rey-Hernández and Inge Bobbink in their article on the floating agriculture of the Chinampas in Mexico. Similarly, Said Madani provides insights into the contemporary relevance of ancient irrigation systems – and their connected governance structures – in the Algerian desert. The case studies of Maria Estefania Gioia, Gül Aktürk and Sara Berahman make clear how natural phenomena are interconnected with cultural objects and practices and they argue for improved governance tools to be able to protect and preserve vulnerable water heritage. Jonathan Doe's account complements this line of thinking with a case in which local "knowledge holders" were sidelined in wetland management. Javier Lizarzaburu similarly presents an ancient traditional water system, decolonizing narratives that obscured the indigenous role in its creation. Nanco Dolman closes this issue with another example of proper collaboration for new natural heritage.

Together, these articles demonstrate the need for a rethinking of "hidden designers": the legal and institutional frameworks in which water is managed. They call for bridging divides between nature and culture, and between "top down" and "bottom up" governance. It is crucial to be able to negotiate the sometimes contrasting values and interests in water management: to preserve and to develop, to build economically viable structures and to protect vulnerable water structures, and to make global decisions with local cultures and interests in mind. The new concepts and methods proposed in this issue help us connect past objects and structures to sustainable water futures.

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 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 of 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), have equipped for the 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 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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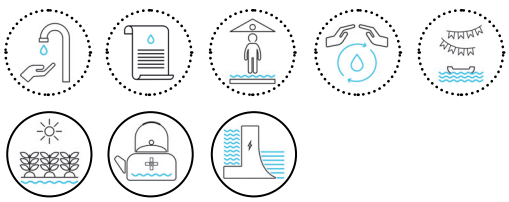
Law and Heritage for Protecting Water Resources and Access to Water in Indonesia

Jacqueline Vel, Tody Sasmitha Jiwa Utama, Hertasning Ichlas and Adriaan Bedner
Van Vollenhoven Institute, Leiden Law School, Leiden University

There are important legal dimensions to the relationship between water and heritage. This paper reports on the challenges Indonesia is facing concerning water management. Age-old customary water governance systems exist in parts of the country and continue to influence local decision making and water use practices. However, such heritage institutions can no longer safeguard local community water rights nor protect the environment. Since the 1990s, business power has been gradually overstepping customary socio-legal arrangements with negative effects on both the local population and water supply. Policy recommendations issued by the World Bank in 2004 supported opening paths to privatization. At present, national legislation and corporate interests have taken control of water management. Simultaneously, water heritage sites have been transformed into tourist attractions. Also, plantation companies promote land heritage issues when that serves their divide-and-rule strategies and turns public attention away from their water grabbing. A change in state legislation is needed that prioritizes the public instead of capitalist business interests regarding water supply and preservation. The lessons from heritage systems are very relevant to bringing about that change.

KEY THEMES



< Fig. 1 Groundwater from deep wells will turn this dry plain into a sugar plantation, East Sumba (Source: Jacqueline Vel, 2017).

Law and Heritage

What is the origin of the rules and laws by which water is regulated? As a local natural resource, emerging from springs and wells and flowing through rivers, water and its use have traditionally been regulated by local societies. What the boundaries of such "local" societies are depends. They have been shaped by mountain ridges, watersheds, and island contours, but also by social and cultural characteristics of kinship and language. From a socio-legal perspective, heritage in the field of water management consists of local customary law, which belongs to a community and defines the territory to which it applies.

In areas where water was never a problem, customary rules about water use and division are usually limited. Scarcity and competing uses turn water into a limited resource and create the need for more elaborate governance mechanisms to distribute water and guarantee access. Moreover, water often flows from one local society's territory to another's, which creates the need for a supra-local legal system of rules and institutions to address water problems such as droughts, floods and pollution. Presently, the state legal system is by far the most prominent one, but how it works in practice can vary. Local variation in how state law is implemented can be the result of decentralization, for instance where it concerns the autonomy of provincial or district governments in regulating water use. Additionally, the local legal water regime can also include customary law and its implementing institutions, particularly when formally recognized by the state.

If we want to learn from water institutions of the past, we need a regional and culturally specific analysis of water use and management that overcomes the limitations of economic and technical thinking about water systems and water management (Mosse 2008, 940). Such an analysis focuses on initial problems with water, the socio-cultural practices associated with that particular water system, the political structure of the society involved, the shape and power of local water management institutions, and the effect of water management on various social groups. The results of the research will indicate whether and why the institutions and their rules provide effective solutions to local problems, but they will also indicate their downsides or limitations, for example, how water politics can increase societal inequalities by excluding part of the population from the benefits of water infrastructures (Fontein 2014; Ley 2022).

The Subak in Bali: A World Heritage Case of Communal Water Management

A famous case of heritage in water management is from the island of Bali in Indonesia. This case is one where autonomy has been granted to local traditional institutions. According to UNESCO:

> The cultural landscape of Bali consists of five rice terraces and their water temples cover 19,500 ha. The temples are the focus of a cooperative water management system of canals and weirs, known as subak, that dates to the 9th century. […]. The subak reflects the philosophical concept of Tri Hita Karana, which brings together the realms of the spirit, the human world and nature. This philosophy was born of the cultural exchange between Bali and India over the past 2,000 years and has shaped the landscape of Bali. The subak system of democratic and egalitarian farming practices has enabled the Balinese to become the most prolific rice growers in the archi-

> pelago despite the challenge of supporting a dense population. (UNESCO n.d.)

In this paragraph, UNESCO gives a rather romantic description of the *subak*, ignoring any downsides of the system, and internal and external threats. Despite its famous reputation, the *subak* is not able to counter present-day threats which do not just arise from increasing population density but are driven by economic policies.

Nowadays the *subak* is challenged by modern agricultural techniques and increasing mass tourism (Roth 2014). These forces of change have transformed water from a social and public resource into an economic good. In the 1970s, the Green Revolution as a national policy to modernize rice production had a profound impact on agricultural technologies, for example by promoting the use of (chemical) fertilizer and high-yielding rice varieties. Agricultural service departments of the national government became important institutions in guiding farmers' rice cultivation, focusing on agricultural inputs rather than water. This sharply contrasted with rice field irrigation in the *subak* system, which was a matter of relationships connected to water. The Balinese water temples were crucial to the operation of water systems, expressing water governance in ritual form (Lansing 1991; Mosse 2008, 942). Traditionally, every *subak* group has its own temple. In each phase of land cultivation, from sowing and planting to water distribution and harvesting, the *subak* members perform ceremonies at their temple by which they recall the community's norms regarding land and water management. Therefore, the temple ceremonies function as an effective means to ensure member compliance with the group norms, including water protection and distribution. If new stakeholders do not acknowledge the authority of the temples as grounded in Balinese Hindu culture, the basis of the temples' power in water management vanishes.

Since the 1980s with the development of mass tourism on Bali, the clash between economic-driven policy objectives and socio-cultural water management has become acute (Benge and Neef 2018). The *subak* cultural landscape has been directly affected by the conversion of agricultural land for building hotels and tourism infrastructure. With increasing numbers of tourists visiting the island, water use in hotels competes for the available water resources on the island – the tourism industry consumes approximately two-thirds of Bali's water resources (Cole 2012). The average tourist uses 20 times more water than the average Balinese rural household. Meanwhile, more than 60 per cent of Bali's catchments are drying up, and saltwater is entering the island's aquifers.[1] At the same time, the rice terrace landscape itself – regardless of its use for food production – has become a tourist destination. The *subak* and its landscape are now an object of the tourist imagination, while powerful stakeholders in the tourism industry are co-opting water management (Benge and Neef 2018, 42). The mechanism for such co-optation works through the legal permits that tourism project developers need when they plan to buy land and build hotels and swimming pools. The regional government institutions authorized to grant the permits are willing to do so when the applications serve their economic interests (Lund 2020; Li and Semedi 2021). At the grassroots level, the local landowners who sell their residential land and rice fields transform themselves into tourism industry loyalists. In such cases, the *subak*

1. https://www.nowbali.co.id/saving-waters-tackling-balis-water-crisis/

^ Fig. 2 Balinese rice fields turned into a landscape for tourist consumption, Bali (Source: Jacqueline Vel, 2022).

loses members and territory. Consequently, the local traditional form of water regulation has been replaced to a large extent by national regulations and therefore has been relegated to second place.

National Water Governance in Indonesia

The developments in Bali show what happens when water becomes the object of competition, and when the stakeholders are no longer just members of local society but include powerful companies from outside the area. Customary law and traditional institutions lose their power to prevent land transfer and conversion, and therefore are slowly discharged from the water governance. The step from local customary water management to regulation based on the national legal system in Indonesia is huge. With the relevant legal permits and some local support in hand, companies are allowed to pump and use water, and can even obtain government assistance in protecting their rights as included in the permits and licenses in the event that neighboring communities protest against their excessive water use.

Indonesia is one nation, but it has many islands and cultures, and a wide variety of water situations. It has one national legal system, in which several aspects of water governance have been decentralized to regional or local governments. National state law concerning water mainly aims at enabling industry, with some protection of water resources in environmental legislation and human rights law. Such fragmentation of legislation also implies that many government institutions are involved in water governance, each of them with only a limited and partial authority (D'Hondt 2019).

Water management is highly politicized, as evidenced by the legal battle in Indonesian water

law between public and privatization. In 2004 a new pro-privatization Water Law was enacted under pressure of the World Bank's Water Resources Sector Adjustment Loan (WATSAL) program. That law was challenged six times by the public before being completely overturned by the Constitutional Court, leaving water management under the previous, outdated 1974 law. Surprisingly, the 2019 Water Law is essentially identical to the one from 2004, giving corporations considerable power to privatize the water business. That privatization process is carried on in the Employment Creation (Omnibus) Law (11/2020) that revised all existing natural resource laws.

Compared to the political attention devoted to land conflicts, water as a natural resource and public good has remained in the shadow of public attention. However, the problems are huge. The current challenges to the water situation in Indonesia listed by the US Agency for International Development (USAID) in its "Indonesia Water Resources Profile Overview" (2021) can be related to four types of causes: (a) the expansion of capitalist industry, (b) climate change, (c) uncontrolled citizen behavior, and (d) poor water governance by the Indonesian government. The problems include:

- Water pollution of surface water
- Little to no control of water use by extractive industry
- Excessive extraction of groundwater in cities and for plantations
- Salination of water in coastal areas due to groundwater extraction
- Subsidence of cities due to the over-exploitation of aquifers, threatening infrastructure and livelihoods, and worsening flood risks
- Excessive rain and floods as well as prolonged droughts
- Poor protection of water resources as public goods
- Poor protection of the rights of citizens to access sufficient and clean water.

State law is key to addressing these challenges, but it can do so only when all stakeholders, including local society members, accept the norms and rules applied to their case. When the regulating capacity of customary law has reached its limits in addressing the above challenges, the state through national law has to take on the role of water protection, or it needs to enable local populations to adapt their customary management systems to this end and provide them with the tools of national law to do so. However, when state institutions obtain the power for regulating water, there is a danger of co-optation, as demonstrated in the following case.

Sugar Plantation on Ancestral Lands in Sumba: A Second Case of Co-Opted Corporate Water Management

An example where several of the problems mentioned above converge is the case of a sugar plantation in Sumba, a sparsely populated island east of Bali, which has a relatively dry climate and a savanna landscape. Until the end of the twentieth century, agricultural land, forest and water were not yet scarce resources and labor was the limiting factor in the local economy (Vel 1994). Consequently, local customary law concentrated on rules that regulate social relations and obligations of Sumbanese people based on their specific position within their clan (gender, class, generation). Customary water law was limited to the protection of springs. In areas with government-built village irrigation systems, the users could manage water distribution and resolve related problems through

their own village institutions, as if applying new style customary law. However, that local capacity cannot cope with extractive industries entering the island.

In 2014, a subsidiary of a large Indonesian business conglomerate obtained a permit from the district government to explore the suitability of around 50,000 hectares for the cultivation of sugarcane (Vel and Makambombu 2019). When villagers downstream of the plantation's enclosed area voiced their concern about a reduction of their irrigation water, the company assured that its operations would not cause any harm. This would be guaranteed legally, because the company needed an environmental permit before being allowed to start its operations. The key step in the legal process to obtain this permit is the environmental impact assessment, which includes projections of effects of operations on surface and groundwater, on quantities as well as dangers of pollution. The assessment, which appeared in 2018, indicated considerable negative effects, but nevertheless the district government used its discretionary power to grant the environmental permit anyway.

This case does not stand on its own: local government officials and local communities can seldom resist corporate power (Lund 2020; Li and Semedi 2021). Gradually, the local community's protests shifted focus from water concerns to claims on the land cultivated by the company. These customary land claims could result in compensation payments from the company, whereas complaints about water issues were not sufficiently visible yet, and legally and politically weak. The company welcomed the turn to local land heritage discussions, which served their divide-and-rule strategies, and turned public attention away from their water grabbing.

Prospects for Water Protection in Indonesia

Despite the huge water-related problems Indonesia faces, the Indonesian government has done little to strengthen legal protection of water resources and citizens' access to sufficient and clean water. Even worse, the latest legal developments further facilitate extractive industry. The Omnibus Law has shortened the procedure for companies to obtain legal licenses for exploitation, while re-centralizing crucial decisions about water resources implies greater control over the licenses by the central government. That takes water management decisions further away from the societies in which water use, distribution and management takes place. The Omnibus Law views water primarily as the object of a license for production on an industrial scale, not as a public good or the object of a citizen's right.

In short, prospects for water protection in Indonesia are bleak. The predictions that Jakarta will sink below sea level within the next 10 years, that there will be an absolute water shortage on Java by 2040 and that the Citarum River will remain the world's most polluted river do not seem to bother most policy makers and lawmakers. Some of the alarming water problems are ignored by moving the industry on to not yet depleted and polluted parts of the country like Sumba. Without counter pressure, large-scale industries and plantations will continue taking over water governance with the single aim of profit for the capital owners. The path to solutions will require respect for and cooperation with customary water governance institutions to create sustainable and locally adjusted water management. To achieve that and to counter the power of extractive industry, changes in the national legal system are needed, with laws and regulations that will restore the balance between public and private interest

in the direction of better protection of water as a public good with access for citizens. Lessons from heritage systems are very relevant for shaping that change.

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"Riverhood" and the Politics of (Mis)Recognizing Local Water Cultures and Water Rights Systems

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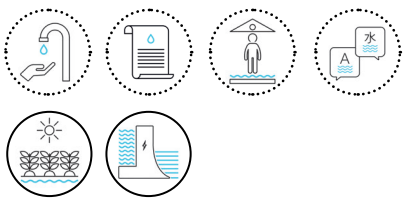
*An appreciation of the diversity of world water cultures – past and present – is essential to recognizing the conflicts and solutions that exist within water management. This article analyzes the intricacies of water governance and politics. It argues for new ways to recognize and negotiate the value of local water cultures, and proposes the term "Riverhood" as a way to understand the political, technological and cultural arenas in which water rights and governance frameworks are being shaped in grassroots movements' everyday practice, in interaction with rivers' adjacent social and ecological communities (*www.movingrivers.org*).*

KEY THEMES



< Fig. 1 Model of the Three Gorges Dam and the Xiling Bridge over the Yangtze River in China. The dam was finished in 2006 (Source: Sharon Nardo, *CC BY 2.0*, via Wikimedia Commons).

Introduction

It is a classic, age-old desire: to engineer utopias through the conquest of nature, especially by domesticating rivers and bringing order to "wild water." Sumerian, Egyptian, Roman and Incan societies all made utopian efforts to transform and control humans and nature at once, through water. In the Andean countries, not only Spanish colonizers, modernist engineers and water bureaucrats, but also indigenous empires and Inca rulers used similar tactics to subordinate local water cultures and collectives.

In present-day water management, customary uses tend to be brushed aside and water demands for mining, hydrocarbon, agro-export and hydropower often get priority. These demands entail territorial transformations, sometimes polluting or drying out downstream regions. This "mega-hydraulic regime" builds on a normative discourse but tends to involve a deep neglect of existing diverse water cultures, overlooking territorial meanings, values, identities and rights systems. Examples of these regimes are large dam schemes, such as Franco's "hydraulic policy" implementation in Spain and, more recently, China's Three Gorges Dam, Brazil's Belo Monte Dam and India's Sardar Sarovar Dam.

After decades of scientific approaches exalting the engineering of nature to maximize water control through river damming, the last two decades have witnessed various new water management paradigms. Approaches such as Integrated Water Resources Management (IWRM) advocate participation and multistakeholder platforms to curb the technocratic engineering tradition.

In fact, however, many of these recent approaches still restrict and deny complex water realities. Governments and political-economic elites, while claiming to respect and recognize local and indigenous water cultures and heritage, commonly deploy subtle cultural politics (the way in which dominant cultural norms, attitudes and beliefs inform political decisions and relationships; see Boelens 2015). They differentiate between two kinds of local water cultures. On the one hand, they identify "good governance water cultures" with "good practices" (meaning those that are compatible with dominant water knowledge and society), which should be "recognized." And on the other hand, they tend to critique the "wasteful, inefficient water cultures" (which they think should be "cured" and "educated," preferably not by force but by "participation"). Our universities' water engineering and governance disciplines have contributed to this problem. Simply said: "disciplines discipline."
Also common to find is that governments and elite bodies in many countries tend to glorify the ancient ("petrified") indigenous water traditions, religions and empires. These do not threaten their present-day hegemony and are unable to challenge their unsustainable water interventions and unfair allocation practices, but rather provide them with national pride and identity. At the same time, however, they oppress the existence of contemporary, actual "living" water cultures of peasant and indigenous societies: because these are "unruly," "stubborn" and do not fit "rational" water norms or follow "efficient" (inter)national legislation. Latin American author Cecilia Méndez (2000) critically framed such elite governors' cultural politics as "Incas yes, indigenous no."

Scientific approaches (market-environmentalism, rational choice paradigms, etc.) that prominently feed the new mainstream ("inclusive") water governance approaches (such as IWRM), equally tend to misunderstand the complexities, contingencies and power-laden interactions

^ Fig. 2 Prime Minister Narendra Modi of India inaugurated the Sardar Sarovar Dam in Gujarat on 17 September 2017. Behind him is India's Minister for Transport, Shri Nitin Gadkari. The construction of the dam began in 1987, but the project was stalled in 1995 over concerns of displacement (Source: Prime Minister's Office, GODL – India, via Wikimedia Commons).

among humans. Naturalization, technification and universalization make the experts' norms, definitions and values the equalizing metric. River basins come to be seen as "natural" water management units, and "rational" allocation, "functional" water rights, "efficient" water use, and "optimal participation" become universalized standards. In water debates, these technocratic arguments are presented as objective, neutral or even "natural." They have become so dominant that they are accepted as normal or inevitable, making it difficult to recognize them as biased representations of good water management.

Grassroots movements, activists and academics have criticized the multiple ways in which mega-hydraulic developments have generated environmental damage and human suffering. Locally existing "living" water cultures do not remain silent but respond. Far beyond any romanticization, now and in the past, they have combined their struggles against cultural discrimination, unequal water distribution and political exclusion, building on ecological integrity to sustain their waterscapes or "hydrosocial territories."

To build a water facility is to establish rights and mutual relationships among families, the collective, the infrastructure and nature. These relationships become the fundamental basis for collective action in water management tasks (Vos et al. 2020). In many places, these rights that are created by building hydraulic artifacts drive the formation of local water culture and identity, water rights defense, and the relationships among local user collectives, river ecologies, and previous or ancestral interactions with

^ Fig. 3 KATRIBU National holds an anti-dam protest in the Philippines (Source: International Rivers, CC BY-NC 2.0, via Flickr).

water and nature – since human-river "investments" can also be inherited and in many places are ritualized. User-developed water works such as community-led irrigation systems, shared wetlands control and inter-community stream diversions, therefore follow a process of coproduction among humans, technology and nature (Hommes et al. 2022), creating and consolidating mutually established "water rights."

The Water Resources Management group at Wageningen University, together with CEDLA-University of Amsterdam, the Water Justice alliance, and many partners in the global North and South, build on these notions. We have started a cross-continental program (www.movingrivers.org) to study and support the large variety of what we call "New Water Justice Movements" (NWJMs). These are rooted, transdisciplinary, practice-based, multi-actor and multi-scalar coalitions. They deploy a variety of institutional and political strategies, new languages of valuation, vernacular water rights frameworks and pro-active "commoning practices," to claim environmental justice, restore or defend "living rivers," and enhance nature-entwined water governance and "pluriversal water cultures" (Boelens et al. 2022). Alternative practices include dam removal, allocating flows to nature, the interlacing of small weirs, river-livelihoods, nature-inclusive hydraulics and recognition of nature's rights.

To conceptualize the program, I revived a mid-nineteenth century forgotten word: "riverhood" – "the state of being a river" (Oxford Dictionary 2019). The program focuses on how humans and nonhumans co-produce riverhoods, and on the role of NWJMs. First, the program considers how NWJMs challenge the prevailing

water governance paradigms. Second, it addresses how they provide grounded solutions to contemporary water crises and innovative perspectives to "reviving the river": as a socio-natural being and as an entwined ecological, cultural and political subject.

Fundamental to understanding these movements is to understand how communities form networks with nature and mutually produce their environment (Shah et al. 2019). Social actors inscribe their life worlds in particular environments following ideologies, epistemologies and power structures, generating environmental knowledge systems, so developing territory and riverhood. With grassroots networks, engaged academics, activists, and policymakers can critically support this in so-called "river co-learning arenas" (Souza et al. 2023). The objective is not to "glorify the local" or "the indigenous," because these may include their own class, ethnic and gender inequalities and injustices. Rather, it contests modernist water legislations and policies that tend to transform local water rights frameworks and water cultures even before local arrangements are known.

Water flows through landscapes and cities, connecting places and spaces to each other, enabling environments for living and production. Water animates cultures and entwines ecology and society in particular ways. The movement of water co-creates social, material and symbolic linkages, lived spaces and boundaries. Water itself produces hydrosocial territories and riverhood.

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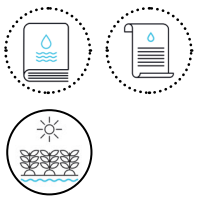
"Catch the Flood Before it Catches You": Spate Irrigation in Arid Regions of Pakistan

Karim Nawaz
MetaMeta

Floods wreak chaos and destruction in many places, but for people in arid regions using spate irrigation, the floods that emerge from ephemeral rivers symbolize life, livelihood and prosperity. Communities pray for floods as they are the only source of water. Pakistan has the largest amount of land under spate irrigation in the world. Spate irrigation is a unique 1000-year-old system. Yet despite its many environmental, social, cultural, managerial and economic benefits, it is not widely known among academics, researchers or practitioners. The practice is based on indigenous knowledge learned from elders and passed down from one generation to the next, with enthusiasm and interest, as part of culture and heritage. This article explores the innovative aspects of this system, which is crucial as a sustainable means of livelihood. It explains how the system lets people effectively manage the spate flows, protecting them against the havoc caused by floods, and allowing land to be developed to meet the needs of future populations.

KEY THEMES



< Fig. 1 Field-to-field irrigation in Pakistan (Source: Karim Nawaz).

Introduction

Spate irrigation is a unique system of water management used in arid regions. Its historical traces are found some 4000 years ago in the Arab Peninsula, where Queen Shiba's spate irrigation structure, known as Marib Dam, still exists in present-day Yemen (Frank et al. 2010). This system prevails in all four provinces of Pakistan. Although there are many different languages in Pakistan, spate irrigation is referred to as "naeen" everywhere. The famous spate streams and ephemeral rivers are Naeen Gaajin in the province of Sindh, Sanghar Naeen in the province of Punjab, Loni Naeen in the province or Khyber Pakhtunkhwa and Narri Naeen in the province of Balochistan. Pakistan has about 8.9 per cent of its total irrigated area (1.4 million ha) under spate irrigation system, the largest amount in the world (fig. 2).

Historic Water Management

Each ephemeral river or stream, despite its size, has its own unique water rights and management practices, which are well documented in the governmental land record of 1872. Floodwater (spate) is used for agriculture, rangelands, forestry, livestock, drinking, and recharging groundwater, making its economic importance vital in harsh climate conditions, thus in accord with SDG 13. Spate agriculture is purely organic in nature and meets local needs; its products are also used in commercial sectors.

