SECOND EDITION

ADB

H2O DIGITALIZING

AN INTERACTIVE E-MAGAZINE

THE FUTURE OF WATER IN ASIA AND THE PACIFIC

INNOVATION-IN-ACTION
Piloting Emerging Water Technologies in ADB Projects

FOUR TIPS ON ADAPTING WATER SOLUTIONS
in the Pacific Context

CAN SMART WATER SYSTEMS OUTSMART THE CLIMATE CHALLENGE?
High Hopes and an Army of Nerds to Fight the Coming Water Crisis

LISTENING TO PIPES
Intelligent Water Leakage Management Systems

TRANSLATING TECHNOLOGY TO THE LOCAL CONTEXT
The Khyber Pakhtunkhwa Cities Improvement Project

A DECISION SUPPORT SYSTEM
for Managing Equitable Water Distribution for the Cauvery Delta in India

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This work is dedicated to our dear colleague, Shiva Prasad Paudel, who bravely fought cancer until October 2024. His kindness, strength, and unwavering commitment to this work as shown in his contribution to this publication will always be remembered.

A Message from the Director General

F. Cleo Kawawaki

Director General
Sectors Department 2
(WUD, AFNR and DIG)
Asian Development Bank

In the face of unprecedented challenges, Asia and the Pacific stands at a critical juncture. Our region, vibrant with progress, also grapples with the harsh reality that over 2 billion people still lack safe water and sanitation. Over 80% of wastewater is discharged untreated into the environment. The recent severe droughts in Southeast Asia underscore the urgency of our mission, as water-related natural hazards continue to threaten our progress and demand innovative solutions.

Our vision is clear: to create a water-secure and resilient Asia and the Pacific through the power of digitalization. The Asian Development Bank's newly formed Sectors Department 2, embodies this commitment: It brings together under one roof the Water and Urban Development (WUD) Sector Office, the Agriculture, Food, Nature, and Rural Development (AFNR) Sector Office, and the Digital Technology (DIG) Sector Office. It is a privilege for me to be at the helm of this department.

The second edition of Digitalizing H_2O showcases transformative stories and case studies–examples that highlight the power of digitalization in revolutionizing water infrastructure and service delivery. By equipping water operators with advanced tools and fostering knowledge exchange, we empower them to make data-driven decisions, optimize resources, and enhance resilience.

I extend my heartfelt gratitude to all contributors, partners, project officers, and stakeholders who continue to drive the work in bringing water security and a resilient future for Asia and the Pacific. Your dedication and expertise are vital in driving the digital transformation of the water sector.

Foreword

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We live in an increasingly complex era and region. Asia and the Pacific, while home to 17 of the world's booming megacities, is also home to 2 billion people without safe and equitable access to water supply and sanitation. The impacts of climate change are posing serious challenges to decades of progress made in infrastructure and services and threatening the lives and livelihoods of people.

As we approach the critical deadline for the Sustainable Development Goals in 2030, it is imperative that we leverage cutting-edge technologies and innovative solutions to ensure a water-secure and resilient future for the region.

The second edition of *Digitalizing H_2O* comes at a pivotal moment. This publication underscores the commitment of the Asian Development Bank (ADB) to harnessing digital solutions to address multifaceted water challenges.

Over the past few years, the *ADB e-Marketplace for a Water-Secure and Resilient Asia and the Pacific* has endeavored to equip the water sector with tools to address water and climate challenges. By spotlighting high-impact innovations and fostering knowledge exchange, the e-Marketplace has enabled water professionals to make data-driven decisions, optimize asset management, and enhance climate resilience. The stories and case studies presented in this second edition of *Digitalizing H_2O* highlight the transformative power of technology in improving water infrastructure and service delivery.

One of the key themes explored in this e-magazine is the importance of data-driven efficiency. The integration of smart solutions such as geographic information system (GIS), online sensors, and automated controls have revolutionized the way utilities operate, allowing for swift and informed decision-making. The success story from an ADB small towns water supply and sanitation sector project in Lekhnath, Nepal, demonstrates the tangible benefits of these technologies in reducing nonrevenue water (NRW), improving service reliability, and ensuring sustainable resource management.

Another critical aspect addressed in this publication is the need for integrated water management systems. Fragmented policies, insufficient funding, and limited institutional capacity are some of the roadblocks to achieving a holistic approach to managing water resources. The ADB case studies from the Mulan River in Fujian, People's Republic of China, show that a collaborative approach from local departments and sectors makes the best decisions for the public. Another project story from Timor-Leste shows how stakeholder buy-in is crucial for digital transformation.