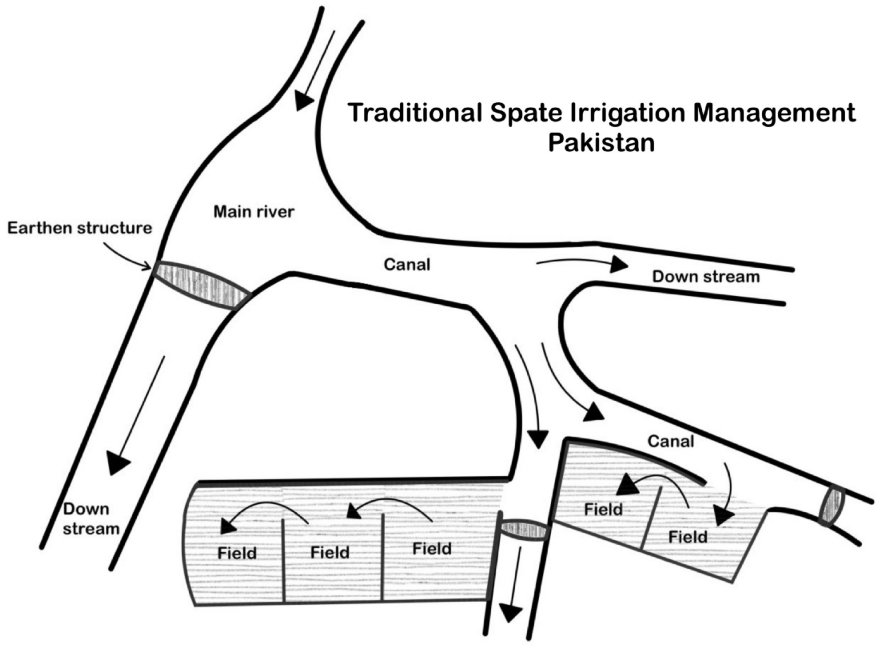
The spate irrigation system provides a unique case of social and cultural dynamics in dealing with climate change and variation. Two extreme ends of the spectrum are drought and extraordinary floods. With spate irrigation, the shocks of both extremes, drought and flood, are absorbed using socio-cultural strategies. Flash floods are used to produce specific crops and surplus floodwater is spread over wasteland used as common pasture equally by local people and nomads. Fields are farmed jointly by owners and others whose land did not receive floods, and nomads also work as field laborers. These socio-economic and cultural arrangements

Spate Irrigation - globally

Country	*Year of Irrigation*	*Total Irrigated Area (ha)*	*Spate Irrigated Area (ha)*	*Spate Irrigated as % of Total Irrigation*
Algeria	1992	555,500	110,00	19.8
Eritrea	1993	28,124	15,630	55.6
Libya	1987/1997	470,000	53,000	11.3
Morocco	1989	1,258,200	165,000	13.1
Pakistan	1990	15,729,448	1,402,448	8.9
Solamia	1984	200,000	150,000	75.0
Sudan	1997/1987	1,946,00	280,000	14.4
Tunisia	1991	385,000	30,000	7.8
Yemen	1987/1997	485,000	193,000	39.8

^ Fig. 2 Table showing spate irrigation in global perspective (Source: FAO Aquastat; Hadera 2001; Kohler 1999).

^ Fig. 3 Earthen diversion structure at Bhaati Spate River, DG Khan, Pakistan. The site is more than 250 years old (Source: Karim Nawaz, 2006).



^ Fig. 4 Traditional spate irrigation management, Pakistan (Source: Karim Nawaz, 2022).

help to keep the population residing in the area, with emigration as the last resort.

Current Approaches

In Pakistan, some of the ephemeral rivers discharge 100,000 cusecs of water and can irrigate more than 200,000 acres; such robust targets can only be achieved through effective social organization and partnerships, as in SDG 17. Floods of ephemeral rivers are diverted by constructing a temporary structure across the river and flow is conveyed to fields by a network of canals (fig. 4). A flash flood lasts a few hours to a few days only and users manage the water within this extremely short duration. Financial contributions from shareholders of the water for the construction of new diversion structures is determined according to their respective allocated shares in the water and the size of a landholding. During spate flow diversion and application, a community guard (Raakha) continuously patrols and monitors sensitive sites, so that floodwater is distributed properly. These local water user associations of spate irrigation are cost-effective, easily approached by members of the community, and socially accountable as there is neither governmental involvement nor remuneration involved. Older generation farmers encourage the youth saying, "Don't be afraid of flood, catch it before it catches you."

Spate irrigation works with gravity so no energy is required, making it an affordable clean energy technique (SDG 7). The water distribution system has evolved over centuries to cope with local conditions such as culture, communal relationship with heritage, and environment. Deeply rooted socio-cultural values contribute to ensuring the equity and efficiency

of this system in an "unkind" environment. The unique system of water rights and associated socio-cultural background are points of pride narrated to young children in village assemblies and storytelling events. Over time, farmers have learned to adjust their growing seasons by applying different types of seeds according to the time of year that floods occur and their relative size. Spate irrigation is an excellent version of climate change adaptation and farmers elsewhere need to learn from this local model.

For centuries, local populations in Pakistan had certain rituals and customs pertaining to this system. Rituals related to rain take place in many cultures but here the rituals are intended to make floods (spate) occur. When floods are late, a donkey is kept under the sun for a longer time during the day than usual; people believe that the animal's prayers will bring rain and floods. In another ritual, a person of religious background is brought to a dry riverbed and bathed in order to receive floods (Personal communication, 2006). Children color their faces black and go around the village, singing for rain and floods to come and collecting grains and chickpeas to prepare a dish which is fed to both villagers and birds. It is believed that the birds' prayers and requests will cause the rain and floods to come. People say special prayers for rain called "Salat e Estisqa."

Challenges

Unfortunately, floods retain connotations of negativity in many circles. There is also a lack of human resources, expertise and experience in dealing with floods as an opportunity. Heavy earth-moving machinery may not be available in time to exploit floods effectively. Currently, the response from the government of Pakistan to floods is to focus on rehabilitation rather than prevention. Yet, these floods are "life" for millions of inhabitants living in these harsh climatic conditions. Spate irrigation systems lack institutional support from the government, donors and international agencies. Local communities see floods as an opportunity while the government sees them as a disaster. Consequently, both respond differently. The government's strategy is to save the infrastructure by allowing floods to flow downstream and join major water bodies, while local communities want to mine the floods for numerous benefits. Recently, the government has started to store spate flows through the construction of dams. This has resulted in violating the rights of downstream users and, moreover, the heavy loads of sediment coming through the spate flow are filling the storage reservoir quickly and most of the modern designs have failed to work adequately.

The spate irrigation system is increasingly affected by climate change. Record-breaking rains and floods are beyond the capacity of the local population to cope. In addition to climate change, additional factors affecting the survival of this traditional irrigation system include population pressure and a lack of support from the government and international agencies. Also, traditional irrigation systems are not part of educational curricula so relevant professionals have not learned about this environmentally friendly and low cost system.

Way Forward

In the devastating floods in Pakistan in the year 2022 half the affected areas were dealing with water from spate rivers and the other half from the inundation of perennial rivers. Perennial rivers in Pakistan are mostly fed by melting glaciers, and their discharge is steadily declining. In such situations, spate irrigation systems

^ Fig. 5 Field-to-field irrigation in Pakistan (Source: Karim Nawaz, 2006).

can play an important role in food security and climate change adaptation. Spate irrigation has inbuilt disaster risk reduction and resilient approaches to disasters (floods) in ways that encourage sustainable human settlements (SDG 11). Spate flows need not be blocked in reservoirs: instead, they should be allowed to flow downstream to allow downstream users to benefit and to avoid the problem of siltation in reservoirs. Rather than storing flood water in reservoirs, we should make use of flood diversion strategies that have been practiced for centuries and that are based on the experience of farmers, in line with SDG 17.

After the floods of 2022, when one-third of the country was badly affected, an innovative strategy was recommended by Flood-Based Livelihoods Network (FBLN, based in the Netherlands) to capture the moisture created by floods before it is too late. Government and donor agencies welcome this approach and as a result, an immediate response was proposed to supply seed and sowing machinery to farmers. This resulted in one of the best examples in contemporary history of a considerable area used for crop cultivation in the wake of a flood.

It is important to involve local people and water user associations in further developing the system. Also helpful will be researching and developing drought resistant varieties of crops and finding ways of avoiding and minimizing the shock of dry years through off-farm activities.

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World Heritage Discourses and the Potential of Conceptualizing Water

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Conceptualizing water and heritage together is a key challenge. Only in recent years has heritage management started to embrace sustainable development in the context of heritage preservation. The UNESCO Historic Urban Landscape (HUL) approach and policy recommendations for sustainable development integration exemplify this recent development. This contribution examines World Heritage discourses through the lenses of water and heritage as a system. It specifically explores the relation between World Heritage management and water management of World Heritage sites. In doing so, it aims to reinforce the role of water and water management in the World Heritage framework, both in terms of theory and process. It concludes with a call for a stronger acknowledgment of water management as part of good practices for World Heritage sites and their management.

KEY THEMES

< Fig.1 Ponte di barche - Torre d'Oglio - view from Cesole, Italy (Source: G. Geleotti, CC BY 4.0 International).

Introduction

In the last 15 years, new approaches have emerged in the field of World Heritage management that aim to integrate the World Heritage conservation framework with economic, environmental and socially grounded approaches and actions. This is a key change in discourse and practice aimed toward more comprehensive World Heritage management.

The 2011 UNESCO Recommendation on the Historic Urban Landscape (UNESCO 2011) notably aims at managing change at World Heritage Sites and preserving their Outstanding Universal Values (OUV), while contributing to sustainable development and promoting social awareness of the role of heritage for local communities. Moreover, new UNESCO policy documents are promoting the integration of sustainable development into the processes of the World Heritage Convention (UNESCO 2015). Open-source online platforms such as the UNESCO World Heritage Canopy present good practices and promote the role of World Heritage as a tool for sustainable development and monitoring systems such as the UN Sustainable Development Goals (SDGs). These platforms include innovative processes, projects and tools aimed at bridging the gap between World Heritage management and sustainable practices, between theory and practice of World Heritage management and sustainable development. Yet, when considering the crucial role of water in sustainable development, these platforms struggle to address the transversal role of water for World Heritage sites and to include nature-culture relationships.

When exploring the opportunities and challenges of conceptualizing water and World Heritage together, it is necessary to first understand how World Heritage sites interact with water systems and how water is taken into account when dealing with World Heritage discourses. Water can be at the core of a World Heritage site even if water is not directly mentioned in the statement of Outstanding Universal Value. In this regard, it is necessary to understand the systems and practices related to water and their relationships with World Heritage, such as agriculture, irrigation, gardening and defense as well as the environmental landscape characteristics such features as rivers, coastlines and deltas.In addition, inquiring about historic water systems may be key to understanding current landscape characteristics and hidden historical traces, or comprehending how former forms of water management are attached to the local context and to local communities. Such an approach allows water to emerge as a shared theme for World Heritage. Secondly, it is crucial to critically reflect on how water is acknowledged on the World Heritage List, and by the practices dealing with World Heritage, such as the ones considered as good practices connecting World Heritage management and sustainability. Taking into account water allows further inclusion of SDGs in the discussion of the role of World Heritage for sustainable development, especially when considering issues such as water for consumption, climate change and rising water levels. Finally, bringing water into the discussion on World Heritage management invites additional management challenges as water systems reach beyond the limits of World Heritage sites and require multi-scalar planning.

Issues Preventing Water And World Heritage from Being Conceptualized Together

Heritage, and the "Culture"–"Nature" Divide

A first challenge toward conceptualizing water and World Heritage together is the culture-na-

ture divide. As critical heritage studies researcher Harrison (2015) observes, the division between culture and natural heritage is at the base of developing a systemic thought that provides a "new notion of heritage after nature/culture" (2015, 33) and broadens the role of heritage in twenty-first century challenges. In this regard, World Heritage as a framework is known for its separate institutional frameworks of "Culture" and "Nature." World Heritage categories, discourses and procedures follow this division. Overcoming such considerations relates directly to how water is framed as an ecological concept and heritage as pertaining to what is of human manufacture. By framing water and heritage relationships as a system, it is possible to bridge the "culture" and "nature" divide.

Silo Thinking, Zoning and Administrative Constraints

Understanding the ways in which silo thinking, procedures and administrative divisions affect the understanding and management of World Heritage can facilitate a re-conceptualization of water and heritage. This requires reconciling existing categorizations, procedures, institutional dynamics, zoning and administrative constraints that are both anchored in international practices unique to each policy and governance context. Using a transversal concept, such as water systems, can provide a connecting theme for diverse stakeholders. It can also provide a foundation for negotiations among diverse actors, disciplines, sectors and technical aspects each with their own water-related needs and interests, to eventually help World Heritage management and water management interactions beyond the institutional, administrative and nature-culture divide.

Plans and Concepts

The role of World Heritage is broadly overlooked by water management and policies beyond the protection and musealization of water infrastructures and/or transformation of water basins into protected areas. Moreover, the Operational Guidelines for the Implementation of the World Heritage Convention (UNESCO 2021) defines World Heritage management systems or plans as one of the main instruments for managing World Heritage. Yet, the lack of alignment between various local and regional policies and World Heritage management hinders more comprehensive World Heritage integration with sustainable development. In this regard, it is vital to conceptualize World Heritage management as a tool for fostering the integration of planning processes and better interactions between World Heritage and water management. This also requires better integration between water management plans and ecological studies in the development of World Heritage management plans, especially concerning cultural World Heritage properties. The integration of World Heritage management in local and regional policies and more inclusive decision making processes can be key for stronger connections between World Heritage management and the life of the local communities.

Institutions, Politics and Local Contexts

Exploring how and to what extent current water management is related to historic water systems and local communities' water narratives is crucial for understanding how water institutions, World Heritage management and local contexts interact and might interact more fruitfully. For instance, the ICOMOS Statement of Significance for Water as Cultural Heritage (2019) calls for connecting water to tangible and intangible aspects such as infrastructures, buildings and public spaces as places of practices, memories and stories of local communities.

^ Fig. 2 The water management system of Augsburg, Germany (Source: Z. Thomas, CC BY 4.0 International).

However, the processes of World Heritage inscriptions are anchored in institutional and governance frameworks defined by state parties. World Heritage is thus closely linked to national political agendas and to the particular context-based dynamics. At the 50th anniversary of the 1972 World Heritage Convention, we still needed to embrace World Heritage as a process influenced by social, environmental and economic dynamics, rather than mobilized by national power interests and international agendas. In this regard, considering the larger system of water, nature and culture as a system may set forth institutional and governance frameworks to integrate local contexts and local communities into World Heritage management.

Final Remarks

Approaching World Heritage from a comprehensive multi-scalar perspective through the lens of water may help overcome monumental World Heritage discourses and facilitate the implementation of landscape-based discourses and approaches such as HUL, as well as more ontological perceptions and nature-culture mindsets.

To conclude, inquiring into how water and heritage is conceptualized makes it possible to give World Heritage's role a new meaning for and in twenty-first century century challenges.

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Underwater Cultural Heritage: Out of Sight, Out of Mind and at Risk

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OUT OF SIGHT, OUT OF MIND. *Tangible and intangible cultural heritage assets located in coastal and near-shore underwater environments are under particular threat due to climate change and its impact on water. These threatened sites and practices have served historically to not only feed and employ large and small coastal communities, but importantly have provided the societal and cultural roots that have helped bond them together. Although it is acknowledged that water environments (in the context of this article "water" is taken to mean oceans, seas and inland waters) function as a major global food source (SDG 2 Zero Hunger), and play a major role as a carbon sink (SDG13 Climate Action), water is also a vehicle for commerce and many other ocean activities labeled "the Blue Economy," all of which are considered of critical importance. However, the societal consequences of damage and loss to underwater tangible and intangible heritage assets and associated practices should not be underestimated. Threatened by sea level rise, with seas estimated to rise by up to a meter by the end of the century, combined with extreme weather events (Gregory et al. 2022), it is anticipated that there will be significant loss of these assets with social and cultural consequences. In extreme circumstances, the very existence of some coastal communities and Small Island Developing States (SIDS) is also at risk. Therefore, how to value, protect and manage these often "unseen" underwater cultural heritage sites sustainably is of vital social and cultural importance.*

KEY THEMES

< Fig. 1 Coastal Protection Scheme – south coast of the United Kingdom (Source: Chris Underwood).

Introduction

For millennia water has been a major component in shaping human activity, notably through exploration, exploitation of economic commodities, transportation, commerce, recreation and conflict. Many of the tangible remains of these activities remain on the ocean floor, in seas and in inland waters. UNESCO estimates that there are three million shipwrecks, not all equally significant, combined with extensive submerged prehistoric and historic landscapes and coastal infrastructure such as harbors and structures representing community fishing traditions. Of equal importance is intangible heritage, reflected in memories, beliefs, and social and cultural values and practices, often linked to the tangible evidence mentioned above. The threat to community well-being (SDG 3 Good health and well-being) is in some cases high, although in many cases it is difficult to quantify. An example of loss and damage to both tangible and intangible cultural heritage with associated negative social consequences is a traditional coastal fishing practice that is widespread in Southeast Asia and other places. Sea level rise is particularly threatening the sustainable fishing practice used by small coastal communities that utilize fish weirs (fish traps). These weirs often have stone barriers/walls that rely on the daily tidal movement to allow fish to enter the weir during the incoming tide and trapping the fish as the water recedes.

An exemplary project "Indigenous People, Traditional Ecological Knowledge, and Climate Change: The Iconic Underwater Cultural Heritage of Stone Weirs,"[1] outlines the consequences. The project is acknowledged by the UN Department of Economic and Social Affairs: Sustainable Development as fulfilling a number of SDG 14 targets:

14.1 …reduce marine pollution…
14.2 sustainably manage and protect marine and coastal ecosystems…
14.7 increase the economic benefits to small island developing states (SIDS)…
14.a increase scientific knowledge, develop research capacity…transfer marine technology… improve ocean health…increase diversity….
14.b provide access for small scale artisanal fishers to marine resources by implementing law such as UNCLOS….
14.c enhance conservation and sustainable use of the oceans….

The potential consequences include the loss of locally caught fish that contribute to the health of the population by improving cognitive performance, strengthening the immune system, and decreasing child mortality. Ocean acidification and pollutant plastics will reduce biodiversity and threaten the harmonious interaction between humanity and ecosystems at a time when exactly the opposite should be the aim. As fish stocks decline, fisherpersons are forced to consider alternative, more modern fishing practices, resulting in the loss of local and indigenous knowledge, the very foundations of the practice.

1. See the UN Ocean Decade Programme: https://sdgs.un.org/partnerships/indigenous-people-traditional-ecological-knowledge-and-climate-change-iconic and "Stone Tidal Weirs, Underwater Cultural Heritage or Not?" by Akifumi Iwabuchi, Tokyo University of Marine Science and Technology in partnership with the University of Guam, Bill Jeffery, Mokpo National University, Yi Hye-Yeon, Chikushi Jogakuen University, Masahito Kamimura, University of the Philippines, Cynthia Neri Zayas, University of Warsaw, Madgalena Nowakowska, University of Dublin, Paul Montgomery, and Nelson Mandala University, Magda Minguzzi. http://www.themua.org/collections/files/original/1977ceab73ddba402c00d31fb77e7843.pdf (Accessed 24 November, 2022).

Current Approaches to Preserving and Managing Water Heritage

The predominant international legal instrument that impacts the management of and practice relating to heritage and culture in the ocean, seas and inland waters is the UNESCO Convention on the Protection of the Underwater Cultural Heritage (Paris 2001). Although it is not universally applicable, UNESCO's definition is useful:

> Underwater cultural heritage is defined as all traces of human existence of a cultural, historical or archaeological nature which, for at least 100 years, have been partially or totally immersed, periodically or permanently, under the oceans and in lakes and rivers. (UNESCO 2001)

To this can be added the ICOMOS Charter on the Protection and Management of the Underwater Cultural Heritage (Sofia 1996) that provided the founding principles of the 2001 Convention's Annex Rules. In addition, the European Convention on the Protection of the Archaeological Heritage (Valletta 1992), the Protection of Cultural Property in the Event of Armed Conflict (Hague Convention (1954), the UNESCO Convention on the Means of Prohibiting and Preventing the Illicit Import, Export and Transfer of Ownership of Cultural Property (1970), the World Heritage Convention (1972) and the UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage (2003). Other legal instruments such as the United Nations Convention on the Law of the Sea (UNCLOS, 1982), International Convention on Salvage (1989) and others not mentioned, can also have relevance. The definition of intangible cultural heritage as used by the 2003 Convention:

> means the practices, representations, expressions, knowledge, skills – as well as the instruments, objects, artefacts 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 provides them with a sense of identity and continuity, thus promoting respect for cultural diversity and human creativity. For the purposes of this Convention, consideration will be given solely to such intangible cultural heritage as is compatible with existing international human rights instruments, as well as with the requirements of mutual respect among communities, groups and individuals, and of sustainable development. (UNESCO 2003)

Many countries have heritage and cultural laws at the national and sometimes provincial level that include the protection of underwater cultural heritage sites, but such measures are not universal. The domestic law of the 71 states that have ratified the 2001 UNESCO Convention must be at least compatible with the Convention. The European Convention also referred to as the Valletta or Malta Convention ratified by 44 Council of Europe member states and two non-member states obliges states to carry out a risk assessment of the threat to heritage defined as "structures, constructions, groups of buildings, developed sites, moveable objects, monuments of other kinds as well as their context, whether situated on land or under water." It also obligates commercial developers to undertake this assessment and consequential mitigation at their own cost.

^ Fig. 2 Illustrated by the large quantities of protective stone blocks and aggregate and the large machines used to place the material, national and local authorities are faced with enormous challenges to protect coastal infrastructure (Source: Chris Underwood).

It should be noted that states have stronger jurisdiction and control over marine activities in their territorial waters and it declines toward their Exclusive Economic Zone and beyond.

Current and Future Challenges to this Water System

Water is not only important for the activities mentioned above, it connects humanity. Valuing, protecting and managing underwater cultural heritage sites sustainably is therefore of vital social importance. Politicians and policy makers often remain unaware of the problem, or consider it a low priority or ignore it. Understandably, the focus is primarily inward-looking in mitigating and finding solutions related to the impact of climate change on terrestrial and coastal infrastructure (fig. 2). Consideration of the impact on this largely unseen underwater heritage is often limited and the absence of planning regulations, or inadequate environmental impact assessments, also constitutes a threat. It is also heritage that remains under the public radar; evidently, the role of the past in being part of the solution is also undervalued (ICOMOS 2022; Gregory et al. 2022).

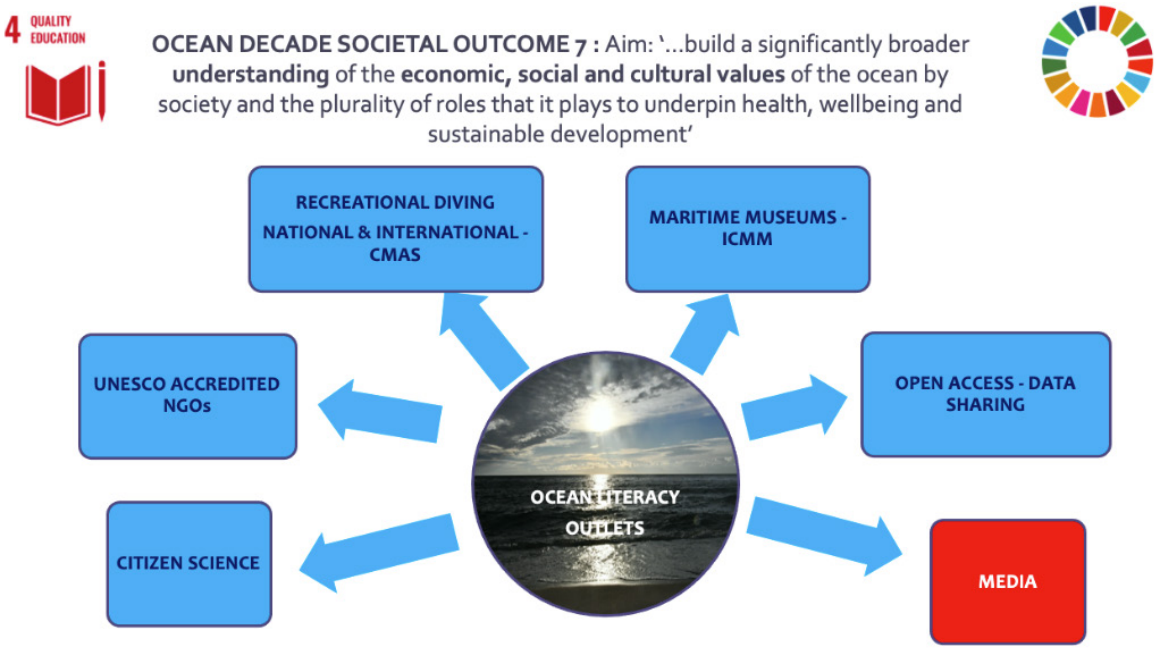
Prior to contemporary times

> clear differences remained with some stakeholders about the utilization and relative importance of underwater cultural heritage, noting other problems. There was a continuing need to dispel stereotypic impressions that it was impossible to undertake science underwater and change the

> public perception of underwater cultural heritage away from the comic book characterizations and romanticizing often seen in the media. (Underwood 2020)

Today, while these earlier problems have largely been overcome, professional and amateur heritage bodies continue to face the very significant challenge of raising awareness of underwater cultural heritage that is often "out of sight, out of mind." Another major and related obstacle is competing for funding with more visible terrestrial heritage projects.

Among current concerns and challenges related to climate change, consequences such as rising sea levels which will exacerbate tidal ranges and increase associated current strengths and the impact of ocean acidification and ocean warming cannot be underestimated and should not be ignored. Ocean deoxygenation might offset acidification, but the related science remains inconclusive and has in many instances not been done. The combined impacts, as yet poorly understood (Gregory et al. 2022), are a significant existential threat to the preservation of underwater cultural heritage, particularly, but not exclusively, in coastal or shallow water environs. Greater investment in science is required to fully understand the impacts and remediation. In addition to the natural hazards underwater cultural heritage is at risk from anthropogenic impacts such as increasing commercial salvage for the economic value of pre-nuclear steel, deep sea mineral mining beyond states' Exclusive Economic Zone (EEZ) where legal oversight decreases. Among other threats is the increasing urbanization and industrialization of coastal zones, with land reclamation projects threatening natural and cultural sites. The race to green economies including windfarms and other ocean-based energy sources without adherence to good management practice can also be a threat to this heritage.



^ Fig. 3 Stakeholders have an essential role in raising public awareness of the cultural, social and economic vales associated with tangible and intangible heritage (Source: Chris Underwood).

SDG 14 Life Below Water, specifically with the associated Decade of Ocean Science for Sustainable Development 2021–2030 ("Decade") has recognised the need to change humanity's relationship with the ocean. In response, the Decade's Societal Goal 7: Inspiring and Engaging Ocean, provides a platform. During the first planning meeting of the "Decade" – Copenhagen 2019 – it was stated that without public support the "Decade" would be unsuccessful.

> Societal Goal 7: An inspiring and engaging ocean where society understands and values the ocean in relation to human wellbeing and sustainable development.

The challenge is to build a significantly broader societal understanding of the economic, social and cultural values of the ocean and the plurality of roles that it plays to underpin health, wellbeing and sustainable development. As part of finding solutions, public outreach aimed at raising awareness of the importance of underwater cultural heritage has been considered an important component of management practice usually referred to as "Public Archaeology", to which can be added a growing trend of including intangible heritage values. Motivating stakeholders with experience in public engagement must play a role in raising awareness and promoting natural and cultural citizen science projects – with appropriate standards and oversight – that contribute to open access data portals.

Within the international underwater cultural heritage community there are nongovernmental organizations (NGOs) – some are accredited

partners of the 2001 Convention – that have longstanding public outreach programes. These include the UK's Nautical Archaeology Society,[2] and the US Florida Public Archaeology Network,[3] both operating since the 1980s and particularly well-known. Other outlets for increasing public awareness include the International Congress of Maritime Museums (ICMM).[4] Outstanding examples of maritime museums with large visitor numbers include the Vasa[5] (Sweden) and Mary Rose[6] (United Kingdom). Additional partners are the recreational diving organizations such as the World Underwater Federation (CMAS),[7] which has affiliations in over 100 countries and has a strong interest in marine science. Not least, a strong relationship with the media is essential to ensure that the "preservation and value" message is promoted.

Conclusion and Future Approaches

Culture and heritage related to the ocean make significant economic contributions through tourism, marine science and data. And most importantly, they contribute significantly to the well-being of coastal communities. In 2022 life has only just returned to something approaching normality from the Covid-19 pandemic, only to be confronted by a global economic crisis that will also have a dramatic impact on sustainable heritage preservation. In some respects, it is too early to do much more than speculate as to the full range of consequences, however, it is realistic to say that in the short term there will be a significant redirection of government resources normally applied to heritage and cultural projects to what are considered more important economic priorities. This would see a reduction in public spending on heritage and cuts to grant programs, putting more pressure on private finance and philanthropy to fill funding gaps.

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5. Vasa (Sweden), https://www.vasamuseet.se.
6. Mary Rose (United Kingdom), https://maryrose.org.
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Religious Heritage and Water Management

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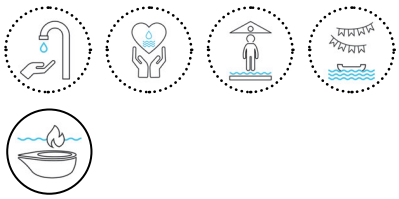
Water is central to most religions. However, the treatment of water in those religions is often far from holy. With examples from the Netherlands and Indonesia, this article shares insights concerning the intricate link between water, religion and world views. In recent decades, religious and interreligious institutions and organizations have taken stands against wastage and pollution and for the sustainable uses of water. As it turns out, religion can be an obstacle to, but also a source of, environment-friendly practices.

KEY THEMES



< Fig.1 Water Festival in Thailand (Source: Takeaway, CC BY-SA 3.0, via Wikimedia Commons).

^ Fig. 2 The mouth of Het Meer in the river Waal, near Nijmegen. In the background is Ooyse Schependom; the Ooyse Gate is in the foreground (Source: Roger Veringmeier, CC BY-SA 4.0, via Wikimedia Commons).

Water has a special place in most religions (McAnally 2018). In Christianity, water is associated with baptism: every church has a baptismal font. In Judaism, washing your hands before and after meals is mandatory. Muslims believe that every living thing is created from water; they use water five times a day for the ritual washing before prayer. In front of every mosque, there are water taps or water basins that meet the requirements of Islamic jurisprudence (at least two-by-two meters in size and 30 centimeters deep). In Buddhism, water is used for funerals. In Hinduism, water is imbued with powers of spiritual purification, and for Hindus, morning cleansing with water is a daily obligation.

This is not to say that religious leaders are at the forefront of water preservation or that religious institutions act in an environment-friendly manner. The holy river Ganges is heavily polluted, including with human excrement, flower and food offerings, and rotting cadavers. Muslims use about 25 liters of water for ritual ablution per day (5 liters per wash), which, according to a strict interpretation of Islamic law, cannot be reused because once used, it is impure. The waters of the Jordan are a source of conflict between Jews and Arabs. Indonesia – home to the largest Muslim population in the world – has the most polluted rivers. Countries with a predominantly Buddhist population are not doing much better. In Thailand, water consumption per capita is the highest in the world. The water here is also heavily polluted, especially from agriculture. The annual Water Festival or Thai New Year, so popular with tourists, uses about 30 million cubic meters of water, while droughts are prevalent in parts of the country.

Yet, a green consciousness and climate activism is emerging within religions. The Roman Catholic Church released the Encyclical Letter

^ Fig. 3 Ritual washing (Source: Frans Wijsen).

Laudato Si' on the care for our common home; it has a full section on "the issue of water" (Pope Francis 2015, 27–31). The World Council of Churches has had a long-lasting program on justice, peace and the wholeness of creation. The leader of the Eastern Orthodox Church is a pioneer of environmentalism within Christianity; he is known as the "green" patriarch. Islamic scholars have released the Islamic Declaration on Climate Change. Hindus and Buddhists fight against water wastage and pollution (Hasselaar and Ijmker 2021).

From 2002 until 2008, Radboud University led the EU-sponsored Freude am Fluss program, and initiated the Waal Weelde (Wealthy Waal) project in 2005. In this project, religious institutes were seen as cultural heritage to be preserved, not as living traditions that inspire human behavior. Yet the researchers also concluded that various worldviews underlie types of river management (Wijsen and Saptaningtyas 2021, 165 to167). In order to acquire a better understanding of the relationship between world views and support for sustainable river management, they developed the Humans and Nature scale. This scale has been validated and used in numerous studies in Western Europe (De Groot, Drenthen and De Groot 2011), North America (De Groot and van den Born 2007) and South-East Asia (Duong and Van den Born 2019).

Since 2012, the insights gained from the Waal Weelde project have been shared with partners in Indonesia. In addition to high levels of pollution in its rivers, Indonesia is facing regular floods due to climate change. Faith-based organizations there have become active in climate change mitigation and adaptation and have been promoting a green and clean Islam.

Based on a common history, rooted in 350 years of Dutch colonial expansion in Indonesia, comparing the Netherlands and Indonesia can help illuminate how religion can be both an obstacle to, and a source of, environment-friendly practices.

Radboud University has been involved in the Alliance for Water Health and Development, an alliance of universities in the Netherlands and Indonesia and non-governmental organizations working on water-related health and development issues. The alliance established the Living Lab Water Indonesia Platform (Wijsen and Saptaningtyas 2021, 167–69). Radboud University is also involved in the Netherlands-Indonesia Consortium for Muslim-Christian Relationships, an inter-university network focusing on education, gender and ecology, in collaboration with Christian and Muslim organizations in the Netherlands and Indonesia. It has a number of water-related projects, such as one involving the recycling of ablution water and a study of the production and distribution of mineral water by Islamic boarding schools.

In Indonesia, my doctoral candidate and I focus on faith-based organizations such as Nadhlatul Ulama (which claims to have 80 million members) and Muhammadiyah (which claims to have 60 million members) and the development of Islamic jurisprudence on water. In 2016, the Fatwã and Islamic Research Council of Muhammadiyah published guidelines in "The Islamic View of Water Use and Conservation." In 2019, Muhammadiyah successfully fought a "constitutional jihad" against the privatization of the water sector in Indonesia. In the Netherlands, we focus on water awareness within the organizations of Green Churches (350 members) and Green Mosques (35 members) and the "implicit religiosity" in the environmentalism movement. Many religious leaders are united in the Faith for Earth initiative of the United Nations Environment Program. Given the importance of water in most religions, this shouldn't be a surprise. Together with the Parliament of the World's Religions, this organization published a book entitled Faith for the Earth, a Call for Action in 2020. Critics say that faith-based organizations come too late and are too slow. They do have a point. Yet, for most people in this world, religion plays an important role in their decision making and religious leaders have moral authority. Despite the ambivalence indicated at the beginning, religions, being both obstacle and source of environment-friendly practices, can make a difference in integral water management.

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PART II Methodologies and Case Studies


محمد المصطفی
صلی اللہ علیہ وآلہ وسلم
علی المرتضی
فاطمۃ الزہراء
الحسن المجتبی
الحسین الشہید
زین العابدین
محمد الباقر
جعفر الصادق
علی الرضا
علی النقی
یا علی یا عبد اللہ
یا حسین
یا حسین

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Living Waters Museum: A Digital Platform for Sustainable and Inclusive Futures

Sara Ahmed
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Sukrit Sen
Arts and Outreach Coordinator, Living Waters Museum

How can knowledge of traditional water practices in India help build more sustainable futures? Launched in 2017, the Living Waters Museum addresses the rich and diverse traditions of water heritage and practices in India. It is building a digital repository of visual knowledge that celebrates the past, inspires the present and is a source of learning to prepare for the future. Through the use of storytelling, digital media and the creative arts, the team behind the Living Waters Museum works in collaboration with young water professionals, conservation architects, urban planners and artists to raise awareness of our water challenges and the need to foster more inclusive and sustainable water futures. As a digital and virtual museum, the Living Waters Museum uses its digital platform to promote capacity building, outreach to youth, and equality in water access. It works toward sustainable development in a number of ways, particularly SDG 5 on gender equality (Living Waters Museum 2019) and SDG 6 on clean water. We are using our content to develop interdisciplinary, innovative and engaging water classrooms for children and youth (SDG 4 on quality education) and to build partnerships (SDG 17).

KEY THEMES

< Fig. 1 Drinking water fountain at Mughal Masjid, Dongri, Mumbai. (Source: Shaikh Mohammed Esa, 2021, https://confluence.livingwatersmuseum.org/water-build-heritage/exhibit03.php).

During the worst periods of the Covid-19 pandemic, virtual platforms were often a substitute for in-person engagement. The Living Waters Museum illustrates why it would be a mistake to think of online efforts as less important than those housed in buildings. Virtuality can be helpful in encouraging activities that consider sustainable water practices in relation to very specific local conditions in a variety of places. As a virtual museum, the Living Waters Museum does not have a physical location, but the work it curates encourages attention to specific local conditions and practices. Since March 2021, the museum has been based as a "special initiative" at the Indian Institute of Science Education and Research (IISER) at Pune in western India and it has ongoing "chapters" in Kolkata, Mumbai, Ahmedabad and Jodhpur. These chapters have evolved around digital exhibitions about urban waterscapes, with the first one launched in Mumbai in March 2021, to mark World Water Day and the one-year anniversary of the first COVID-19 pandemic lockdown in India of March 2020. The exhibition Confluence (Living Waters Museum 2021), brought together more than 30 professionals – from conservation architects and urban planners to artists, photographers, marine life enthusiasts, students and social activists – to trace Mumbai's water heritage and its changing relationship with livelihoods, culture, faith, the ocean and public health. The bilingual interactive digital exhibition was launched with a week of panels, music, curated digital walks and short films to an engaged audience from India and around the world.

Buoyed by this success, the Living Waters Museum started working on Pune's water narratives (Living Waters Museum 2022) in late 2021, collaborating with local NGOs, artists and PhD students at IISER's Department of Humanities and Social Sciences, to explore Pune's water stories – from rivers to dams and floods and from the massive underground aqueduct system to public water fountains. Similar efforts are underway in Jodhpur, Rajasthan, where the museum team is collaborating with the Mehrangarh Museum Trust and local partners and artists to trace Jodhpur's water history, from the ancient water systems, including Persian wheels, in the Mehrangarh Fort to stepwells in the old city that are being renovated and restored through public-private partnerships. And in Kolkata, the team is again collaborating with a diverse group of partners to develop a digital exhibition on the city's rich cultural heritage of water, from its famed Eastern Wetlands to the Hooghly River, from the architecture of the ghats (steps) along the riverfront, to the drainage system and the myriad of people and their cultural practices associated with the waters of Kolkata.

In all the initiatives we have undertaken, building capacity within youth has been one of our primary goals. Two initiatives with particular emphasis in this area are the projects Climate Wall (Ahmed 2022) and Water Classrooms (TESF India 2022). In association with the US Consulate General in Kolkata, the Climate Wall project, through the Living Waters Museum, reinforces the commitment of the US and India to encourage climate advocacy through the creative arts. It aims to engage young students of Kolkata and the Sundarbans, which is a biodiversity hotspot recognized by the Ramsar Convention (wetlands protection) and UNESCO, in understanding their surrounding environment and its challenges and in developing both physical and virtual climate walls. The physical climate wall project allows young leaders in the Sundarbans to learn about the different species of mangroves and develop a strategy to collect seeds, segregate them, grow them in nurseries until they have roots long enough to withstand the tidal forces, and finally plant them in riverbeds. The virtual wall project gives young

^ Fig. 2 "Oti Bharane" – a ritual offering by women to the river goddess Bhivai, a rustic deity, Pune (Source: Vijaya Srinivasan, Minal Sagare and Niranjan Garde, 2022, https://punyachepaani.livingwatersmuseum.org/story/tracing-the-lost-waters/).

^ Fig. 3 The young climate warriors of the Sundarbans (Source: Sukrit Sen, 2022).

^ Fig. 4 Participants in the Water Classrooms playing the Privilege Game (Source: Chhavi Mathur, 2022).

^ Fig. 5 The (Bhistis) Water Carriers of Mumbai (Source: Aslam Saiyad, 2021).

leaders in the Sundarbans and Kolkata an opportunity to look at various creative arts, such as painting, dance, poetry and music, as mediums to raise climate awareness and to include those members of local communities who have been left out by traditional, top-down methods of awareness-raising.

The Water Classrooms is a project supported by the Global Challenges UK program on Transforming Education for Sustainable Futures (TESF) through the Indian Institute of Human Settlements, Bengaluru (IIHS). Building on our collaborative partnership for Punyache Paani (Living Waters Museum 2022), we have been developing pedagogy on water issues with an inclusive, ethical and interdisciplinary lens, using visually engaging and interactive content for secondary school students (standards 6th to 8th, ages 11 to 14). The project tests the efficacy of these tools and approaches and seeks to build the analytical capacities and competencies of students and teachers to close the knowledge-action gap toward sustainable futures. Project outputs will include teaching resources for educators and a policy brief that can contribute to the ongoing discourse on education for sustainable development in India and globally. An exhibition of learning is also being planned to creatively communicate the journey of our students and capture their perspectives through diverse media.

When the Living Waters Museum was launched in 2017, there was no blueprint for a water museum in India and no one had any idea what a virtual museum would look like. The pandemic changed that in some ways, with everyone wanting to go digital. We, however, have always maintained that while our portal defines us, we are much more than just a "website." We have always been hybrid, engaging children and youth not only in our content development but equally on water heritage walks, talks, panel discussions, art competitions, music, theater, storytelling and dance. During the pandemic, our concern about the mental health of youth and children in India compelled us to launch several online initiatives such as Paani ki Kahani (Living Waters Museum 2020), inviting short videos of water music, songs or performance pieces. We strengthened our partnership approach through our focus on urban waterscapes, linking water heritage to public health challenges as we traced the history of Mumbai's water systems, cultures and livelihoods through the first year of the pandemic toward our first digital exhibition, *Confluence* (Living Waters Museum 2021). And finally, we launched the Water Seekers Fellowships in 2020 with the Social and Political Research Foundation (SPRF 2020), New Delhi, to give young people an opportunity to engage with water policy issues as well as develop visual narratives on specific fellowship themes. This year, WWF-India joined us, and we expanded the number of fellowships we could offer to look at the diversity of "flowing rivers" in India and the many challenges they face, particularly from riverfront development projects. We are also using our digital content in teaching about water with an interdisciplinary and inclusive lens focusing on issues of water governance, equity and gender in the context of learning from our fluid past. And we are looking at expanding our partnerships globally, beginning with our collaboration with the Global Network of Water Museums on a digital exhibition about water memories, *I Remember Water*, which was launched in early 2022 (GNWM 2022). We are now working with the Water Club at MIT, students at MIT and local partners to create a visual narrative of the Charles River in Boston (2023).

Indeed, there is much to learn from the soft power of a digital museum, which can facilitate contextual partnerships to co-create public

knowledge about all aspects of our rich and diverse water heritage.

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Sukrit Sen from Kolkata, India, is a heritage manager by profession and musician by passion. He is trained in *tabla* and has been associated with Indian classical music for over two decades. Given his background in music and architecture, Sukrit takes a keen interest in the linkages between tangible and intangible heritage, exploring them to engage with communities and develop more holistic heritage conservation strategies. This approach informs his more recent engagement with disaster management, observing the role of traditional knowledge and other intangible aspects in risk reduction practices. Sukrit is a member of ICOMOS India, ICORP and is a zonal representative of the Emerging Professionals Working Group. He is currently associated with the Living Waters Museum and ICCROM.

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Water-Linked Heritage as a Vector of Ecosystemic Change in Cities and Regions

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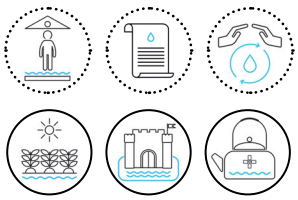
Water and water-linked heritage play a very important role for many cities and regions. They are at the center of many places' identities and key activities. Consider historic waterfronts and infrastructures such as bridges, port facilities, sluices, dams, water towers, mills and specific water-related landscapes, both in the city and in the countryside. Consider also intangible aspects of water-linked heritage, from traditional water management practices to values and local stories. These all have the potential to galvanize the interests of diverse stakeholders and provide a foundation for an ecosystemic approach to sustainable urban and regional development. This is not only because of positive values associated with water, but also because water-linked heritage valorization can effectively connect environmental, economic and social dimensions of sustainability. By working with water-linked heritage as a vector of the ecosystemic transformation of cities and regions, one can span multiple boundaries. First, doing so can attract a diverse set of stakeholders representing different disciplines and policy sectors, engaging them in place-making and the co-creation of transition strategies and tactical activities. Second, water allows for defining functional geographies and strategically linking diverse places connected by water bodies, cutting across administrative boundaries. By drawing upon five international case studies involved in the Interreg WaVE project, the authors have elaborated a typology to classify and compare different approaches to heritage valorization.

KEY THEMES



< Fig.1 One of the historical redoutes redeveloped in Breda, the Netherlands, through "development in dialog" process with diverse stakeholders to promote valorization of historical defensive structures with that of the Dutch landscape (Source: Brigitt Albers, Bureau Vormgeving / Municipality Breda).

^ Fig. 2 Tibi dam on the Monnegre River in the province of Alicante, Spain. The site is revalorized as part of the "Blue Routes" tourist attraction and Monnegre Green Corridor strategy connecting diverse water-linked heritage sites (Source: Brigitt Albers, Bureau Vormgeving).

Introduction

This article builds on the Interreg WaVE project implemented between 2019 and 2023.[1] WaVE stands for "Water-linked Heritage Valorization by Developing an Ecosystemic Approach." This project entailed knowledge transfer and close collaboration between five diverse European locations – Breda in the Netherlands, Aarhus in Denmark, Ravenna in Italy, Alicante province in Spain and Ister-Granum Euroregion across the Slovak-Hungarian border – supported by Delft University of Technology (knowledge provider) and two companies, CertiMac (communication) and Grants Europe (project management). The project aimed at promoting an integrated adaptive reuse of water-linked cultural heritage sites for driving wider ecosystemic changes toward more sustainable regional and urban futures. One of the hallmarks of the project was the emphasis on including a broad range of regional stakeholders in a process of co-creating action plans to valorize this heritage. The stakeholders involved included representatives of diverse regional public organizations related to planning, tourism, water management and heritage valorization, including museums, academic institutions, local businesses and civil society groups.

The action plans co-created across the five locations were based on regional status quo analyses engaging local stakeholder groups in identifying key water-linked heritage sites and values, features of the policy context, as well as challenges and opportunities for heritage valorization strategies. Local stakeholder groups were involved throughout the status quo analysis processes in different ways, ranging from simple provision of information to active forms of engagement involving partnership and

1. More information about the project can be found under the link, https://projects2014-2020.interregeurope.eu/wave/.

co-creation when identifying cost-benefit issues or regional strengths, weaknesses, opportunities and threats for water-linked heritage valorization (Dąbrowski et al. 2019a; Interreg WaVE 2022). On that basis, the actions proposed in each of the plans aim first at the realization of the jointly defined place-specific vision for the future of water-linked heritage, and second, the cross-fertilization of ideas and transfer of elements of good practices identified in each of the five locations (Interreg WaVE 2020).[2] Most of these good practices emphasized storytelling and place-making, engaging stakeholders and citizens, and using the water-linked heritage as a strategic connector across places and diverse policy agendas, from urban development to water management, climate adaptation, restoration of nature, culture, tourism, economic development and agriculture. The action plans are implemented as part of wider efforts to promote reforms in spatial and developmental policies on both municipal and regional levels, positioning water-linked heritage valorization as a driver of ecosystemic changes. In many cases, especially those in Southern and Eastern Europe, these actions are to be co-financed through the European Union's Cohesion Policy programs.

Current Approaches to Preserving and Managing Water Heritage

Through a comparison of the results (see table 1) from the regional status quo analyses conducted across the WaVE's five locations and through questionnaires and online workshops with the experts from those locations, we elaborated a typology to classify and compare different approaches to heritage valorization. This comparative research revealed substantial differences in approaches to water heritage valorization across different European contexts, but also highlighted some commonalities.

The typology is based on five dimensions, for which we defined three-step scales. The first one is the *degree of protection of heritage* and refers to the extent of flexibility in the approach to heritage valorization (for more details on the policy contexts in our five sites, see Interreg WaVE 2022). This degree can range from (1) restrictive / rigid (heritage has to be preserved as it is, there is little room for change) – this approach may restrict the use of heritage as a vector of wider socio-economic or environmental change; through (2) intermediate (mixed approach), in which there is a degree of rigidity, but also adaptation of heritage is possible; to (3) flexible (openness to use of heritage as a policy resource, for adaptive reuse of heritage sites or buildings) and more freedom is given to stakeholders in working with heritage in a more market-oriented approach. We found that in most of our case study areas the degree of protection of heritage was intermediate, with only Alicante standing out as having a rigid approach with little room for creative use of heritage as a resource for policy change.

The second dimension is the degree of integration and coordination of heritage policies with other politics, for instance, environmental or economic policies. This can range from: (1) segregation from other policies (the heritage policy has few links to spatial planning and/or other policy agendas); (2) coordination with other policies (elements of heritage valorization policy are coordinated with spatial planning and/or other sectoral policies to generate syn-

2. For more details on the regional status quo analysis, please see the WaVE Library online. https://projects2014-2020.interregeurope.eu/wave/library/

City / region	*Protection*	*Integration*	*Understanding*	*Participation*	*Decentralization*
Aarhus	Intermediate	Coordinated	Built and intangible heritage	Active	Deconcentrated
Breda	Intermediate	Integrated	Built and intangible heritage as well as natural heritage	Active	Decentralized
Ister-Granum	Intermediate	Coordinated	Mainly built heritage	Passive	Deconcentrated
Alicante	Rigid	Coordinated	Built and intangible heritage as well as natural heritage	Passive	Decentralized
Ravenna	Intermediate	Coordinated	Built and intangible heritage as well as natural heritage	Active	Deconcentrated

^ Table 1 Overview of the typology across the five WaVE project location (Source: Ana Maria Fernandez Maldonado, Marcin Dąbrowski, Kasia Piskorek and Wout van den Toorn Vrijthoff).

ergies and avoid tensions between them); to (3) integration with other policies (heritage is used as a vector of economic, social, environmental change, as an integral part of spatial planning and other development-oriented policies). Breda stood out as the only one of the five cases where the water-linked heritage policy was deemed "integrated" with spatial planning and other sectoral policies, namely water management and economic development policy. In other cases, heritage policy was only "coordinated" with other policies.

The third dimension – *broadness of the understanding of heritage* – examines the degree to which intangible and natural heritage are considered in heritage policies. Thus, heritage policies can be: (1) focused mainly on built heritage (buildings and infrastructures); (2) focused both on built and intangible heritage (including elements of identity, customs, storytelling, etc.); or (3) focused not only on built and intangible heritage, but also on natural heritage (considered alongside the valorization of tangible and intangible cultural heritage). In Ravenna, Breda and Alicante, the understanding of heritage in valorization policies was the broadest and included intangible and natural elements. In contrast, in Aarhus and Ister-Granum, the policy remains focused on built and intangible cultural heritage, ignoring natural heritage.

The fourth dimension is the *degree of participation* of stakeholders in decision-making on heritage valorization. This can range from (1) passive (stakeholders are informed or consulted); to (2) active (stakeholders engaged in a two-way dialogue on heritage policy, having some degree of responsibility for the implementation); and (3) (elements of) co-creation (co-creating knowledge, co-designing solutions, or co-evaluating the outcomes, etc.). In Aarhus, Ravenna and Breda, based on the assessment by the stakeholders and experts in a workshop setting, participation was deemed as "active," whereas in Ister-Granum and in Alicante, participation remained "passive," without active engagement in the decision-making.

Finally, the *degree of decentralization* allows us to gauge the extent to which heritage policy is defined locally or centrally. This ranges from (1) centralized (with decisions taken, funding provided, rules set by the central government); through (2) deconcentrated (with representatives of the central authority at sub-national

^ Fig. 3 Port of Darsena in Ravenna, Italy, including diverse industrial heritage sites and connecting the city to the coast through water (Source: Ravenna Turismo, Municipality of Ravenna).

levels playing a key role); and (3) decentralized approach (with a degree of autonomy of the local or regional level authorities in defining and managing their heritage policies). In Breda (city) and Alicante (province), we noted the greatest degree of decentralization. In Aarhus and Ravenna, the municipalities are less autonomous, having to work with the representatives of the central government playing a major role in the policy. In the case of Ister-Granum, we noted deconcentration as well, however, here we deal with a cross-border entity functioning as part of an European Grouping of Territorial Cooperation banner, making it a community of local governments rather than part of the territorial administration of a single state.

Current and Future Challenges for Water-Linked Heritage

An important task of the WaVE project was to rethink the very meaning of (water-linked) heritage and consider how it can be a strategic vector for sustainable change. This requires a degree of flexibility and openness to adaptation of heritage sites. Breda and Aarhus have experience using water-linked cultural heritage as a catalyst for city regeneration, while heritage values are recognized in planning and policies. The situation is different for Ister-Granum and Alicante, where heritage approaches have been rather conventional and divorced from regional policies. The projects in these two cities are helping to create a regional vision in which water-based heritage valorization promotes economic development while helping mitigate climate change risks. Italy has a broad and quite complex legal framework for heritage, but water-linked heritage is not specified in the framework, apart from the mention of environmental water-system heritage.

Furthermore, this new meaning of water heritage should include both intangible aspects – traditional techniques and professional skills, stories, and customs – and natural heritage aspects. By valorizing ancient dams, riverbanks, and water management practices, the WaVE projects strived to create synergies by preserving or regenerating natural habitats and restoring biodiversity, bringing host ecosystem services to the citizens.

Another challenge, frequently highlighted by the WaVE partners, was the need to engage a variety of stakeholders, especially citizens, in decision-making (for an overview of the engagement methodology used, see Dąbrowski et al. 2019b). Such engagement is a crucial element in the implementation of heritage projects, because it is linked to the availability of funds for the projects and the commitment of the stakeholders to their realization.

Then, there is climate change. Its impacts affect all the WaVE locations, especially since they are surrounded by rivers and seas, which bring significant risks. This challenge is probably most acute in Alicante province: part of the municipality of Almoradí, for instance, within the alluvial plain of the Segura River, is categorized as a severe risk zone. Alicante's action plan developed as part of the WaVE project includes the valorization of intangible water-linked heritage (traditional irrigation and land management techniques) as an element in mitigating the growing flood risk. Ister-Granum acknowledges the danger of floods from rising levels of the Danube. Facing similar risks, Breda is developing a water retention area in the Zoete delta (sweet delta) former industrial zone for water management purposes, as well as using brownfields adjacent to the Mark River as water retention spaces. Aarhus is looking for synergies with environmental policies to mitigate the

^ Fig. 4 Green embankments of the restored the Aarhus River in the city of Aarhus, Denmark (Source: Phillip Fangel, Aarhus City Archive).

impact of climate change in the area of the old industrial harbor.

Other global challenges are looming in the horizon, which may shift priorities away from heritage, but the effects remain uncertain. These include the post-Covid-19 public health situation, increasing inflation and the economic crisis as well as the acute energy crisis caused by the recent geopolitical events and conflict in Ukraine.

Conclusion and Future Approaches

The WaVE project delivered important lessons regarding the importance of water-linked heritage that may be useful for policy and research (Dąbrowski et al. 2022). Even if water-linked heritage is vulnerable to climate change impacts, it may help develop new solutions for climate adaptation, building on traditional techniques and knowledge. Water-linked heritage is also an asset in building awareness of climate change impacts among stakeholders and citizens and of the need to embrace water, rather than to keep it at bay.

Moreover, the WaVE project acknowledged the need for more inclusive and active engagement of diverse stakeholders and social groups. Using input from citizens with different values, cultural backgrounds and experiences can help realize the potential of heritage as a vehicle for inclusion and social integration. Involving diverse stakeholders to co-create strategies for heritage valorization makes it possible to identify new possibilities and to think "outside the box." Co-creation processes require build-

ing and maintaining long-lasting relations with stakeholders, supporting long-term collaboration, ownership and social acceptance of heritage valorization strategies.

The WaVE project's results also suggest that instead of a human-centered approach to water-linked heritage valorization, we need an ecosystemic one, in which past knowledge and heritage values inform the design of new landscapes and pathways to sustainability. Water is then an important element connecting the visions for a far-reaching ecosystemic urban and regional transformation with the necessary transitions in the basic elements of urban systems and structures (energy, mobility, blue-green spaces).

Heritage, like water, is always in flux. Instead of preserving it in its current state, we should strive to use water to develop dynamic and multi-functional waterfront areas, to create new values and new uses of heritage through a process of development in dialogue and to guide our cities and regions toward more sustainable futures.

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Chinampas Agriculture and Settlement Patterns: The Contemporary Relevance of Aztec Floating Gardens

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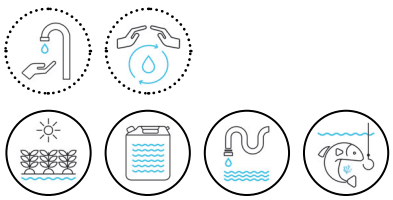
*The Chinampas are a system of floating gardens in the Valley of Mexico, including Mexico City, allowing for effective agriculture and sustainable water management since approximately 200 BC (Rojas-Rabiela 1993). Vernacular water systems like the Chinampas create opportunities for landscape architects to learn from historical approaches to water management to solve today's challenges (Bobbink and Ryu 2017; Bobbink 2019). Through a layered visual analysis – the illustrative method – vernacular knowledge about the Chinampas was collected and communicated by drawings to gather (new) visions toward more resilient, circular and interdisciplinary approaches (Surajaras and Rey 2021). The research is part of the "Circular Water Stories LAB," TU Delft, the Netherlands (*https://circularwaterstories.org*). Once the case study has been systematically documented, its circular character provides insights into landscape-based approaches to water-related cultivation. From there, it is possible to discuss the value of the traditional water system in addressing today's challenges.*

KEY THEMES



CLIMATE

Dsa
Hot, dry-summer continental

< Fig. 1 "Chinampa," September 2015 (Source: Sari Dennise, CC BY-NC-SA 2.0, color modified from original).

Origins and Development of Chinampas as a Land and Water Management System

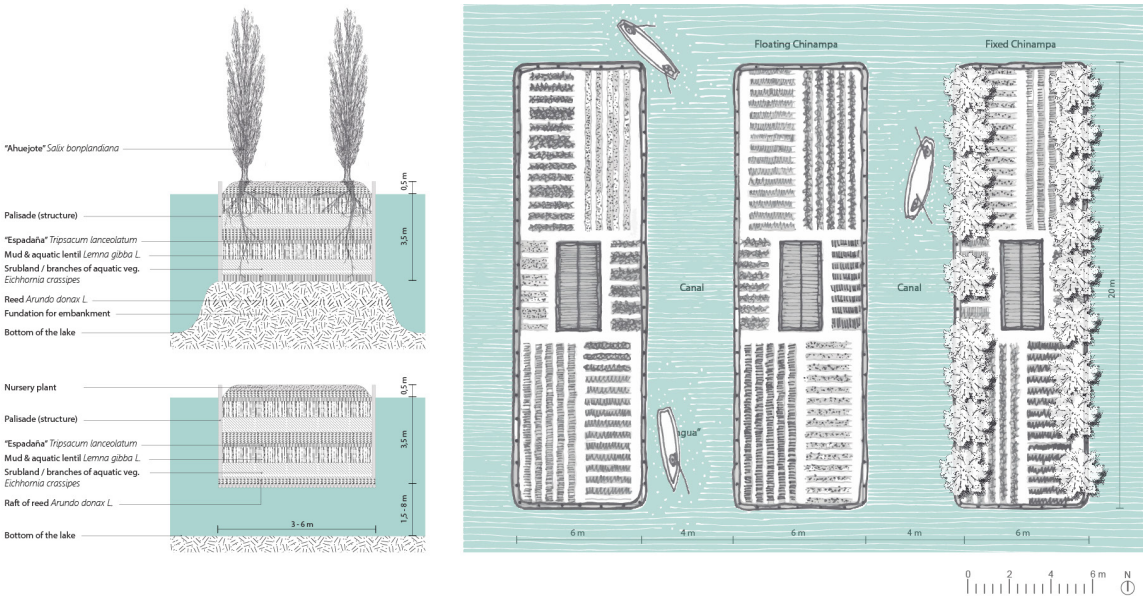
The Chinampas represent an ancient Mesoamerican land and water management system developed by the Aztec civilization to aid agricultural and territorial expansion in the enclosed basin of the Valley of Mexico, which once contained a wetland ecosystem of now-extinct interconnected lakes (Scarborough 2003). The Aztecs built the capital of their empire – Tenochtitlán – in the middle of the shallow waters of the now-extinct Texcoco lake, strategically protecting their city from external threats (Alcántara 2007). However, with the rapid growth of Tenochtitlán and its population, they soon faced a lack of land. Therefore, they started developing the Chinampas land-water management system to enlarge parts of the island where the water was shallow enough to reclaim land for settlement and agriculture (Gibson and Campos 1978). To do so, they developed a technical knowledge and practice of land reclamation that gradually expanded their territory into the surface water, transforming Tenochtitlán into a "floating city" (Surajaras and Rey 2021).

The Chinampas were developed through rafts made of reeds and fenced in a rectangle shape with a wattle (Alcántara 2007). The raft was then layered with mud, lake sediments and selected biodegradable and fertile topsoil constituted by grass, leaves, and husks. After being layered over and over, several artificial islands would eventually create a new landscape pattern (Surajaras and Rey 2021). Each of these islands formed a "Chinampa": a movable land area that Aztecs tied with ropes to their canoes to take them from one place to another in the lagoon, according to the territorial needs of Tenochtitlán (Gibson and Campos 1978). When necessary, they fixed some of the Chinampas by planting trees such as *Salix bonplandiana* and *Taxodium mucronatum* in the corner of the raft to secure it to the bottom of the lake. The mobile islands were mainly used as nurseries for vegetables that would later be transplanted to the fixed Chinampas.

With the arrival of Spanish conquistadors and subsequent colonization, the Chinampas system was transformed from movable land patches to static ones due to the newly introduced tax system, which did not consider the moving islands "taxable land." Therefore, the Spaniards ordered fixing all the floating gardens to the bottom of the lagoon with Ahuejotes trees *(Salix bonplandiana*) (Alcántara 2007). Furthermore, the lakes were drained to avoid flooding and to expand the city, transforming the lacustrine landscape into a dry valley, which led to the disappearance of large areas of Chinampas (Surajaras and Rey 2021).

Present and Future of Chinampas

The lake's draining process continues to the present day with the illegal extraction of water through clandestine wells (Alcántara 2007). This systematic drainage, combined with the ever-growing urban pressure in Mexico City (former Tenochtitlán), has modified traditional Chinampa techniques and the cultural landscape. However, despite these past and current challenges, Chinampas use and management have partly survived in the southern part of the Valley of Mexico, in the lacustrine zone of Xochimilco and Tlahuac (Government of Mexico City 2017). These zones form an extensive island of traditional urban agriculture in the middle of a densely populated Mexico City. In these areas, a variety of vegetables and ornamental plants continue to be cultivated. Productive activities have diversified, creating conditions for devel-



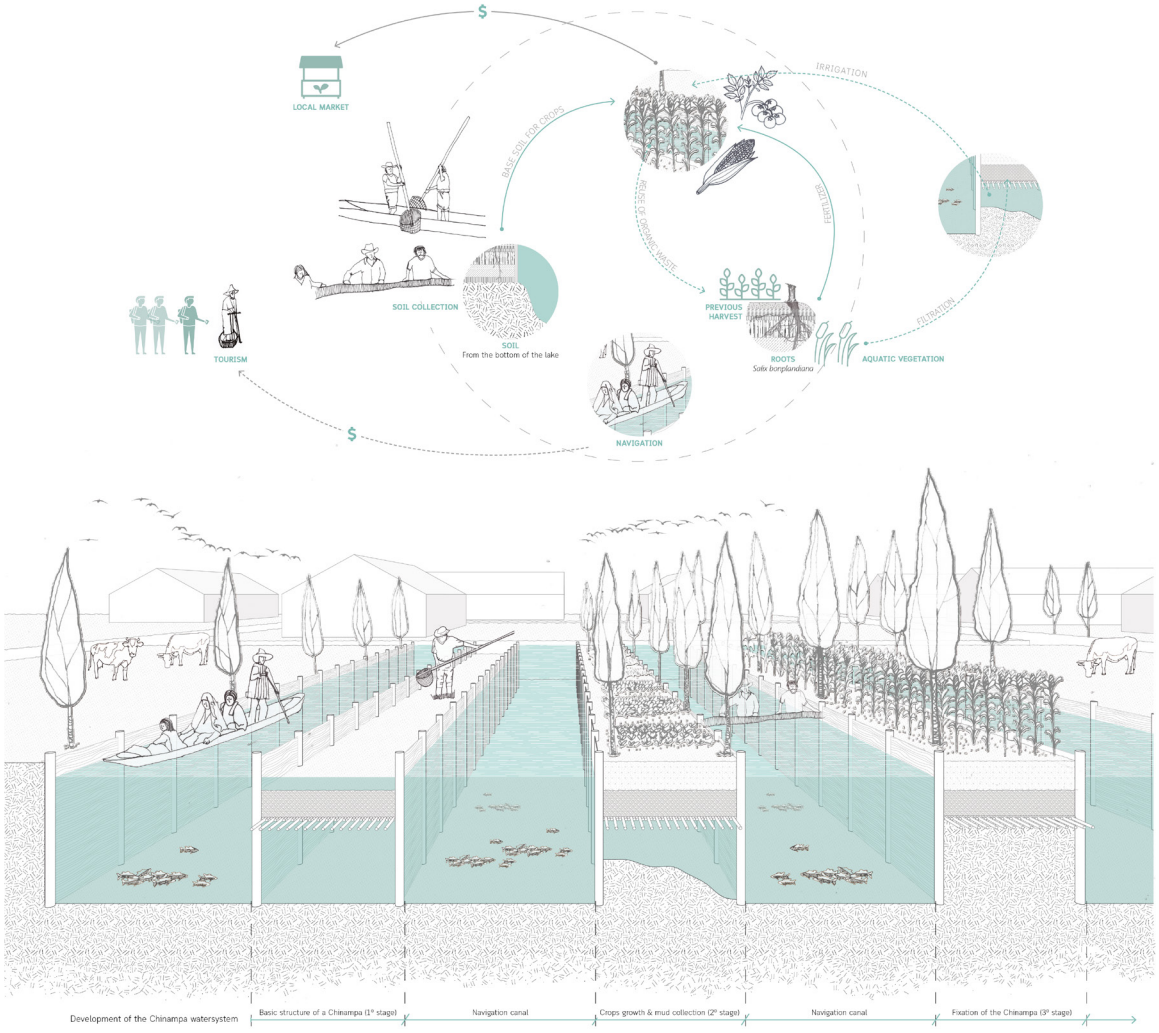
^ Fig. 2 Detail plan and section of Chinampas water system, 2019 (Source: Catalina Rey-Hernández, based on literature review).

oping the local economy and providing goods and services for the city. Tourism, stabled livestock, backyard crops, greenhouse floriculture and Chinampas horticulture are the main activities associated with the conservation of fertile soil fields (Echeverría 2009). Specifically, Xochimilco stands out for two kinds of cultivation: nursery production of horticultural plants to be later transplanted in the mainland, fulfilling a significant economic role. The second is the cultivation of ornamental flowers which are displayed in the Chinampas year round as an important tourist attraction as well as for symbolic reasons related to Mexican commemorations and local festivities (Government of Mexico City 2017). Many tourists are attracted by the traditional cultivation and the flower nurseries, which can be experienced by taking *piragüas* (traditional canoes) (Echeverría 2009).

One of the main changes in terms of the spatial development of the system has been in the Chinampas pattern and size: the pre-colonization Chinampas plots have been merged due to land reclamation and drainage processes, in which many areas are becoming bigger land plots to host new zones for urbanization. However, some of the Chinampas are still sustainably used for agriculture. Farmers use roots, lake bottom mud and organic waste from the previous harvest to maintain and build the Chinampas. They use and reuse 100 per cent of the resources from the fields, as their ancestors did. The use of organic matter in the construction of the land layers allows water to filter and soak the upper soil layers, generating natural irrigation. At the same time, the system helps water retention through its filtration of the subsoil, avoiding erosion and subsidence (Alcántara 2007; Echeverría 2009).

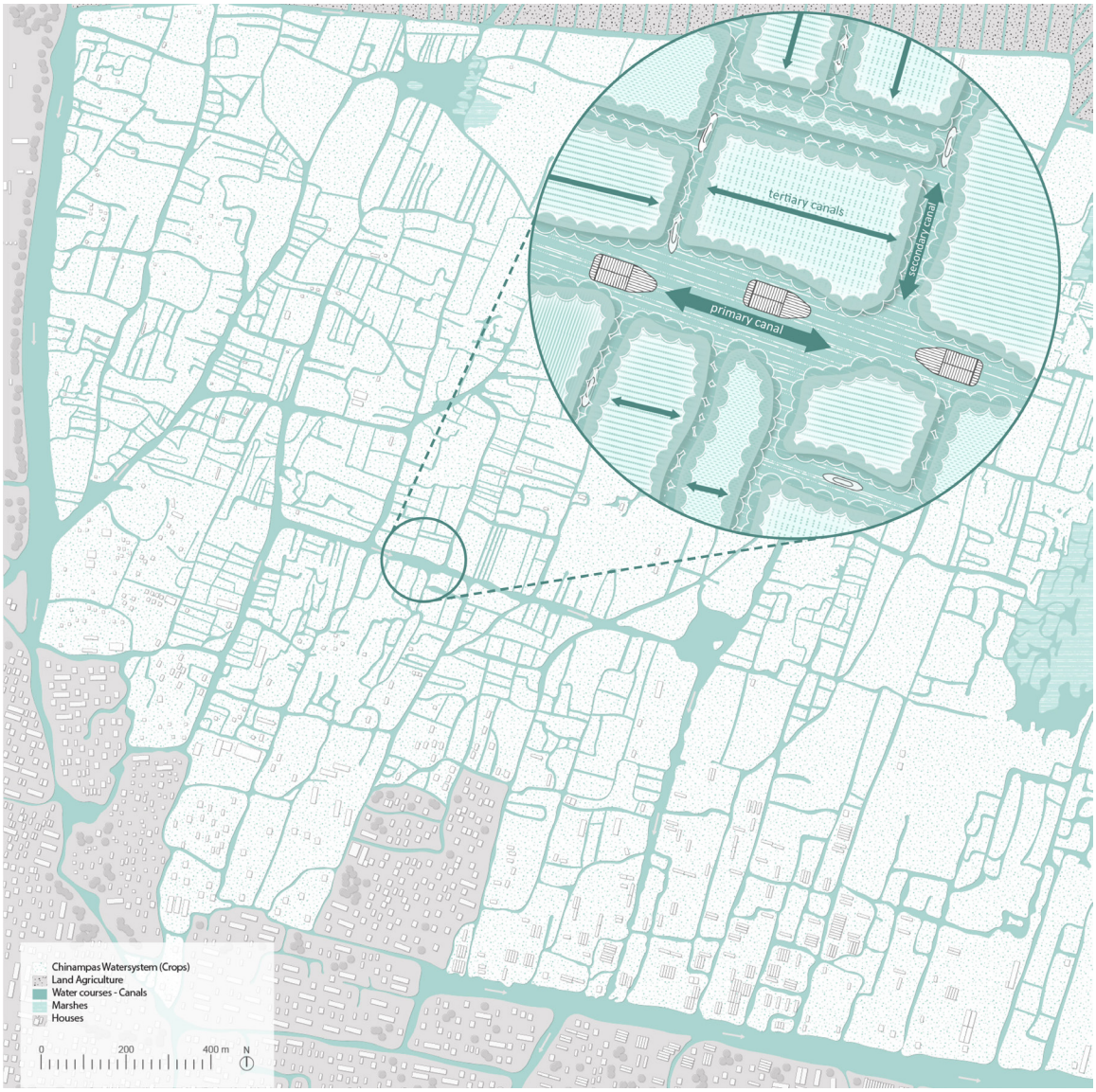
Lessons Learned

The Chinampas water system has been traditionally used for agriculture. Still, due to the



^ Fig. 3 Chinampas: Circularity of the system / Representation of sustainability (Top); Section perspective of the Chinampas water system (bottom), 2019 (Source: Catalina Rey-Hernández, based on literature review).

landscape and cultural transformations in the territory, the system has evolved to provide the possibility of new land uses such as cattle grasslands and horticulture combined with new economic activities like tourism. There is a new awareness of this system's landscape and economic value, encouraging farmers to continue using these sustainable traditional agricultural methods. Using the illustrative method, several values can be defined in relation to the Sustainable Development Goals (SDGs) defined by the UN.



^ Fig. 4 Overall (current) plan of Chinampas water system in Xochimilco (Source: Catalina Rey-Hernández, 2022, based on satellite image from Google Earth).

SDG 6

"Ensure availability and sustainable management of water and sanitation for all."

Ethnographic and identity values: Because the Aztecs created the system, it is one of the most tangible legacies still in use by farmers who continue to identify themselves as inhabitants of the Valley of Mexico. Vital to the construction of their identity is the water-related community they have been able to build around the construction

and maintenance of Chinampas, creating sustainable and circular water system management as part of their daily lives.

SDG 8

"Promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all."

Strategic values: Building Chinampas is an ingenious way to use the site conditions to achieve maximum profitability with minimum resources and infrastructure by taking advantage of natural wetlands that help generate efficient crops without using external energy sources.

SDG 11

"Make cities and human settlements inclusive, safe, resilient, and sustainable."

Values of sustainability and circularity: The materials from the surrounding area provide a sustainable way to use resources, creating cyclical crop harvests using natural irrigation and filtration of the water. The system uses the water existing in the site for natural irrigation, bringing it back into the biological circuit.

SDG 12

"Ensure sustainable consumption and production patterns."

Material and tangible values: The structural elements of the system derive from the knowledge of traditional construction techniques of the Aztec culture and are vernacular and situated. Due to its composition and materiality, the Chinampa water system allows constant humidity throughout its structure, which is helpful for growing a variety of crops.

SDG 15

"Protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss."

Landscape values: The lacustrine landscape of the Valley of Mexico has dramatically changed due to the drainage used to build a city and avoid flooding events. Most of the territory has been transformed, from a lacustrine to a mountain valley landscape. However, approximately 16 per cent of the original Chinampa's extension remains (Armillas in Rojas-Rabiela 1993; DW 2020), along with its traditional and ancient understanding, generating a cultural landscape that rescues the water qualities of the former lakes with resilience and an adaptive version of land cultivation.

The analysis of Chinampas, especially its circular character, is instructive regarding landscape-based methods of water-related cultivation. Understanding water and land management systems based on the circularity of resources makes it possible to extrapolate specific design strategies that can be used to tackle current urban-rural issues related to sustainability and resource consumption patterns. By learning from these landscape-based approaches, we can (re)formulate the role of landscape as a multifunctional provider, where natural entities such as wetlands and lakes can be seen and understood as potential areas for multifunctional development by embracing cultural (heritage), as well as social, economic and ecological values.

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An Ingenious Heritage System for Collecting and Distributing Flood Water in the M'zab Valley of Algeria

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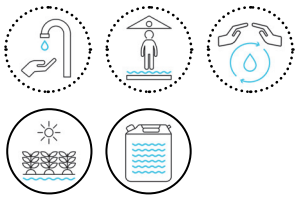
Ferhat Abbas University Setif 1

Foggaras are traditional Algerian water systems, which historically have made it possible to collect and redistribute water in the Sahara Desert. Although threatened by climate change and unsustainable urbanization, foggaras are still in use today and for hundreds of years have been managed by the same customary laws and groups. They are an example of tangible water heritage and ingenious water works, adapted to the needs of an arduous environment along with local society and culture. Such structures can inspire future ways of engaging with nature.

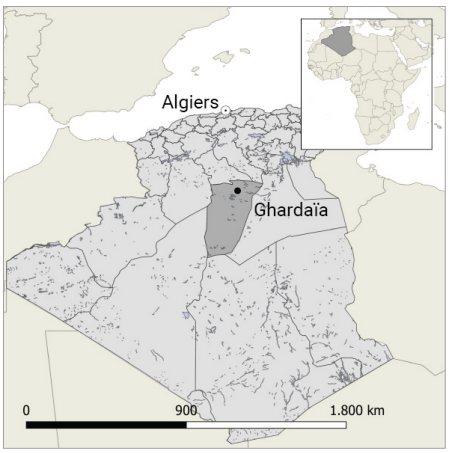
> *"These are not human settlements that are valued only because of the effort made to maintain them and the relative degree of production and well-being, these are settlements valued for their absolute perfection. They represent the best we can imagine and achieve as an oasis culture."*
> *(Quoted in Parvard 1974).*

KEY THEMES



CLIMATE

Bwh
Tropical and subtropical desert



< Fig.1 M'zab Valley (Source: D. Sloan, 2017; Creative Commons Attribution-Share Alike 2.0).

Historical Introduction

The M'zab Valley is a region in the northern Algerian Sahara that consists of a vast rocky plateau cut by four deep major valleys. Ghardaia, the main city, is located at a distance of 600 km south of the capital Algiers. It is the capital of the *wilaya* (administrative division, translated as "state" or "province") of the same name. It runs along the M'zab River over an area of 25 kilometers. The inhabitants have largely preserved the same lifestyles and construction techniques since the eleventh century, adapting both spatially and socially to the demands of this unique environment. This traditional human habitat, created in the eleventh century by the Ibadites, ancestors of the current Mozabite population, has been preserved intact in the M'zab Valley. The M'zab River crosses the valley from northwest to southeast. This configuration is known as the "Chebka" (network) (Cataldi and Al 1996). Between the eleventh and fourteenth century, urbanization led to the creation of five *ksour*, or fortified oasis towns: El-Atteuf (1012), Bounoura (1046), Ghardaia (1048), Ben-Isguen (1347) and Mélika (1350). Each contains a system of irrigation, cemeteries and a palm grove. The distribution of private land, divided into garden plots assigned in the palm grove, was based on an agreement made among the co-founding families (Diafat and Madani 2019; Babanedjar 2008). The town structure reflected the social structure with a series of interconnected spaces with various functions: *ksar* (attached dwellings) for urban life, cemeteries for the dead and palm groves as agriculture (Cataldi et al. 1996).

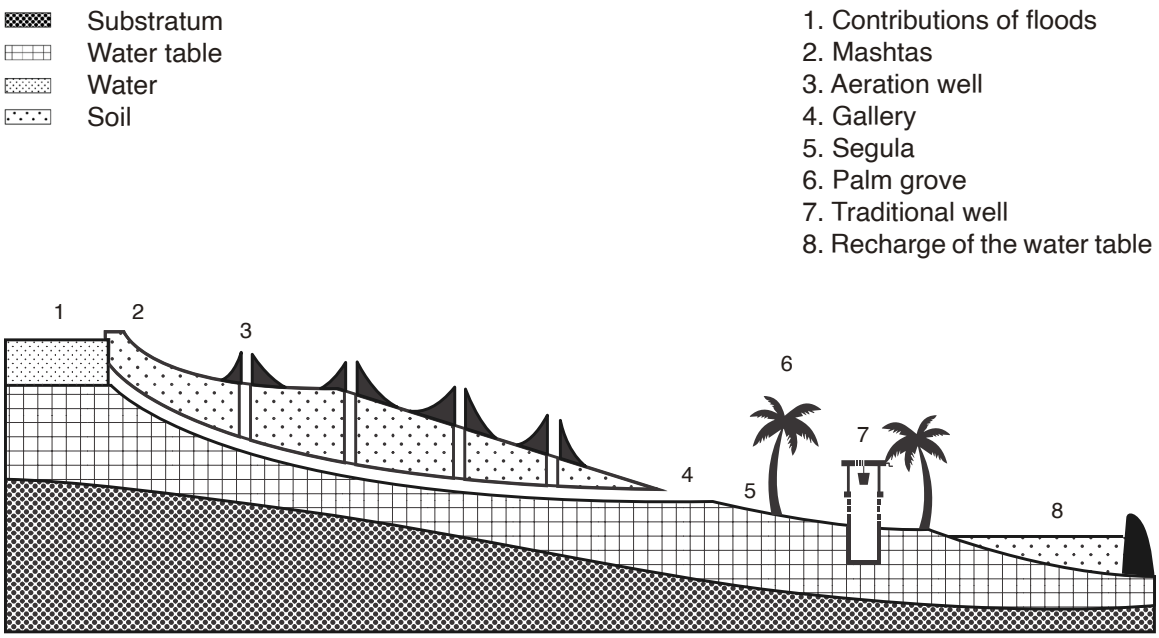
As unlikely as it may seem, the scarcity of water was the primary draw of the M'zab Valley. The Mozabites retreated to this difficult, uncultivated and inhospitable area of the Sahara Desert to hide from enemies. They established an urban civilization that includes fortified towns with a mosque, a minaret that also serves as watch tower, grain storage and arsenal. Living in this area is made possible by a very complex ancestral hydraulic system that exploits and regulates floods for irrigation purposes and recharges the aquifers.The Mozabites have implemented a technical and social organization to manage the danger of floods and take advantage of the floodwaters to supply the *ksar* and meet the demand for irrigation. The Mozabites have conserved practically the same way of life and the same building techniques since the eleventh century, ordered as much by a specific social and cultural context, as by the need for adaptation to a hostile environment, the choice of which responded to a historic need for withdrawal and a defensive imperative.

Water System Characteristics

The M'zab Valley, as a hyper-arid region, suffers from drought (Atlas of Ghardaia 2004). The scarce rainwater is exploited in an innovative and useful way. The Mozabites have invented a hydraulic system unique in the world, a network of underground tunnels for collecting and managing floodwater, called foggara.

As a collection system of galleries and wells, foggara have similarities across the region. They are found in many parts of Algeria, and in Iran there is the similar qanat, the *khettara* in Morocco and *falj* in Oman. In the Algerian Sahara there are seven types of foggara that differ in terms of the source of the water and the technique of water sharing. The Mozabite foggara serves the oasis of Ghardaia, in the M'zab Valley, and is a unique example of water management in Algeria. Once it is collected at the *bouchene (*reservoir), the water is channelled by four galleries, approximately 200 meters long, equipped with ventilation shafts.

^ Fig. 2 Sharing waters of the flood foggara at Mzab (Source: Remini 2007).



^ Fig. 3 Diagram of flood foggara (Source: Remini, Achour and Kechad, 2010).

This distribution system allows all existing gardens and orchards to receive the same amount of water. In addition, this network allows the city of Ghardaia to avoid flooding of the river. During floods, the water flows through the valley directly to the reservoir (*Tissembath*). Once the reservoir is full, it feeds the groundwater of the region. From the reservoir, the water flows through underground channels to reach the paths between the gardens. In times of high water, the paths act as canals. In times of drought, they act as a walkway. Each canal feeds a specific area of the gardens, which are equipped with various rectangular openings. The width of an opening is different from one garden to another depending on several parameters: the distance of the garden from the arrival of the underground canal, the surface of the garden and the number of palm trees. When the garden is flooded, excess water flows into the M'zab Valley (Khelifa and Remini 2019). This foggara system of floodwater sharing, mainly composed of dams, dykes, gullies and underground canals, is characterized by very high precision, allowing a rational use and an equal distribution of water. The ingenuity of the process lies in its design and its adaptation to the conditions of Saharan life and climate.

The water system represents an ancestral technique bequeathed for more than seven centuries which was structured – and is still structured – by the socio-cultural system of the region. The urban and spatial organization of the *ksour* (fortified oases) of the M'Zab includes integrated social and political structures and religious buildings with urban components. They are a balanced ecosystem, a projection in space of a particular way of living and thinking. A ksour is the organization in a delimited space of a homogeneous population in the form of clans and fractions. *'Achiras*, notables, *'arsh* and *'azzabas* are the institutions (religious and secular) that ensure the management of the *ksar* and various aspects of life (political, economic, social and moral), while guaranteeing total autonomy from the other *ksour* (Naidja 2022).

Water and Heritage Management

Water is managed according to written Ibadite legislation established in the twelfth century. The system is still managed by a group of controllers called Oumana Essayl, under the authority of the Djemaa, called Halqa Azzaba, the Committee of the Wise, which guides the Mozambites spiritually and advises. The Oumana Essayl monitor weather and climate change with their local expertise, which helps to prevent floods. They use a system of signs with mirrors or fire to allow communication between the different water diversion points to the gardens, while their watchtowers also function as warehouses. Their role is to enhance this ancestral heritage (the watershed system in the M'zab), to preserve the place as a site of history and civilization, as well as to aid related ecotourism activities. They are called upon to shed light on all the ancestral hydraulic works and to determine possible actions to preserve this heritage in close collaboration with the Office for the Protection and Promotion of the M'zab Valley (OPVM), in accordance with the regulations and the law concerning the preservation of cultural property (APS 2018).

The Algerian government recognized the region (particularly the M'zab Valley) as "national heritage" in 1971. In 1982, UNESCO designated the whole M'Zab Valley as a UNESCO World Heritage Site in recognition of its *ksourien* urbanism, a (pyramidal) shaped oasis in an arid area and its ancestral hydraulic system (https://whc.unesco.org/en/list/188). Following this classification, a permanent plan to safeguard and

^ Fig. 4 Devastating floods of 2008 in the M'Zab valley (Source: Smail Babaousmail).

develop the protected area (P.P.S.M.V.S.S) was launched. The OPVM committed to an ambitious program of restoring historic monuments such as religious and defensive buildings as well as a few water structures (https://whc.unesco.org/en/list/188).

The OPVM has created a number of technical guides, educational materials and brochures on traditional water management systems and wells. The technical guides include clear explanations of construction principles, materials and techniques, in an accessible format and language, with large illustrations. The publications aim to raise awareness about cultural heritage values and guide residents in the maintenance and restoration of their buildings. In 2001 UNESCO approved $25,000 USD to fund the rehabilitation of the traditional hydraulic system in M'Zab Valley and the organization of training workshops. In 2002 during the "Elaboration of a Preliminary Plan of Conservation and Development of the M'Zab Valley," UNESCO approved $35,000 USD and requested the World Heritage Centre to coordinate the implementation of the activity in close collaboration with the national authorities concerned (UNESCO 2001).

Contemporary Challenges

This oasis system has functioned well for centuries and the *djemâa* has supervised the free supply of drinking water to the *ksar* until today. The Mozabites have managed to face floods and maintain the balance of the ecosystem, on which sustainable life in this region of the Sahara absolutely depends. However, the balance of this system is currently disturbed by uncoordinated human actions, aimed at responding

quickly and in an unsustainable way to a social and economic demand. Accelerated urbanization, significant population growth and the lack of urbanizable space inside the valley have led to vertical extensions, the occupation of part of the palm grove, and the degradation of the landscape, further altering the natural oasis ecosystem. The water quality is increasingly suffering from pollution produced simultaneously by the accumulation of infiltration by sewage from the Albian aquifer in the Algerian Sahara, the largest freshwater reserve in the world, and the retention of dams built upstream, which reduce floodwater and the periodic washing of the aquifer (Dahmen and Kassab 2020).

Furthermore, climate change considerably increases the risk of flooding, drought and desertification (fig. 5). There is a need for better-adapted amenities and suitable developments in this hyper-arid zone. These developments require consideration of prior impact studies, taking into account the increase in population, urban sprawl and climate change scenarios, to ensure sustainable development that recognizes the value of the foggara heritage.

Takeaway Points

The M'Zab Valley is not only a simple urban site that must be protected from flooding: the particularity of this remarkable space and the need to safeguard this World Heritage Site must also be taken into account. The heritage of the M'zab Valley is not only historical and architectural, it is also cultural and intangible. Tts classification as a World Heritage Site is an additional asset for the economic development of the region based on tourism (Zafane 2022). Today, several elements of the system have been destroyed, putting this heritage in danger. The actors concerned must save what remains of the ancestral hydraulic system, which reflects the genius of the ancestors of the Mozabites.

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Following Water at the Mantua and Sabbioneta World Heritage Site

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Reflecting on water and heritage as a system linking nature and culture raises challenges and opportunities for both water and heritage management. This case study explores what integrating water and heritage management means for Mantua and Sabbioneta, two cities in Northern Italy listed by UNESCO as a World Heritage Site because of artistic, architectural and urban values associated with the Renaissance. It considers how World Heritage management recalls water-based visions, interactions between heritage institutions and water institutions and the role of water in innovative heritage projects promoting local communities' involvement and challenging partnerships. It argues that embedding water and heritage relationships for sustainable development could be recognized as an opportunity for the Mantua and Sabbionetta World Heritage Site to integrate Sustainable Development Goals (SDGs) 11 and 8 with goals 4, 12, 15 and 17.

KEY THEMES

CLIMATE

Cfa
Humid subtropical

< Fig.1 Part of the "Pescherie di Giulio Romano" from the "Rio" during a market day for local products (Source: Maria Estefania Gioia).

The Mantua and Sabbioneta World Heritage Site

Mantua and Sabbioneta are two cities in Northern Italy, located in the Pianura Padana (Padana plain), a territory shaped by the water of the rivers Po, Oglio and Mincio. The two cities, both located in Mantua Province in the Lombardy region, are separated by approximately 30 km. Mantua (capital city of the province of the same name) currently has almost 49,000 inhabitants and Sabbioneta has 4,200 inhabitants (ISTAT 2020).

During the Renaissance period, the Gonzaga family shaped their territorial domains into land for agriculture, hunting and horse breeding, while constructing the dukedom's defensive capabilities. Moreover, their patronage of artists and architects, such as Andrea Mantegna and Giulio Romano, transformed Mantua's territory from Roman remains and medieval settlements into a dukedom of outstanding art, architecture, urban interventions and hydraulic works. During the Renaissance, Mantua was an artificial island in the middle of a plain where the Mincio River was made into four artificial lakes surrounded by embankments, swamps and systems of fortresses, ports and reclamation lands. Close by, in the second half of the sixteenth century, following urbanistic principles of the Renaissance, Vespasiano Gonzaga built Sabbioneta as a new city and fortress surrounded by embankments, forests and swamps.

The artistic, architectural and urban achievements during the Renaissance period in both Mantua and Sabbioneta were inscribed on the World Heritage List in 2008 as one Cultural Serial World Heritage property. Although both cities have distinctive characters, the World Heritage List inscription focuses on their shared World Heritage values. Both sites are managed together at the local level through a World Heritage management office that aims to assure permanent coordination between the two municipalities and the Italian Ministry of Culture. Such a framework requires the reconciliation of different interests and the development of shared visions to reinforce the World Heritage character of both cities. Currently, the Mantua and Sabbioneta World Heritage management plan follows the 2011 UNESCO Recommendation on the Historic Urban Landscape (UNESCO 2011) to facilitate the integration of comprehensive strategies framing World Heritage values in a broader socio-economic and environmental sustainable development perspective, in which local actors may play an active role in a site's protection and enhancement.

Based on these considerations, this case study explores how the focus on water systems, water-based visions and water-based projects that shape the Mantua and Sabbioneta World Heritage Site improve its heritage management while working to integrate heritage and water; in doing so, it addresses water and heritage interactions in three parts. The first highlights the role of water for the Mantua and Sabbionetta World Heritage property by exploring interactions between heritage institutions and water institutions. The second demonstrates the role water can play in innovative projects, recalling local communities' involvement and challenging partnerships. The third recalls the role of water as an opportunity for the Mantua and Sabbionetta World Heritage Site to include Sustainable Development Goals (SDGs). To conclude, this case study draws attention to future challenges and opportunities pertaining to the water-heritage relationship at Mantua and Sabbioneta.

Water and World Heritage Interactions

Water affects heritage in different ways. It can be important at the creation of a heritage site and it is also part of future challenges. When considering water and heritage relationships, water erases the limits between what is inside and outside a World Heritage property. This situation facilitates the understanding of challenging World Heritage management approaches such as the Historic Urban Landscape approach. Therefore, it is important to examine how Mantua and Sabbioneta World Heritage management reference water systems, how institutional water frameworks interact with the World Heritage site, and to explore the role of water in local communities. Water can be approached as a common value to reconcile different interests and contribute to understanding World Heritage from a sustainable development perspective while promoting projects that increase local capacity and support challenging governance integration.

Water and World Heritage management

The Mantua and Sabbioneta World Heritage Management Plan 2020 depicts each city's relationship with water systems through time, recalling the vision of Mantua as a *città d'acqua* (city of water) and the vision of Sabbioneta as an *isola fortificata nella pianura di bonifica* (fortified island in the reclamation plain). These water-based visions for the current Mantua and Sabbioneta World Heritage management plan have influenced the interaction between water management and heritage management. For instance, the systems of lakes, channels, and reclamation lands, among other water systems that now connect the Mantua and Sabbioneta World Heritage sites with their territories, involve various water and heritage stakeholders. These stakeholders recall the role of water protection for historical and environmental purposes, as well as the use of water inside and outside the areas protected as World Heritage. For example, the Mantuan lakes link the Mincio River and the water systems connecting the Mantuan territory (fig. 2). The Parco del Mincio (Mincio Park) is part of the Mantuan World Heritage buffer zone, and as a regional institution establishes a *contratto di fiume* (river agreement) about the role of biodiversity and environmental protection throughout the Mincio River and the municipalities between Garda Lake and the Po River. Moreover, in Sabbioneta, traces of the historical water defense systems are present in the reclamation lands shaping the Sabbioneta World Heritage buffer zone (fig. 3). These lands belong to private owners currently using them for agriculture; and their use depends on water irrigation systems managed by *consorzio di bonifica* (water management boards).

Mantua and Sabbioneta as a case study demonstrates that involving water institutions in World Heritage management is as crucial as involving World Heritage in water protection and water management. Although there is no official interaction between the World Heritage Sites and water management frameworks, understanding water and heritage together has the potential to break the administrative boundaries between a World Heritage Site and water and heritage management. Exploring water and heritage relationships allows the Mantua and Sabbioneta World Heritage Site to show how these interactions occur at the local level, for instance as projects, partnerships or just in the everyday life of the communities living in the heritage-protected area.

Water, local communities and heritage projects

This section of the case study uses as examples projects promoting innovative heritage ap-

^ Fig. 2 Recent photo of Mantua from one of the lakes (Source: Teseo, CC BY Creative Commons Attribution-Share Alike 3.0 Unported).

proaches, connecting different institutions and local communities as active stakeholders for Mantua and Sabbioneta World Heritage management. In Mantua, public-private partnerships connect water with innovative approaches to protect heritage. The World Heritage Management Plan 2020 follows the vision "Mantua, City of Water" and links incremental planning processes promoted by the Mantuan municipality and public-private initiatives with the rehabilitation of public spaces such as the Mantuan lake shores and the restoration of buildings linked to water systems inside the city. For example, the local initiative "Pescheria di Giulio Romano" is a heritage-based project to restore and reuse an abandoned building that connects the city with the "Rio" (an artificial channel crossing Mantua). The building allows access to the water and to the "Beccherie" (loggia underneath the city level), a public space used as a fish market until the nineteenth century (fig. 1).

The project led to the establishment of Fondazione Pescheria di Giuio Romano, a foundation in charge of the building restoration works and the management of the project in the next 30 years. The foundation holds crowdfunding campaigns involving civil society as new partners of the project and it also sponsors events and educational programs with local schools. This public-private partnership was recognized as innovative heritage management by the EU-Urbact INT-HERIT network. Currently, the project and restoration works are still in development.

In Sabbioneta, concerns about the local communities and heritage relationship led to an innovative initiative called "Cerchio d'Acqua" (Circle of Water), a project carried out in 2016–2018. The project developed a participatory process aiming to strengthen local community involvement, resilience and value creation in Sabbioneta. This project reinforced the World Heritage

^ Fig. 3 Current photo of Sabbioneta fortification wall and agricultural lands (Source: Teseo, CC BY Creative Commons Attribution-Share Alike 4.0 International).

Management Plan 2020 vision of "Isola fortificata nella pianura di bonifica" (fortified island in the reclamation plain) aimed at enhancing the role of the fortification walls, the reclamation lands, and the embankments as water-land management systems surrounding Sabbioneta. One of the main challenges of the project was to gather actors usually not involved in heritage management (like local agricultural institutions, institutions managing water irrigation systems, and private landowners) and promote dialogue among all the different local actors involved in Sabbioneta territory. The project conducted several progressive meetings and it developed digital cultural mapping made by and for local communities during exploratory walks in the reclamation lands and at participatory tables with local actors. Moreover, the projects followed an educational program working for and with local schools. Among the results, the project elaborated a database for the water-land management systems surrounding Sabbioneta, which did not exist until the development of the project. Unfortunately, after the project ended, there was not a monitoring system to measure the impact of the project in Sabbioneta.These projects demonstrate the ability of water-based visions to be a medium to mediate between different institutional frameworks and stakeholders. They show how interaction between water and heritage can drive dialogue and actions that increase local communities' awareness of the possible significance of World Heritage and the sustainable development of their cities.

Water, World Heritage and the Sustainable Development Goals

The World Heritage framework aims to integrate the Sustainable Development perspective into the procedures of the World Heritage Convention as evidenced by the Policy for the Integration of a Sustainable Development Perspective into the Processes of the World Heritage Convention (UNESCO 2015). Even though each national context has been slowly incorporating Sustainable Development Goals (SDGs), World Heritage Sites still struggle to integrate SDGs into World Heritage management systems and plans.

The Mantua and Sabbioneta World Heritage management plan does not use SDGs for defining and monitoring World Heritage efforts. However, at the UNESCO World Heritage Canopy,[1] Mantua and Sabbioneta World Heritage site managers have identified SDG 11 (sustainable cities and communities) and SDG 8 (decent work and economic growth) as targets for the shared management framework. Even though SDGs 11 and 8 are crucial for the Mantua and Sabbioneta World Heritage Site, using water as a holistic vision for World Heritage management can also help address other SDGs and broadens the role of water in World Heritage conservation from a sustainable development perspective. The interactions between the Mantua and Sabbioneta World Heritage Management Plan 2020 and the projects Pescheria di Giulio Romano and Cerchio d'Acqua can be examples. For instance, World Heritage management could consider SDG 17 (partnership for the goals) to measure the evolution of private-public partnerships and local communities' involvement at the Pescheria di Giulio Romano project. Furthermore, the building's historical connection with water, the participation of local communities and the activities developed with local schools may help to bring in SDGs 4 (quality education) and 12 (responsible production and consumption) to reinforce the role of research, knowledge and education about water contamination and water consumption in cities. The Cerchio d'Acqua project links to SDG 4 by measuring the project's impact on local schools and younger generations and to SDG 17 by measuring the participation of actors dealing with water that do not usually interact with heritage-based projects. Moreover, targeting SDGs 12 and 15 (life on land) could help to connect the role of agriculture and water irrigation systems to the environment and their impact on World Heritage management.

1. This case study reflection started with my PhD research "World Heritage and Locally Based Planning Interaction" (tentative PhD title) at Politecnico di Milano, an application to the case studies call at the UNESCO World Heritage Cities Forum 2021, and the presentation "Shared Vision, Shared Strategies: The Case of Mantua and Sabbioneta World Heritage Site through the Examples of 'Pescherie di Giulio Romano' and 'Cerchio d'Acqua'" at the forum at the UNESCO World Heritage Cities event "Celebrating the 10th Anniversary of the 2011 UNESCO Historic Urban Landscape Recommendation" held online on 21 June 2021. This presentation is available online at https://whc.unesco.org/en/canopy/mantuaandsabbioneta/ and it was jointly made by myself and the site managers of Mantua and Sabbioneta. The information available at the UNESCO World Heritage Canopy website titled "Creating a Shared Framework in the Serial World Heritage Property of Mantua and Sabbioneta (Italy)" builds on text and photos chosen by Mantua and Sabbioneta site managers and the World Heritage Center.

The projects Pescherie di Giulio Romano and Cerchio d'Acqua are not of my authorship. Information about these projects is open-access. I have gathered more information through interviews with project authors and key stakeholders as part of my PhD research in urban planning, design and policy.

Final Remarks About Water and Heritage at Mantua and Sabbioneta

The analysis of the World Heritage Site of Mantua and Sabbioneta highlights how crucial it is to gain institutional capacity for World Heritage and water interactions. In this regard, it is key for World Heritage management practices to pursue constant planning that aligns different levels, frameworks, policies and governance plans. For instance, at an international and national level, World Heritage management must align with SDG monitoring systems, and in the local context, align World Heritage management with existing policies and studies focused on water. For instance, in the case of Mantua and Sabbioneta, it is important to learn from studies of climate change and of water contamination due to the industrial use of the Mantuan lakes and the agricultural activities in Sabbioneta. The results of such alignments may lead to a framework for integrated interpretation and management of World Heritage cities and the pursuit of sustainable development.

Furthermore, in Mantua and Sabbioneta it is crucial to include World Heritage in spatial and urban plans and actions, such as improving better public transportation between both World Heritage cities and within each city's nearby areas. In this sense, connecting water and heritage could promote new forms of mobility by recalling the role of rivers, ports and lakes for transportation or by reusing traces of historical embankments as cycling routes. Such measures could be linked to slow tourism efforts and projects reframing tourism at World Heritage Sites. These aims promote alternative forms of the development of Italian World Heritage cities with cultural tourism often functioning as a mono-cultural economic development model. Similarly, Covid-19 has posed both a challenge and a source of new opportunities for more locally based tourism, with potential benefits for both locals and visitors.

Finally, tracing water and heritage interactions invites us to explore the role of World Heritage cities as heritage for local communities. For instance, recalling local communities' involvement in the projects Pescheria di Giulio Romano and Cerchio d'Acqua shows how water requires trade-offs and compromises for stakeholders with divergent interests. Nevertheless, further reflection must consider what and how heritage narratives and memories involving water emerge when local communities examine water and heritage relationships. How will local people recount local stories about water traditions inside the World Heritage Site? Will they be reminded of how much water was and is part of everyday life in the local community? Understanding past, present and future water and heritage relationships is crucial for the Mantua and Sabbioneta World Heritage Site. Water was important in the past, continues to be in the present and it will remain so in the future of these two cities, their inhabitants and their territories.

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How a Rainy Climate has Shaped the Artifacts and Communities of Fındıklı and Rize in Türkiye

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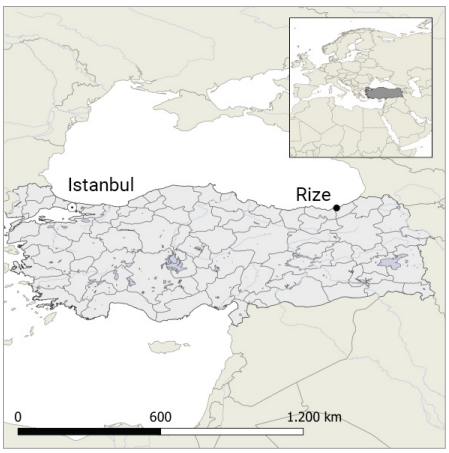
Steep slopes, rivers, a rainy climate, and rich vegetation: the region of Fındıklı and the city of Rize (Türkiye) have been shaped by humans living with water. To understand the region's traditional settlements, vernacular buildings and local culture, it is crucial to analyze its geomorphological setting. Yet, despite the importance of climate and geomorphology for understanding how living with water has shaped everyday artifacts, water-related heritage in this region is not well documented. This article makes a case for seeing cultural and natural heritage as connected and to protect already sustainable practices and use them for future development.

KEY THEMES

CLIMATE

Cfa
Humid subtropical



< Fig.1 Harvesting tea leaves (Source: Gürsoy Tokgöz, Creative Commons Attribution 3.0 Unported).

Introduction

The geography of the area and its water management have shaped architecture for centuries. The city of Rize is located in the Eastern Black Sea region of the Kaçkar mountains, where the highest elevation is 3,937 meters. The high mountains and hills lose elevation south of Fındıklı. The total annual mean rainfall in Rize amounts to 650 mm, which is close to four times the average amount in the country. High levels of humidity and precipitation year round are underlying causes of recurrent floods and landslides. The river plains and valleys were formed by three main rivers: Arılı, Çağlayan, and Sümer. Local communities built settlements compatible with the natural environment. Most of these settlements are concentrated along the Çağlayan and Arılı valleys. Crops include tea, hazelnut, fruit and corn; people also tend beehives and fisheries.

Adaptation to rainwater played an important role in the past. Some 250 years ago, local builders set up houses, bridges, kilns and mills that were adapted to the particularities of the landscape. Local builders carefully selected appropriate locations for the buildings in response to water requirements. They located their houses on the higher end of the slopes to control the water flow on their lands, but also so that rainwater would fertilize the land by carrying animal scat downslope. Locals determined construction sites by hanging meat at the desired location. If the meat or a side of the meat became rotten, it was determined that the building's facade facing the rotten side would decay faster due to the prevailing winds carrying precipitation.

The builders chose local materials that could withstand the rainfall and extreme humidity. They collected stones from nearby rivers and chestnut timber from local forests for the exterior and interior walls and furniture; chestnut wood is particularly resilient to water. Over time, they also developed appropriate structures (fig. 2), notably 150 cm wide roof overhangs to prevent water from permeating building facades.

Current Approaches to Preserving and Managing Water Heritage

Heritage protection for these sites is hampered today by particular national heritage policies. In Türkiye, the conservation of cultural heritage is based on the Cultural and Natural Heritage Protection Act. But the conservation of natural heritage is no longer the responsibility of the Ministry of Culture and Tourism. Since 2013, it is the responsibility of the Ministry of Environment, Urban Planning, and Climate Change, a combination which has led to many issues involved in preserving cultural and natural heritage sites together. However, the protection of natural sites is separated from those of cultural ones. The three local rivers – the Çağlayan, Arılı, and Sümer – for example, are listed as natural heritage because of their ecosystem and biodiversity.

Vernacular buildings in the area are listed under the authority of the Ministry of Culture and Tourism and the Regional Board Directorate for Preservation of Cultural Assets in Trabzon, according to conservation status. A first degree conservation site largely retains the original form and design of its architectural elements, thus, the interior and exterior must be kept intact and cannot be modified. The first degree listed buildings are usually grand mansions and buildings; village houses are listed as second degree. Local residents of historic buildings can modify the interior of second degree sites, but not the exterior. The third degree sites are most flexible: here modifications are mostly allowed.

^ Fig. 2 Timber buildings elevated on stone in Hara village (Source: Gül Aktürk, Hannah Fluck, CC BY 4.0).

^ Fig. 3 Stone-infilled building in Çağlayan village (Source: Gül Aktürk, Hannah Fluck, CC BY 4.0).

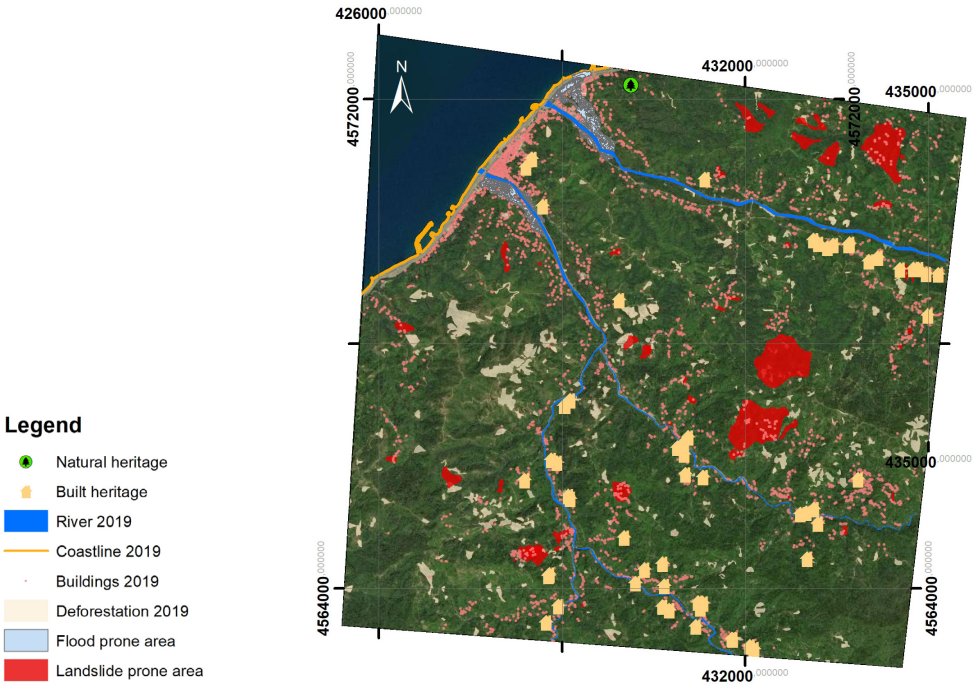
The designation of houses as heritage depends largely on the initiative of individual homeowners. Individual buildings can be listed as a result of individual action. To receive money from the government to restore their houses, homeowners can apply for their houses to be listed. If the building is not designated, the owner is free to modify it. Only a couple of sites from various villages have been listed as heritage. Moreover, there is no conservation for rural areas that include vernacular settlements with their kilns, mills and other practical elements. The intangible heritage of lifestyles and practices surrounding water is not officially valued and has mostly been abandoned. So far the region has failed to develop a comprehensive approach of valuing and protecting the landscape.

Current and Future Challenges to this Water System

Water patterns in Rize have changed over the last decade, with an increase in precipitation, rainfall and humidity. As a result, disasters such as river flooding and landslides occur more frequently and severely. Murat Kurum (Turkish Minister of Environment, Urban Planning, and Climate Change) announced the Regional Climate Action Plan for the Black Sea region on 12 July 2019. He explained the active role of NGOs and universities in mitigating the effects of climate change. The 15 actions to be taken include several practices in the building sector (Aktürk and Fluck 2022). The 13th article encourages the use of locally available materials in the construction of new settlements to aid climate resiliency, creating an exemption from any type of fees or taxes in the construction of houses. Despite the decision to protect these areas, local authorities allowed urbanization in these areas. There have been recent building developments along the rivers of Çağlayan and Arılı (natural heritage sites), which made them vulnerable to floods. In addition, land reclamation in the coastal area of Rize and the narrowing of the river channels increased the pressure of the water flow. The pressure of water flows further increased when construction materials were released into the river waters, blocking them. Plans for a hydroelectric power plant in the area, moreover, increased concerns about access to clean water and about the risk of flooding. The regional climate action plan conflicts with the development plans.

There is an ongoing disagreement between public institutions, locals and NGOs regarding the implementation of large-scale projects. On the one hand, public institutions impose national and regional projects, including the construction of a hydroelectric power plant and the Green Road. The latter is a project connecting the highlands in the region to improve highland and nature tourism. On the other hand, with the support of NGOs locals object to any intervention that could interfere with the river ecosystems. In addition, locals are requesting new roads and housing developments. These contradictory stances affect heritage sites. Because the rivers are listed as natural heritage sites, the collection of stones from the rivers that are needed for traditional housing is prohibited. Also, to protect against deforestation local communities can no longer collect chestnut timber from the forests (paradoxically, large-scale deforestation is caused by the auctioning off of forests to private companies, who have depleted the area for economic development). Both spatial decisions and local level actions have played a role in the deterioration of these heritage sites. Therefore, the protection of natural heritage sites such as rivers and forests sometimes hinders the preservation of cultural heritage as it can prevent the use of local materials in the maintenance of cultural heritage.

^ Fig. 4 Mixed construction on a building in Hara village (Source: Gül Aktürk, 2019, CC BY 4.0).



^ Fig. 5 The flood- and landslide-prone and deforested areas in the selected area of Fındıklı in 2019 (Source: Gül Aktürk, Stephan J.Hauser, CC BY 4.0)

Conclusion and Future Approaches

Dilemmas regarding the protection of heritage and the development of a region have to be resolved in integral ways. Identifying heritage as part of a living past and present, and acknowledging the interconnection between natural and cultural heritage is crucial. To do this, more analysis and data is needed including geographical locations, historical background, specific descriptions of materials, techniques, and uses, and even visuals of the past and present that explain what water systems are now lacking.

Creating a shared language

Finding relevant data often requires studies beyond traditional archives. Oral traditions, for example, can provide a better insight into the use of techniques and materials in vernacular buildings. Moreover, combining data on flooding and erosion (often available from public institutions) with data on the location of vernacular and natural heritage, and aerial images in ArcGIS can reveal heritage sites threatened by natural disaster (fig. 3). Such integral data analyses can help stakeholders value cultural and natural heritage at risk by viewing them as an interrelated system, and uncover the historical layering of vernacular landscapes and translate it into heritage values. This approach allows us to further clarify the importance of historic water systems for vernacular settlements like those in Fındıklı.

Bringing together relevant stakeholders

Different levels of stakeholders should be in-

volved. Not only formal institutions at the national and local levels, but also institutions dealing with disaster and water, and NGOs dealing with local communities should discuss values and interests at various scales to integrate heritage in development policies and practices.

Raise awareness and engage communities

Community engagement tools (as proposed by UNESCO's Historic Urban Landscape approach) can bring stakeholders together for a fair dialogue that aims to both preserve cultural and natural resources and allow for local development. For example, in Fındıklı, workshops such as the EU-funded project "Training Masters for Rural Built Heritage in the Eastern Black Sea Region" have provided education in carpentry to local artisans (Aktürk 2020). Local historical knowledge and artisanship are crucial for sustainable development: techniques and materials that have long withstood disasters can inspire future construction. As a result, the promotion of heritage has become an additional source of income for locals. It has also led to an increase in the number of skilled artisans, who have worked to construct similar buildings in other regions of the country. Raising awareness of the preservation of these sites is only possible through collaboration. In this case, bringing together the university and local communities have led them to reevaluate the importance of both tangible and intangible practices in present-day developments.

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Saving Lake Urmia: The Impact of Water Heritage on People's Lives

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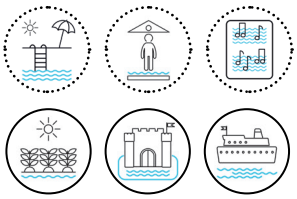
Lake Urmia is one of the largest saltwater lakes on Earth and a highly endangered ecosystem. It is on the brink of a significant environmental disaster, similar to the drying up of the Aral Sea. UNESCO has inscribed Lake Urmia on its list of Iranian biosphere reserves. The existing situation is due to a lack of water heritage management and the absence of an integrated, straightforward method that includes support for the ecological and social aspects of the lake. Recognizing the significant factors behind Lake Urmia's drying up and the impact on people's lives can significantly raise awareness about this catastrophic phenomenon. Reviving Lake Urmia and protecting it can decrease pollution, maintain species diversity and increase tourism. It will ultimately lead to sustainable development by improving health, contributing to the economy and preserving culture and identity.

KEY THEMES



CLIMATE

Dsa
Hot, dry-summer continental

< Fig.1 Lake Urmia in northwestern Iran, taken from the International Space Station on 12 september 2016 (Source: NASA, Public domain, via Wikimedia Commons).

Introduction

Lake Urmia, also known as Rezaiyeh Lake, is located northwest of Iran and in the Azerbaijan region. Based on the latest country divisions, this lake is divided between the two provinces of East Azerbaijan and West Azerbaijan. Lake Urmia is the largest inland lake in Iran and the second-largest saltwater lake in the world. The water of this lake is very salty, and it is mainly fed by the rivers Zarinee Rood and Simine Rood (Dastranj, Tavakoli and Soltanpour 2018, 151).

While historical documents concerning the decay of the Aral Sea have been included in the UNESCO Memory of the World Register, UNESCO has inscribed Lake Urmia on its list of Iranian biosphere reserves (UNESCO 2021). A unique feature of this Biosphere Reserve and National Park is its hypersaline environment, with salinity ranging from 217 to more than 300 g/l, approximately eight times higher than seawater (UNEP 2012; Ghaheri et al. 1999; Ahmadzadeh Kokya et al. 2011). Unique types of diatoms, phytoplankton and bacteria can survive in this kind of hypersaline environment. The Lake Urmia water basin, with a population of 6 million people, has been an essential source of life and fertility for a long time, from farmers who irrigate their fields with water from rivers and groundwater to the unique shrimp species called Artemia that live in the lake and provide food for a wide range of migrating birds, including flamingos (Zagharmi et al. 2015). The lake is surrounded by several freshwater wetlands, forming a critical ecological zone around the lake.

Current Situation of Lake Urmia

Water has always been a key social issue and the drying up of Lake Urmia has become a national concern. The gradual destruction of Lake Urmia would mean the disappearance of a part of the natural history of several thousand years and a loss of social history due to increased migration to cities.

Climate change is one factor behind Lake Urmia's decreasing water level. When comparing the situation of Lake Urmia with other nearby lakes – such as Swan in Armenia and Van in Turkey (Hesari and Naskili, 40) as well as lakes in Iraq and Beyşehir in Turkey (Birkett et al. 2009) – the role of climate in the drying up of Lake Urmia is not convincing as a primary cause. Recent increases in rainfall have not stopped the drying of the lake (Abbaspour et al. 2012).

Economic, social, cultural and political factors lead to a specific level of demand for water. The population growth in the catchment area of Lake Urmia and the excessive use of water in agriculture in this area are among the factors that have decreased the water level of Lake Urmia. The production culture of the farmers in this area relies on traditional methods: basin irrigation leads to evaporation and the infiltration of water in non-cultivable areas and its absorption by weeds. This has resulted in the overexploitation of the area of this lake (Alamohammad et al. 2014, 646).

The construction of the Shahid Kalantari highway to connect the two cities of Tabriz and Urmia, a project based on a railroad that crosses Great Salt Lake in the US state of Utah, inspired much criticism pertaining to the drying up of Lake Urmia. The construction of Shahid Kalantari highway has caused changes in the process of natural sedimentation, which, in addition to disrupting the natural order of the water cycle and the distribution of sedimentation of suspended matter, has changed the natural process and ecological state of the lake (Alavipanah et al. 2005, 58). The unbalanced distribution

^ Figs. 2 & 3 Lake Urmia in 1998 (left) and 2011 (right) (Source: Landsat imagery, courtesy of NASA Goddard Space Flight Center and U.S. Geological Survey).

of salt in the north and south and changes to the normal process of sedimentation resulting from the construction of the highway are factors behind Lake Urmia drying up (Ahmadi and Akbarzadeh 2018, 115).

The results of a variety of research on Lake Urmia reveal that if this process continues without optimal environmental management, we will soon witness the destruction of the ecological, economic, touristic, social and aesthetic values of the lake, where the problems are currently being exacerbated by drought and human interference in the natural environment of the lake.

Current and Future Challenges to this Water System

Any discussion of Lake Urmia as heritage must pay special attention to the impact of the lake drying up and how its drying has been changing society and people's lives. The impacts summarized in this section illustrate the current challenges of water heritage management and the impact of decisions on the future.

Destructive effects on wildlife

In Lake Urmia National Park, 23 species of water birds have been identified in wet years, but

^ Fig 4. The ferry used to lie in a dried up area of Lake Urmia. This part of the lake has slightly recovered, causing the ship to be surrounded by water again. (Source: Solmaz Daryani, 2016, CC BY-SA 4.0, via Wikimedia Commons).

this number has decreased to less than ten in dry years. The disappearance of key species shows that Lake Urmia has undergone drastic ecological changes and has lost its habitat value for water birds (Behroozirad 2011, 2).

Immigration

The drying up of Lake Urmia is causing the destruction of thousands of hectares of agricultural land near the lake. One of the consequences is the unemployment and migration of an estimated 3 million people in the provinces of East and West Azerbaijan (Soleimani Ziveh 2010). Also, according to studies of the Lake Urmia Restoration Headquarters, the dryness of the lake causes the deposition of salt sediments and a bed is emerging that produces dangerous fine dust during intense storms. The salt storm phenomenon will cause even more destruction of agricultural fields and will increase the occurrence of diseases such as asthma and cancer, which in turn will lead to an increase in migration away from the region.

Destructive impact on the tourism industry

Research indicates that the complete drying up of Lake Urmia would be detrimental to tourism. Many people around Lake Urmia have left their villages in response to the ongoing environmental disaster. The village of Golmankhane, for example, was home to 550 people, most of whom worked in tourism. When the lake dried up, they migrated to other cities and can be considered the first victims of this catastrophe (Daryani 2021). Continued reduction of the lake water has damaged recreational opportunities, residential communities and coastal infrastructure.

The issues and problems have led to the creation of the Urmia Lake Restoration Program, which works on supplying lake water from oth-

^ Fig. 5 On weekends, locals and tourists come to see the parts of Lake Urmia around the Shahid Kalantari highway that still have water (Source: Solmaz Daryani, CC BY-SA 4.0, via Wikimedia Commons).

er sources, efficient water management, especially in the agricultural sector, and cooperation among experts. Despite appropriate funds from the government, various specialists' requests, and university invitations, so far the Urmia revitalization project has failed. Annual rainfall partly fills the lake, but a lack of strategies (conserving water, changing the agricultural system, etc.) leads to the lake completely drying up again. Pouladi and colleagues (2021) have analyzed interviews with farmers in the lake basin and specialist staff at the Urmia Lake Restoration Program. Their research indicates that so far, there have been several socio-economic barriers to the restoration of Lake Urmia: a lack of awareness among farmers of advanced irrigation and cultivation techniques, high dependency of rural households on agricultural incomes from small farmlands, water allocation and distribution conflicts between different users and low involvement of local stakeholders in critical policies and management decisions.

Conclusion and Future Approaches

The current condition of Lake Urmia requires immediate action to prevent or reverse the drying process. The Urmia Lake Restoration Program has so far failed due to a lack of participation and a failure to consider the opinions and concerns of local people in the planning phase and when implementing management strategies. Yet ignoring them can affect livelihoods and lead to severe social, environmental, economic and governmental crises. Without the participation of local people and attempting to meet their needs, it will be impossible to revive

Lake Urmia. This will mean the loss of natural heritage and the habitat of species and a loss in the cultural, spatial and historical value of the region, not only because of the reduced water supply but also because of changes in the lives of the residents. Without appropriate action, not only the ecosystem of the lake is at risk, but also the health and well-being of the residents of the basin. Dealing with the challenges and creating a suitable and inclusive process is crucial for the environmental, social and economic sustainability of this region.

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Keta Lagoon: Uncovering Suppressed Heritage Practices for Sustainable Wetland Management

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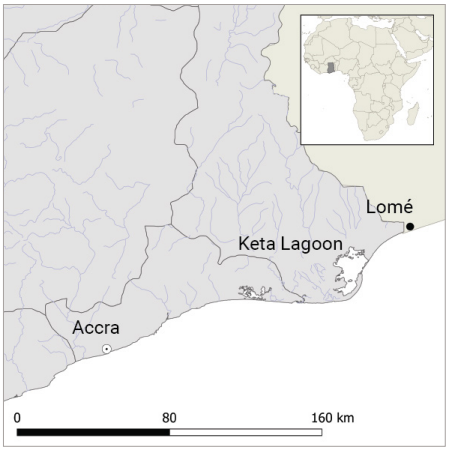
Current efforts to integrate heritage practices in the sustainable management of wetlands in postcolonial nation-states assume that these practices have always existed in the forms they are now. The colonial order, whether deliberately or otherwise, suppressed many local traditional practices. The postcolonial authority's adoption of Western science invariably continued the suppression, albeit in a more liberal form. In the Ramsar Convention, natural scientists were assigned the role of conserving wetlands "for the benefit of humankind in a way compatible with the maintenance of natural properties of the ecosystem." This became known as the wise use principle. This article highlights the history of the Keta wetlands and proposes an integration of key knowledge holders into management plans for a wise use of wetlands in postcolonial states. The colonial and postcolonial regimes made the knowledge holders invisible. Modern imaginaries – Western legal institutions, Western science and Christianity – were privileged over local heritage practices. It therefore requires historical and heritage expertise to uncover local sustainable knowledge for integration into the Ramsar management plan, hence a wise use of wetlands in postcolonial states.

KEY THEMES

CLIMATE

Aw
Tropical savanna



< Fig. 1 A fisher using sail on canoe, 2021 (Source: Jonathan Doe).

Introduction

On August 14 1992, Keta Lagoon, located in Ghana, was designated the Keta Lagoon Complex Ramsar Site on The Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention) list. Although Ghana as a contracting party to the Ramsar Convention has five wetlands listed, the focus of this article is on Keta Lagoon, the largest and most complex wetland in Ghana, and the Aŋlo-Ewe people who live on the banks of the lagoon. Aŋlo-Ewe people migrated from the ancient town of Ŋotsie to the banks of the Keta Lagoon in the early sixteenth century (Amenumey 2008). Their institutions and belief systems made them well-adjusted to the vagaries of the Keta Lagoon and the Atlantic Ocean (Akyeampong 2001; Nukunya 1969). From the ethnographic record, they attribute female and male genders to the Keta Lagoon and the Atlantic ocean respectively. Many decades after that, the Aŋlo-Ewe people came under the control of Danish, German and British colonial regimes. Their chiefs, priests, diviners (*boko*) and belief systems became entangled with colonialism. Local belief systems were also suppressed in colonial and postcolonial regimes. Here, the local fishing practice, *atsidza*, will be highlighted as a *wise use* and as a sustainable fishing practice. In this article, "local belief systems" is used interchangeably with "heritage practices."

Suppression of Heritage Practices during Colonial and Postcolonial Contexts

In postcolonial Ghana, Western science, Western legal regimes and Christianity occupy a dominant position. All three have been perceived as vehicles of modernity and hence modern imaginaries that influence policy choices. Christianity was introduced during colonial encounters and embraced by a large section of the people. The local belief systems were thus perceived as non-Christian, non-scientific and antimodern (Akyeampong 2001). Colonial laws were established to regulate knowledge holders, local belief systems and practices in relation to the Keta Lagoon. For instance, the authority of the priests of Togbi Nyigbla and Mama Bate – a male and female god respectively among Aŋlo-Ewe – was undermined regarding how the lagoon could be used. In 1914 the priests in charge of gods banned the use of sails on the lagoon. The reason for the ban is not clear from the archival records. Suffice it to say, there were sails on European slave ships docked at the nearby Danish slave fort, Fort Prinzensten (Ghana Museums and Monuments Board). The people observed the ban from 1914 until 1920s when the colonial district commissioner teamed up with the paramount chief to remove the ban. Though sails are part of contemporary fishing practices in the area (fig. 1), the agency of knowledge holders had been chipped away. In the same period, some of the mangroves along the banks of the lagoon were seen as shrines, and thus were (p)reserved as such. In 1915, a sub-chief who had been converted to Christianity destroyed the mangrove-shrines in his jurisdiction as an attempt to "christianize" all his subjects. Then, in 1959 the colonial government introduced the concept of a forest reserve along a portion of the lagoon, but there was no relationship between the reserve and local belief systems nor was the agency of the priests of Togbi Nyigbla and Mama Bate engaged in management of the forest reserve (Asafu-Adjaye 1961).

The trend of suppression of local belief systems and knowledge holders took place under colonial direct rule and indirect rule regimes. The forest reserve laws and the laws that banned some of the local practices were implemented

through the chiefs of the Aŋlo-Ewe. Thus, the priests, diviners and leaders of the shrines were sidelined. When Ghana attained independence in 1957, Christianity and its associated modernity continued to be on the rise, while the local belief systems, as well as holders of such knowledge forms, continued to be suppressed. The logic in modern philosophy that allowed for the suppression of local beliefs took on new forms when Ghana ratified the Ramsar Convention in 1988. The lagoon was seen as a scientific object, and it was scientists who determined who should play what role in its management. The involvement of local knowledge holders followed the same logic as the colonial indirect rule system. The Keta Lagoon management plan acknowledges that the traditional council of Aŋlo owns the Keta Lagoon. It is further acknowledged that the Aŋlo traditional council determines who is a community member; the council also resolves conflicts among traditional members.

Furthermore, the council makes "by-laws for wetland resource management based on local knowledge of the ecological dynamics and institutes measures to deter local people from using wetland resources" (Tufour 1999, 27). However, the composition of the traditional council did not directly include priests or diviners, nor was any role directly assigned to them during either the colonial or postcolonial period. Again, the notion of ownership does not include the families and clan heads, some of whom could disagree with the traditional council (Doe 2022).

Instead, traditional authorities, district assembly and civil society groups, which are mainly modern institutions, are recognized as having "decision-making" roles (Ministry of Lands and Forestry 1999, 17). These groups are not direct knowledge holders, as was the case in 1914. There is no clear-cut role for diviners (*boko*), Togbi Nyigbla or Mama Bate priests.

The *Atsidza* Fishing Technique

The *atsidza* fishing process begins with cutting stems and branches of trees from the bank of the lagoon or on the mainland. The number of trees depends on how big the fisherman wants the *atsidza* to be. The cut branches are allowed to dry for about three weeks. The fisher then piles the branches in a boat and ferries them to a desired part of the lagoon, which is usually in deeper areas (*Uego*). The branches are dropped at a specific spot to cover a radius of about three meters. The fisher uses stronger and taller stems for three purposes. The most obvious is to serve as a barrier to prevent the lagoon currents from dispersing the branches. The *atsidza* eventually becomes compact and firm, trapping sediment (mainly anaerobic mud, sand and shell) and creating soft ground for fish to burrow in. When it is left for about a year, the bigger fish (tilapia) go deeper by digging holes in the ground, and the *atsidza* becomes a covering. The other purpose is that the poles serve as a signpost and a warning to other fishers that there is a deposit of branches there. The final purpose of the taller poles is as a stamp of ownership. In some cases, the fisher hangs a bundle of red cloth and cowries, signifying that the *atsidza* is under the protection of his god, so everyone in the community knows the *atsidza* is owned by a particular member of the community.

With the poles showing, it is clear that the *atsidza* occupies space in the Keta Lagoon and has an owner (fig. 2). However, if the poles become weak, it is pushed down by the lagoon currents and it is assumed that no one owns it, so others can harvest the fish residing in the *atsidza* or they may find different uses for the

^ Fig. 2 A fisherman using the atsidza technique in the Keta Lagoon, 2021 (Source: Jonathan Doe).

^ Fig. 3 Seine fishing net, 2021 (Source: Jonathan Doe).

branches. Therefore, *atsidza* ownership is subject to time: it is temporary, with no guaranteed ownership. After a period, the space can revert to another person in the community. There is yet another factor that is important for the duration of ownership: labor. Sure enough, there is labor involved in the cutting of the trees and the making of the *atsidza*. Continued maintenance is needed to ensure the lagoon currents do not overpower the poles. The individual's time and labor become intervening factors in the duration of ownership. It can be said that the time-labor factor, the involvement of personal gods and the belief in the instructions of local priests regulate(d) communal resource ownership in the Keta Lagoon. Given the time-labor factor, most fishers prefer seine net fishing with wooden canoes and sails. However, the *atsidza* fishing technique is sustainable in that it does not pollute the lagoon and does not necessarily deplete the fish stock, but serves as a temporary haven for the fish from those who use the seine net method daily (fig. 3).

Conclusion

In conclusion, the search for sustainable heritage practices for wetland management in postcolonial states requires a deep look at heritage practices that have been suppressed in the colonial and postcolonial periods. There are some that remain visible, like the *atsidza* fishing technique, but they require a shift from dominant modern imaginaries to see how they innovatively complement sustainable measures of SDGs 14 and 17. The combination of archival research, participant observation and awareness of colonial direct and indirect rule would help uncover sustainable heritage practices and their knowledge holders. The current roles ascribed to some local leaders were convenient for the colonial enterprise and may not be helpful for fully integrating heritage practices in wetland management plans. Communal ownership is one viable concept that could be part of management plans. Finally, when heritage practices in Aŋlo are better known, they could promote Ramsar's *wise use* philosophy.

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The Canals of Lima: Landscape and Memory

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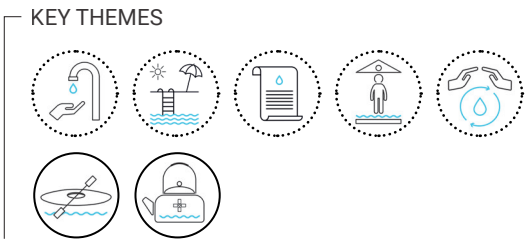
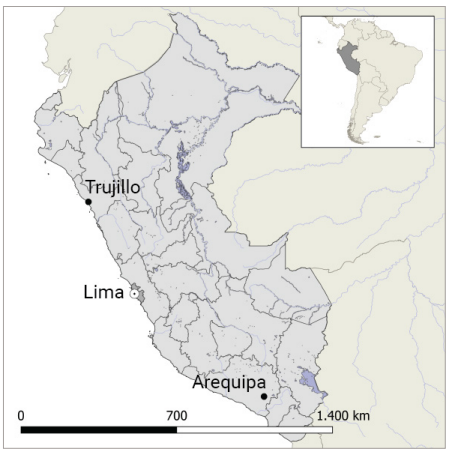
This article examines the ancient irrigation canals in Lima, the capital of Peru, and it reveals the role of indigenous groups who transformed the desert into agricultural valleys over millennia. The current role of the surviving canals is explained, as is their relevance to the city's environmental sustainability. It discusses aspects related to their management from precolonial times to the present and outlines the key elements of the campaign for their declaration as cultural heritage of Peru, sharing the main results, including the 2019 declaration. It also discusses the work done to decolonize traditional narratives that had obscured the indigenous role in the creation of the canal system.





< Fig.1 Beginning of the route of the Surco canal (Source: Gonzalo Cáceres, published in "Canales de Lima, 2000 años regando vida").

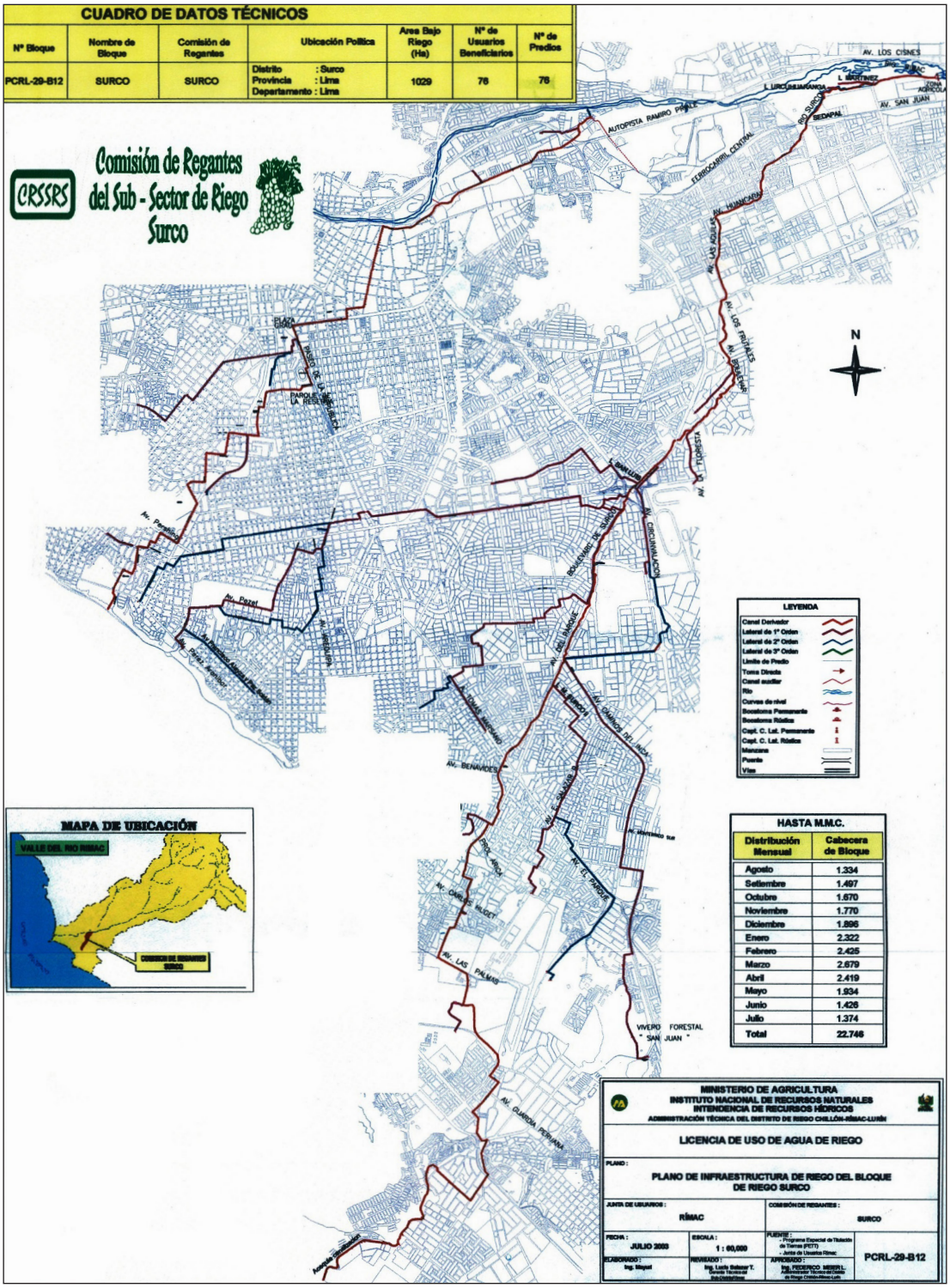
^ Fig. 2 Surco canal running through a park in Lima (Source: Roger Haro, 2018).

Introduction

The city of Lima sits on cliffs overlooking the Pacific Ocean and is part of the Rimac River basin, a vital source of water supply for human consumption, agriculture and energy, including five hydroelectric power plants. The Rimac River originates on the western slopes of the Andes at an altitude of 5,500 meters, some 130 km from Lima, and flows into the ocean. Even though water availability is limited, the Rimac River meets 90 per cent of the water needs of a population of 11 million people. By way of comparison, the Amazon River, which begins in the mountainous region of southern Peru and makes its way down to the Atlantic basin, has an average annual discharge of 215,000 m^3/s. The Rimac's average discharge is 25.8 m^3/s (Surco-Huatica Comisión 2016). Archaeological evidence shows that early indigenous cultures began an extensive system of irrigation canals in what is now the Peruvian capital some 2000 years ago. Their main purpose was to irrigate the desert and use the land for agriculture. These waterways were originally built by redirecting sections of the Rimac River and they traditionally provided water for irrigation by flooding, taking advantage of the city's natural slope. Metropolitan Lima reaches an altitude of 850 m, and the two canals under consideration here begin to descend to the ocean at an altitude of 174 m, which roughly corresponds to where the historic center of the city is today (IRA 2015) (fig. 1).

Originally, there were four "mother" or main canals from which multiple other waterways branched off, in varying degrees of importance and size, crisscrossing the territory. The present article focuses on the two main ones: Surco and Huatica, whose area of influence extends over central areas of the capital, home to about one-third of the city's population. All green areas in the city depend on the canals for their survival, and the canals depend on the flow of the river for their existence. The Peruvian coast is a desert 2.250 km long and Lima, located roughly in the middle, receives an average annual rainfall of 7 mm, which places it in the category of hyper-arid territory. However, a combination of other factors, such as temperate climate, high humidity, an abundant phreatic layer and seasonal green belts contribute to a unique landscape. Two elements that enabled the efficiency and survival of the system over millennia are the progressive slope towards the sea – the route has a descent that varies by one grade per 100 m – and the force of gravity. Today, the Surco and the Huatica canals are managed by an official Water Board and are largely used to irrigate parks and green areas in Lima. The Surco runs for 29.5 km from its source in the Rimac River to the ocean; the Huatica, 15 km. When their main function was agricultural, these mother canals were on average six metres wide and 1.5 m deep, having an additional margin of another six meters on each side (Comisión 2007). Over time, the various indigenous cultures that inhabited Lima continued to expand the system by making new canal branches into existing ones. At the time of their greatest expansion (sixteenth century), they came to cover some 30,000 hectares, which largely corresponds to the total area of present-day metropolitan Lima.

According to Peruvian experts, a distinction must be made between excavating the first canals, which had a limited territorial reach and were not connected to each other (archaeologists have determined that they became connected in Lima around 4000 years ago), and the creation of a hydraulic system or irrigation system, which is the hierarchical organization of these waterways over a large territory (Chacaltana 2016). Available information points to the fact that this system began in Lima around



^ Fig. 3 Current route map of the two canals (Source: Surco-Huatica Water Board, 2003).

2000 years ago. For his part, architect Juan Günther (2012, 50), elaborated on the type of canals that were created, explaining that:

> Building them parallel to the contours of the water level risked causing the water to flow too slowly and silt up the soil it carries on the bottom, forcing the level of the canal to rise gradually until it becomes inoperable (...) On the other hand, building it perpendicular to the contours would have forced the torrent to increase its speed, with the consequence of eroding the bottom of the canal and thus increasing its depth to the point of ruining it as an irrigation feature.

That is a reason why, in Günther's view, the canals were built in a meandering shape and not in straight lines (fig. 2). Arguably one of the greatest achievements of the indigenous cultures here was the transformation of the desert into agricultural land over millennia, a feature that later sustained the local colonial economy. Lima's agricultural landscape remained virtually untouched until the first half of the twentieth century. From the 1950s onwards, the rapid and disorderly growth of the city on former agricultural land led to the destruction of part of the system. As a consequence, the available land watered by the canals was reduced to about 3,000 hectares (Observatorio del Agua 2017). The two canals referred to in this article irrigate 85 per cent of all green areas in central Lima or 1.150 hectares. This is the equivalent of 711 parks in 17 (out of 43) districts where more than three million people live (Comisión 2016) (fig. 3).

History and Evolution

Metropolitan Lima covers an area of about 3,000 km^2 and is home to 11 million people. Throughout pre-Hispanic or precolonial times, and for some 4,000 years, the territory was home to five cultural groups – the Incas were the last of these. Spanish Lima was founded in 1535 on an already existing indigenous system that included valleys with high agricultural production, roads and canals. Due to the very nature of these waterways, which are still in constant use, precise dating is impossible. In archaeology, therefore, inference is used. A key factor is that most of the abundant adobe architecture that has survived would not have been possible without access to abundant water sources – brought by the canals.

A study by the National Water Authority (ANA) found that the first canal in Lima could date back to 2000 BC, being associated with the ancient temple of "Las Salinas," in the district of El Agustino, next to the Rimac River (Casareto and Perez 2016). But this would have been only a canal and not part of any system of canals. It is only around 200 BC that the civilizations in this part of Peru embarked on a pattern of urban development different from that of earlier times, free from rivers (Canziani 2009). Santiago Agurto, another Peruvian architect, believed that the construction of the early canal system allowed the people of Lima to become independent from the riverbank and to be able to build ceremonial and administrative settlements in the heart of the valley, in wide and flat areas suitable for large urban development (Agurto 1984).

In the absence of written records from precolonial times, little is known in detail about how canals were managed. What is better known is that ancient cultures developed and there is knowledge of the relationships between the communities and their canals. There was a very close relationship between the population dedicated to their crops and the water system.

^ Fig. 4 Ancestral ceremony of the blessing of the canal, carried out by an Andean priestess (Source: Joaquin Narvaez).

This relationship was expressed in the form of dances, songs, rituals and cleansing festivals (fig. 4), some of which have survived in the rural areas outside Lima. In precolonial times, the most common crops were cotton, potatoes, avocados, chilli peppers, beans, sweet potatoes, guavas, pineapples and plums. With the arrival of the Europeans, new crops were introduced, like olives, apples, oranges and sugarcane.

Very early on, the Spanish realized the importance of the canals for their subsistence and one of the first pieces of legislation they passed was aimed at protecting them. During the colonial period, the institution of the Water Judge was introduced to deal with the many legal disputes that would arise (Cerdán y Pontero 1793). Many of the cases had to do with complaints from lowland users who had less access to water because their neighbors, in higher areas, were using more than they had been allocated. Despite the constant legal conflicts, agriculture remained the primary activity in Lima until the mid-twentieth century. By then, there were some 800 estates and farms (Orrego 2008), all of which continued to benefit from the existing pre-Hispanic irrigation system.

After the 1950s, as the city grew through successive waves of informal settlements – the result of migration from poorer parts of the country – the irrigation system was severely affected. As agriculture gradually disappeared, many of the primary, secondary and tertiary canals were destroyed or incorporated into the sanitation system. As a result, there are only a few green areas in these new urban sectors. With fewer fields to irrigate, the Water Board reduced the width of the canals from six meters to one and a half. This process of unregulated

urban growth revealed a system that was naturally fragile and became a scenario that represents a pattern of inequality in the city. Today, the greener parts of Lima, where the Surco and the Huatica canals survived, correspond to the richer areas. Here, they irrigate most parks, avenues, universities, golf courses and cemeteries (Comisión 2016).

Water Management

The early inhabitants of the territory managed to use this natural resource efficiently and in a sustainable manner. A few reasons help to explain this. One of them is that before the arrival of the Spaniards, the territory of Lima was politically divided into different groups and archaeological work so far has not found evidence of any continuous warfare (Eeckhout 2019; Gaither et al. 2012), a fact that would have affected the distribution of water. Another reason has been revealed by scientific studies that analyzed bones and stable isotopes of people who died in the area before the sixteenth century: they found consistency in the consumption of healthy diets (Marsteller et al. 2017; Williams and Murphy 2013; Béarez et al. 2003). This suggests a period of peaceful coexistence (albeit of indeterminate duration), possibly in the knowledge that their survival depended on the good use of the canals. It is possible there were rules that had to be respected. That is, each group of people knew who received how much water, where, at what time, and for how long. The same principles still apply today. In other words, this situation reflects the political balance of complex societies, whose planning is the result of a process of continual negotiation (Gavazzi 2014).

At the beginning of the twentieth century, the water boards were reorganized and incorporated into the role of the state. Irrigation Commissions and Water Boards were set up under the Local Water Authority (ALA), the Water Administration Authority (AAA), and the National Water Authority (ANA). The local water board is responsible for the main or mother canal. The Surco-Huatica Water Board is one of 17 such organizations in metropolitan Lima and is the only one serving millions of people. It is made up of 69 users who each pay a rate of 0.10 Peruvian cents per cubic meter of water (US$ 0.028 approx.). Among its members are local authorities (17 municipal districts for both canals), 10 public institutions (including the city's two main cemeteries), 7 private institutions (including 3 universities and 4 private clubs), as well as a small number of urban farmers.

The most common risk factors for the proper function of the canals along the main Surco canal (the Huatica now runs under the city streets) include those stemming from urban sprawl, encroachment on private and/or public land, waste dumping, illegal use of the waterway and unauthorized diversion of the route (Lizarzaburu 2018) (fig. 5).

The irrigation board organizes an annual cleaning operation twice a year, in February and August, excluding emergencies (overflows, floods, accidents), to allow for the correct flow of water (fig. 6). Although traditionally irrigation was accomplished by flooding, in recent years, more technical irrigation systems are being installed. In other cases, irrigation is carried out with water carts, in which trucks draw water from the canals. When the research on the canals I did for the campaign was initiated, in addition to the risk factors affecting them, some striking data related to the availability and consumption of water in Lima soon came to light:

- Peru ranks number 8 in potential water

^ Fig. 5 Illegal dumping of waste is one of the major problems in functioning of the canals (Source: Javier Lizarzaburu).

^ Fig. 6 Cleaning of the canal (Source: Surco-Huatica Water Board).

availability in the world, with 1.89 per cent of the total (FAO 2013). However, 98 per cent of those resources go directly into the Atlantic basin.

- Most of the population, 66 per cent, lives close to the Pacific basin, where water availability is calculated at 2.2 per cent (ANA).
- The WHO recommends an average water usage of 100 liters per person per day. The average in Lima is 250 lt pp pd (Ministry of Housing 2018).
- The richest districts consume the most in Lima: San Isidro, 477 lt pp pd, and Miraflores, 436 lt pp pd.
- In comparison, in the city of Amsterdam, the average is 133 lt pp pd (Waternet), Paris 143 lt pp pd, down from 151 in 2008 (Statista).

If people were using so much water in a place where there is so little, it seems clear that there was a lack of awareness. Even though the use and distribution of water is not the responsibility of the water boards, this data together with other developments happening at that time prompted the Surco-Huatica Water Board to rethink their way of working (Lizarzaburu 2021). Additionally, the process of global warming has had its greatest impact here, causing the loss of more than 50 per cent of tropical glaciers, the source of water for the capital, in the last 50 years. And the process continues. In this context, Lima's environmental sustainability depends to a large extent on the proper management of this water infrastructure. Without the canals, green areas are impossible and Lima, with an average of 3 m^2 pp, already has a serious deficit of those.

In 2015, the Sustainable Development Goals and the New Urban Agenda were launched, and the Surco-Huatica Water Board understood that

this new vision for city, landscape and natural resource management offered new opportunities. Consequently, they decided to incorporate some of the elements suggested by the international agreements. Thus, together with the campaign a vision of a sustainable city was developed, defined by:

- Sustainable management of water resources;
- Protection and enhancement of biodiversity;
- Creation of new, safe, accessible public spaces;
- Promotion of sustainable mobility;
- Recuperation of cultural heritage;
- Support for urban resilience through green areas (Comisión 2017).

Campaign/Decolonizing Heritage

While canals in a country like the Netherlands are part of the national identity, this is not the case in Lima. Here, the dominant narrative had historically obscured their existence as an indigenous creation, popularizing the myth that they were natural rivers. In this way, that narrative became a symbol of an erased memory that began during the colonial period and continued until recently. Originally the canals were a visible part of the urban landscape (fig. 7).

However, in recent decades, and in order to protect them, they were covered (fig. 8). This is the case for the entire length of the Huatica canal and for 21 km of the 29.5 km of the Surco canal. Thus, both continued to disappear from the urban fabric, losing their potential as generators of identity and as a structuring element of an urban space that fosters encounters and the shaping of citizenship.

In 2014, I started researching and writing about the Lima canals. My proposal for a full-fledged campaign to raise awareness about them was officially approved during an Extraordinary General Assembly of the Irrigation Commission on 29 February 2016. The main and most immediate objective was to secure recognition of the Surco Canal as Peru's Cultural Heritage, to be granted by the Ministry of Culture. Additional objectives included raising awareness about the canals' environmental importance and vulnerability, fostering links between citizens and their canals and green areas, and rehabilitating their indigenous, precolonial origin.

In the eight months that the campaign officially lasted, over 100 stories were published in the press, TV and radio, both in the national and international media. The social media campaign reached over two million people and 25 public meetings were held in citizens' associations, municipal auditoriums and cultural centers. As the campaign expanded, artists, urban and heritage activists and citizens came together in different ways to offer their support, all of which gave further momentum to the petition to have one of the canals declared national heritage.

Process for the Declaration of National Heritage and UNESCO Historic Urban Landscape Approach (HUL)

As part of the process, the Ministry of Culture required a document produced by the petitioners justifying the reasons for requesting such a declaration, which was produced. An advisory board was appointed to ensure academic and professional support, and the members provided advice along the way. Equally, some concepts had to be clarified, one of them the reasons why the canals should be considered heritage. The answer to this was based on the fact that there existed precolonial and colonial

^ Fig. 7 Huatica canal in the 1940s as it went through the city of Lima (Source: Colección Juan Mulder).

^ Fig. 8 Covered canal: the curved paving follows the route of the canal, underneath (Source: Javier Lizarzaburu).

evidence, material and written, showing that it was a pre-Hispanic creation, that over time the system of canals had transformed the desert into valleys, and that despite having survived in a very complex urban environment, they had a definite impact on the environmental sustainability of the city. Along with this, the document incorporated a section on the values that, in the opinion of the petitioning group, were associated with the canals. They included cultural, historical, environmental and territorial values.

In October 2016, the final report was submitted to the ministry. What made the experience unique was the willingness of the authorities to engage in regular contact with the petitioning group in order to advance the request. Despite that initial openness, during the first meetings some officials expressed their reluctance to grant national heritage recognition to the canal. The ministry contended that they only considered the "monumental and extraordinary" to be National Heritage – a view that eventually changed but made the process longer. The first legal argument supporting the request did not manage to convince the authorities.

It was later that the group learned of UNESCO's 2011 Recommendation on Historic Urban Landscapes (HUL), and how heritage considerations had been adapted precisely in the light of changing urban environments. The group then decided that this approach fitted the case well. Together with the HUL argument, a UNESCO report on Heritage Canals, from 1994,[1] was included in the new document to the ministry. Two and a half years later, in March 2019, Vice-Ministerial Resolution N° 041-2019-VMPCIC-MC was officially published in which (one of the four segments suggested by the group) was declared to be part of Peru's National Cultural Heritage (El Peruano 2019).[2]

Conclusions and Challenges

Although the main objectives of achieving heritage status and raising awareness about the canals were attained, the final result shows progress and setbacks. One of the shortcomings of the campaign is that it did not reach the most problematic areas. This was partly due to the fact the activities that were organized and the information that were produced were mainly disseminated through the media and social media, to which many of the people living in these areas do not have access. Organizing public presentations there to explain the process, as happened in other parts of the city, proved to be a difficult task. Consequently, many of the original problems there continue to exist. At the water management level, some fundamental changes are underway. The main one has to do with Lima's vulnerability to climate change and its increasing levels of water stress. In the last five decades, over 50 per cent of the glaciers that feed the city have melted, and the process is now unstoppable. At the same time, every year Lima produces 500 million m^3 of wastewater. Of this total, 80 million m^3 are treated and discharged into the sea (OEFA 2014). On the other hand, the water provided to the city by the Surco and Huatica canals is on average less than 20 million m^3 per year (Inventario 2007). So, the organization is now working to achieve a far-reaching transformation. That is, the plan in the medium-to-long term is to stop using water from the river and start using treated wastewater instead, which would be exclusively for parks and green areas. It is an ambitious plan, but it seems there is a new understanding of the future threats and the focus is changing.

At the level of narratives, it was important to make the effort in reclaiming the indigenous memory and identity of the canals, especially in a city where this contribution historically tended

to be minimized or erased. Beyond academia, this narrative of continuity did not exist, so this was the first time an integrated vision was put into the public domain. As part of the production of the book that was later published, more than 120 places watered by the canals, or which were irrigated by them at some point in the past, including parks, archaeological sites and public spaces, were visited. This made it possible to immerse oneself in the different layers created by this system. It's not just the green spaces. It is the variety of species of trees, birds and flowers that have made their habitat in a city where it never rains. They are the places that citizens use for sports, walks, games or wheelchairs. They are the spaces for community, commercial and artistic activities. Without these spaces that exist thanks to the canals, Lima would be less Lima. There are important challenges ahead, but there are also important lessons from the past, which have not lost their relevance.

Acknowledgment

This text is the result of work carried out by the author between 2014 and 2019 on the canals of Lima and the city-wide campaign he led to obtaining official recognition of them as part of Peru's cultural heritage, achieved in 2019. The two pillars of this work were memory and sustainability, and the underlying aim was to restore the canals' indigenous identity. The campaign and the publication of the book were funded by the Surco-Huatica Water Board. 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.

1. https://whc.unesco.org/archive/canals94.html

2. https://busquedas.elperuano.pe/normaslegales/declaran-patrimonio-cultural-de-la-nacion-al-paisaje-arqueol-resolucion-vice-ministerial-no-041-2019-vmpcic-mc-1752226-1/

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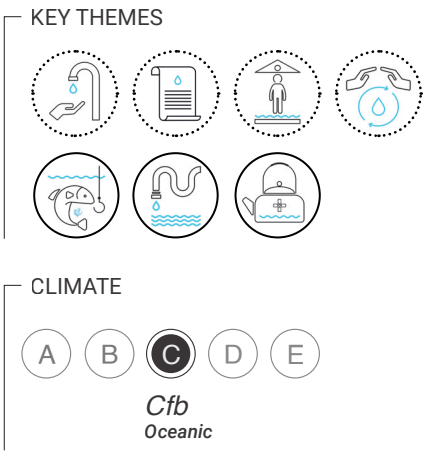
Blue-Green Infrastructure: An Opportunity for New Natural Heritage in Zwolle

Nanco Dolman
Deltares

Living with water is an essential part of the cultural heritage of the city of Zwolle, NL. The historic development of the city within its water systems has been recognized as an inspiration for climate adaptation. In July 2019, the city of Zwolle presented its Adaptation Strategy. Building on its water heritage, a cohesive blue-green network (city scale) in the city can develop and expand, with room for urban sponges (neighborhood scale) that will combat heat stress. This will create a new natural heritage that is recognized and supported by the community. In this plan, various components are interconnected and will strengthen the blue-green network as the physical basis of an adaptation strategy to make Zwolle and its surroundings climate proof and adaptive. Zwolle's blue-green transformation aims at achieving SDG 11 "Sustainable Cities and Communities" and has the potential to fulfill targets regarding climate action (SDG13), the protection of water quality (SDG 6) and the restoration of biodiversity (SDG 14 and 15).



< Fig. 1 Museum the "Fundatie" (foundation) along city canal in Zwolle's historic city center (Source: Nanco Dolman).

Dutch Demonstration Delta in Zwolle

Zwolle is a mid-sized city in the IJssel-Vecht delta in the Netherlands, which has become a demonstration model of water resilience and climate adaptation. Efforts there align with the National Environmental Vision (NOVI) of the Zwolle Region for climate adaptive growth as designated by the Dutch Government. The IJssel-Vecht delta is a historic and vulnerable cultural landscape, with a unique delta ecology. It is close to Lake IJssel, dominated by several rivers interspersed with both low-lying wet polders and higher, dry catchment areas. In synergy with urban growth and climate change, the IJssel-Vecht delta adapts to water extremes, including floods and droughts.

Zwolle, which became one of the Dutch Hanseatic cities in the thirteenth century, marks the location in the IJssel-Vecht delta where the local and regional water system flows into the main water system. Water is a cornerstone of identity and mindset in Zwolle. Living with water, working together on water: these have always been taken for granted in Zwolle as necessary and important. In the synergy between its heritage and the current water issues, Zwolle has developed an adaptation strategy (Dolman 2019b) that proposes required activities and measures to transform Zwolle into a city with sufficient resilience to cope with climate change. By strengthening green infrastructure and giving water more room in both the public and private domain, Zwolle's ambition is to become the leading blue-green city of the Netherlands.

Although the definition may vary around the world, mid-sized cities have one thing in common: they represent the majority. Zwolle may well exemplify many mid-sized cities worldwide. The diversity of issues in Zwolle has sparked skills and solutions that could well be utilized in other mid-sized cities. Zwolle's spatial transformation aims at achieving Sustainable Development Goal (SDG) 11 "Sustainable Cities and Communities" (Dolman 2021). The blue-green infrastructure (BGI) in Zwolle has the potential to fulfill multiple targets outlined in the SDGs, such as those related to water (SDG 6 and SDG 14), land (SDG 15) and climate change (SDG 13).

The Dutch Water City of Zwolle

Zwolle was founded in the Middle Ages on a sand ridge between the IJssel river and the Overijsselse Vecht (Municipality of Zwolle 2019). This was an elevated and habitable place in an otherwise swampy landscape where the inhabitants of the city were protected against rising water. Due to the parallel location of the sand ridge along IJssel and Vecht, Zwolle originally had a linear shape. Until the middle of the sixteenth century, the low stream valleys around the city remained undisturbed. In 1294, Zwolle joined the Hanseatic League as a trading city. Since the city of Zwolle was only a few kilometers from the IJssel, to facilitate trade people wanted to dig a canal as early as the Middle Ages. This plan was successfully opposed for a long time by the competing IJssel towns of Kampen and Deventer. They managed to prevent the canal-building until 1819 when the Willemsvaart was opened, a canal which runs from the center of Zwolle to the river IJssel.

In the middle of the nineteenth century, the city walls lost their military function. For public health reasons following the 1866 cholera epidemic, the first sewer system was installed (in 1873). In 1900 railways began to influence Zwolle's spatial development. Workshops and working-class and residential areas were built in the immediate vicinity of the city center. And

to enable the expansion of the city and its traffic network, many natural stream valleys and waterways were filled in and "buried" under the urban expansions.

In the early 1960s, digging started on the Zwolle-IJssel Canal, which would connect the Zwarte Water with the river IJssel. This new canal was necessary to improve access to the new industrial area along the Zwarte Water after the expansion of the Holtenbroek district. In addition to shipping, the canal is also used for roach and bream fishing. Zander and eel are also caught with some regularity. Mussels are also found in the canal. After the Zwolle-IJssel Canal opened in 1964, the Willemsvaart became redundant. The old canal with the associated locks is now valued as heritage. The lock complex and the bridge keepers' houses at the Katerveer can still be admired, as can the remaining part of the old canal. The locks near the river IJssel are still in the same condition as in 1819.

In November 2017, the city council adopted the environmental vision "My Zwolle of tomorrow," a vision of the future that invites, inspires and stimulates citizens to fill in the space in the city together. The Environmental Vision for Zwolle indicates how the city can develop between now and 2030. The vision not only concerns growth and quality of life, but also sustainability, recreation, education, welfare, employment and efforts to deal with climate change.

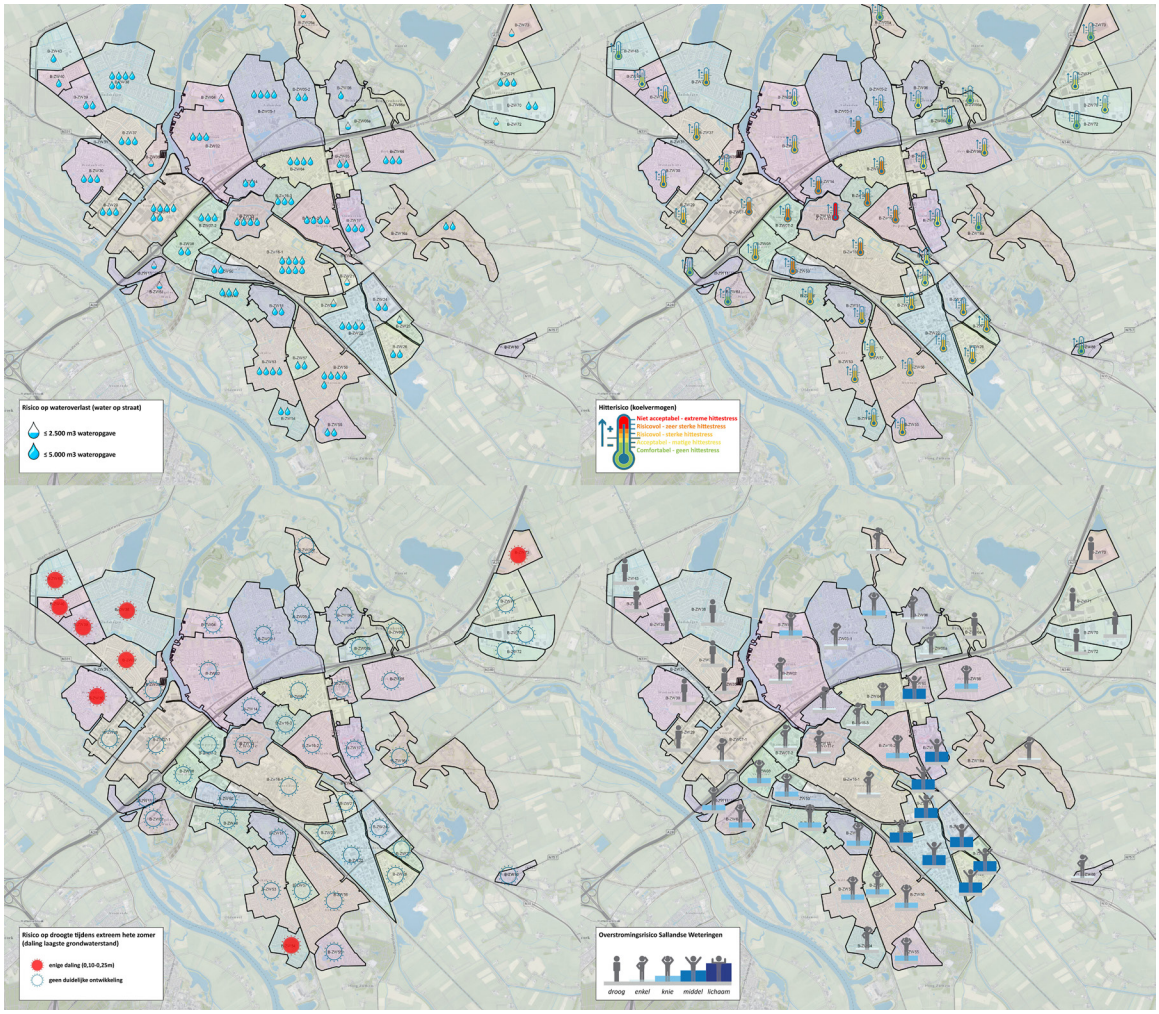
Zwolle Adaptation Strategy Based on Water Heritage

The Zwolle Adaptation Strategy has been developed because of Zwolle's vulnerability to the effects of climate change, namely, increasing heat stress, flooding and drought. The impacts of climate change are mostly felt through water, to which Zwolle is inextricably linked because of its history. In Zwolle, water comes from five sides: (1) Lake IJssel – wind/ storm, (2) rain, (3) the main river system of IJssel and Vecht, (4) local and regional water courses of Salland and (5) groundwater. Changes in these water systems also affect the city's cultural heritage, including historic buildings, the quays along the canal around the city center and the monumental trees.

The city of Zwolle presented its Adaptation Strategy (Dolman 2019b) in July 2019. The strategy's development was supported by the Zwolle climate team and divided into four constructive phases: (0) inception report, (1) assessment of climate vulnerabilities-climate stress test, (2) risk dialogues and strategy development and (3) implementation agenda vision 2050.

A climate vulnerability assessment or stress test has been performed. The different vulnerabilities to climate change, like pluvial floods, heat stress, droughts and fluvial floods, were placed in mutual perspective and in relation to water quality, vital infrastructure and the mobility and building program, which focuses on reconstruction.

Following a preliminary version of the stress test based on the climate atlas of the local water authority, Zwolle conducted more in-depth stress tests. Different situations were investigated, including nine rainfall events (pluvial flooding), different regional fluvial flooding scenarios (regional water courses) and two heat scenarios (tropical day and warm nights). Various analyses and filters were then applied. This process has provided tailored insight into the level of specific urban land use, like buildings and infrastructure. More information can be found in the geo-portal climate atlas of Zwolle for professionals as well as in the public version



^ Fig. 2 Hot-spot maps of climate change effects (from left to right and top to down): pluvial floods, heat stress, droughts and fluvial floods, 2019 (Source: Nanco Dolman).

of the climate atlas (Municipality of Zwolle 2019).

Not all districts and neighborhoods in the city face the same climate stress challenges. To understand the differences, Zwolle is divided into 55 subareas based on urban typologies/period of construction, watersheds in the (storm) water system and elevation of the surface levels. The climate stress effects (pluvial floods, heat stress, droughts and fluvial floods) are translated into these subareas in zo-called climate hotspot maps (fig. 2).

The Zwolle Adaptation Strategy is not a generic campaign. Zwolle opts for a targeted strategy in which actors are actively involved in solving specific challenges and co-creating opportunities. And the municipality of Zwolle cannot implement climate adaptation alone. Meas-

ures must also be taken by owners on private property. The municipality is therefore seeking explicit cooperation with private parties and residents. To this end, various city talks, multiple actor meetings with joined interests, urban design ateliers and climate risk dialogue workshops have been organized. These workshops in Zwolle took a thematic approach, including a dialogue about the opportunities of cultural heritage for climate adaptation. Historical water system maps turned out to be an especially important source of inspiration and a foundation for strengthening the urban blue-green network. To accelerate implementation of climate adaptation projects in Zwolle and in the IJssel-Vecht delta region, in 2018 the Climate Campus partnership for professionals was established. And to help private parties and residents, the municipality of Zwolle has appointed a so-called "climate proof" acceleration team. This team provides (internal) road shows about the role of the city and it facilitates, inspires and motivates action in climate adaptation.

Parts of Zwolle are largely paved, with little space for BGI, especially in the areas in and around the historical city center. Moreover, the drainage capacity around the city center (outside the dikes) is limited. Zwolle is actively working in the focus areas with little surface water and a lot of paving. Following the risk dialogues, Zwolle is taking the initiative to draw up so-called "blue-green solution maps" in collaboration with interested parties and residents.

Transition to a Blue-Green City

Zwolle aims to become climate proof by 2050, and it is one of the cities where pilot projects were implemented in the context of the EU Interreg project CATCH (which stands for "Water Sensitive Cities: the Answer To Challenges of Extreme Weather Events"). This project aims to accelerate the climate resilience process by redesigning cities' urban water management (Özerol et al. 2020). A city's path to greater water sensitivity has traditionally followed a sequential path whereby each "state" builds on the development of the previous stage. Zwolle has been classified as one of the "Drained and Waterway" city states.

The development of the Zwolle Adaptation Strategy was one of the CATCH pilots. This targeted strategy to be climate-resilient by 2050 was developed in 2019, in a context of increasingly extreme weather conditions and urban flooding. The Zwolle Adaptation Strategy involves six components, including (1) spatial elaboration in a "blue-green" city, (2) the "new normal" for professionals, (3) private action perspective, (4) regulations, (5) financing and (6) monitoring and evaluation (Dolman 2021). Furthermore, the strategy is built on three blue-green spatial design principles and collaborative spatial planning (table 1). Working toward a livable and attractive blue-green city, is at the forefront of the Zwolle Adaptation Strategy. By strengthening green infrastructure and giving water more space in both the public and private domain, Zwolle has the potential to become the leading blue-green city of the Netherlands. Zwolle is therefore focusing on a blue-green design, based on the three principles included in table 1 which are mapped spatially in figure 3.

The first principle refers to sufficient urban sponges for detaining, retaining and delaying rainwater. In this respect, the city of Zwolle, together with residents and businesses, collectively work to expand Zwolle's sponge effect at the neighborhood/district level. The second principle is the blue-green city network, within which the sponges can drain excess water and provide discharge and storage. To address this

Blue-Green design principle	*Spatial scale*	*Who?*
Sufficent urban "sponges" for detaining (using), retaining or delaying rainwater	Buildings, streets and neighborhoods	City, together with its residents and actors
Blue-green city network on which "sponges" can drain excess water and in which discharge and storage takes place	Neighborhoods, disctricts and city	City, together with water authorities
Emergency valves for the blue-green network and overflow areas where water can temporarily go in extreme situations	City, region and delta	City, together with water authority, regional authority and neighboring cities

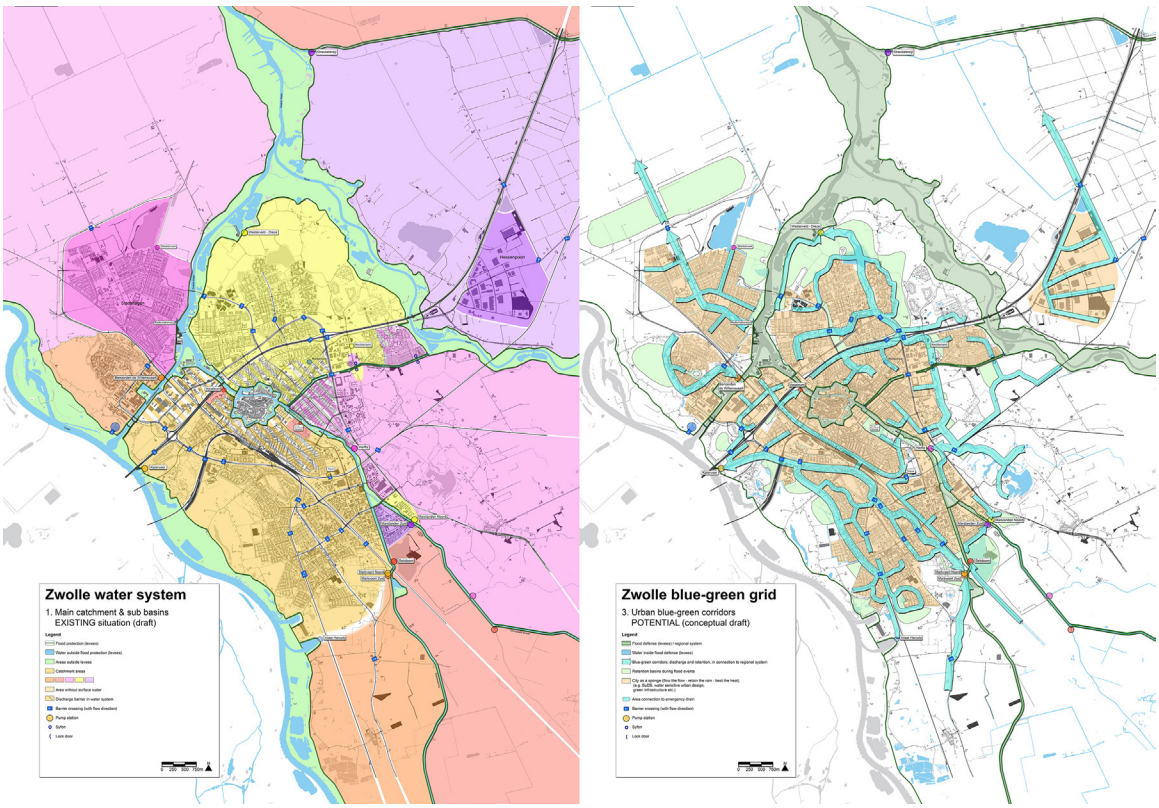
^ Table 1 Design principles for a blue-green city of Zwolle, 2019 (Source: Nanco Dolman).

principle, the Adaptation Strategy aims for a blue-green grid at the urban level, which entails a joint responsibility between the city and the water authority. Finally, the third principle refers to emergency valves for the blue-green network and overflow areas where water can temporarily go in extreme situations. This is related to the "Water-resilient Zwolle" plan at the regional water system level, in which responsibility is borne by the central government, the regional authority, the water authority, the city and neighboring cities.

Based on the analysis of the historical and current water system in Zwolle, additional water connections in the city have been proposed. The aim is to create a robust water system that builds on Zwolle's water heritage. With the cohesive blue-green network (2nd principle), the city can develop and expand, with room for urban sponges (1st principle) and combating heat stress. The future water system is without dead ends, connected on all sides, has multiple drainage routes and no hydraulic bottlenecks (e.g., bridges instead of culverts).

By preserving and strengthening Zwolle's historic water and green infrastructure, like the canal that surrounds Zwolle's historical city center, it should be possible to restore several missing links in the blue network. This includes daylighting of buried watercourses and restoring them to more natural conditions. An example is the former canal along the Deventerstraatweg in Assendorp, as part of the Spoorzone (railway area)-Hanzeland (re)development. This is part of a larger scale blue-green design, which includes the green corridor (*groene loper*) connecting with the city center, a super sponge in the station square, a green footbridge (*passerelle*) and a new Koggepark.

The municipality of Zwolle also actively engages residents in measures related to climate change. In Zwolle everyone is a delta worker. For example, after a Neighborhood-by-Neighborhood survey conducted in 2016, residents reported concerns about flooding in the Stadshagen district. In this context, the city started the SensHagen project that encourages residents to measure temperature and air quality through sensors in their gardens. There is also a web form where residents can report flooding in the city, indicating the exact location on a map. Another relevant local non-governmental actor is the initiative 50 Tinten Groen (50 Shades



^ Fig. 3 Zwolle water system in current situation (left) and potential blue-green grid beyond 2050, projected on the existing water systems and green infrastructure, 2019 (Source: Municipality of Zwolle).

of Green), organized by and for residents of Zwolle's district Assendorp. This non-profit organization is built on a collective neighborhood approach to make the neighborhood greener and more sustainable, resulting in more than 40 projects up to now. It has received financial support from the city of Zwolle, the regional authority, water authority and the collaborative support of Windesheim Honors College.

Conclusion and Future Steps

Living with water is an essential part of the cultural heritage in Zwolle. The historic development of the city within its water systems was recognized as inspiration for climate adaptation in Zwolle. Building on this water heritage, a cohesive blue-green network (city scale) in the city can develop and expand, with room for urban sponges (neighborhood scale) that can combat heat stress. This will create a new natural heritage, recognized and supported by the community, in which various components are interconnected and strengthen the blue-green network as the physical basis of the adaptation strategy to make Zwolle and its surroundings climate proof and adaptive. By implementing Blue-Green Infrastructure (BGI) in three levels of collaborative spatial planning (neighborhood, city, region), Zwolle has been promoted as a frontrunner Blue-Green City in the Dutch

^ Fig. 4 "Pelsertoren" (medieval defensive tower) along Thorbecke canal seen from the Diezerpoorten bridge (Source: Nanco Dolman).

demonstration delta.

Climate change and the current Covid-19 pandemic highlight the value of green spaces in cities. The move toward blue-green futures involves a spatial transition and needs a shift in understanding. Such a step change will also require a culture change, from seeing water and its supply, transport and drainage as add-on infrastructure, to realizing how multifunctional BGI can be an integral part of our living environment. We must invest and build social and institutional capital to create a sophisticated city attuned to an ecologically sustainable lifestyle.

Although part of the current water infrastructure is valued as heritage now, cities like Zwolle have historically invested heavily in single-purpose and (engineered) infrastructure, and consequently, in the maintenance and upkeep of these systems. This calls for developing multifunctional infrastructure, based on regenerative or water-positive measures, like nature-based solutions as nodes of blue-green infrastructure networks. People will benefit from the exposure to nature, but the approach will also enhance biodiversity. This will stimulate urban planners to redesign the urban water management by considering Zwolle as a water catchment and urban ecosystem promoting self-sufficiency. Additionally, sustainable water usage and the transition to a water-sensitive city can be promoted along with other transitions, such as clean energy and a circular economy.

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