Climate resilience is another cornerstone of our efforts to digitalize water management. The escalating impacts of climate change necessitate adaptive and flexible infrastructure solutions. Nature-based solutions, advanced climate tools, and resilient infrastructure designs are essential to safeguarding our water resources against unpredictable climate shocks. The ADB case study from the Cauvery Delta in India shows how an irrigation system can protect and inform coastal districts regarding cyclones and flooding, as well as aid in analyzing crop rotation and water planning.

Finally, the uptake of technology does not always have to be drastic. Seemingly simple applications like installing an intelligent water leakage system to monitor pipes in an ADB project in Dehradun, India, can drastically improve NRW loss. A simple, peer-to-peer learning session about activated sludge was deemed relevant in the Pakistan context.

As we continue to navigate the complexities of water management in the 21st century, it is clear that innovation and digitalization will play a central role in our success. ADB will continue to promote emerging technologies and foster collaboration among water operators, technology providers, and development partners. By accelerating the adoption of smart water solutions, we can create a more resilient and water-secure Asia and the Pacific.

In closing, we would like to extend our gratitude to all the contributors, partners, and stakeholders who have made this publication possible. Your dedication and expertise are instrumental in driving the digital transformation of the water sector.

Programs Supporting Digitalization

Digitalizing Water: How the ADB e-Marketplace Is Spotlighting Innovative Solutions for a Water-Secure and Resilient Future

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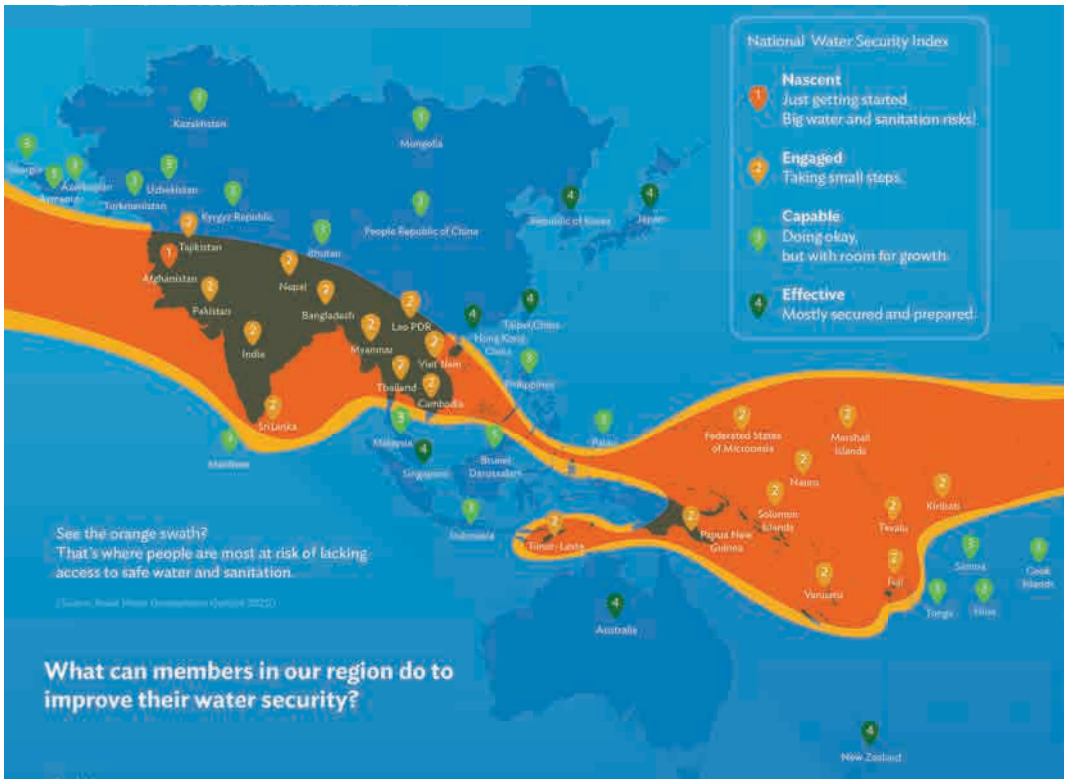
In 5 years, the world will approach the deadline for the Sustainable Development Goals (SDGs). Are we, the water sector in Asia and the Pacific, close to achieving water for all as we pledged under SDG 6?

Here is some good news: the region has seen an overall improvement in national water security. Assessments from the ADB Asian Water Development Outlook 2020 (Figure 1) revealed that the number of ADB developing member countries (DMCs) in the "nascent" and "engaged" stages of water security cumulatively decreased from 30 to 22, while the number of DMCs in the "capable" and "effective" stages increased from 19 to 27.

Figure 1: National Water Security Index

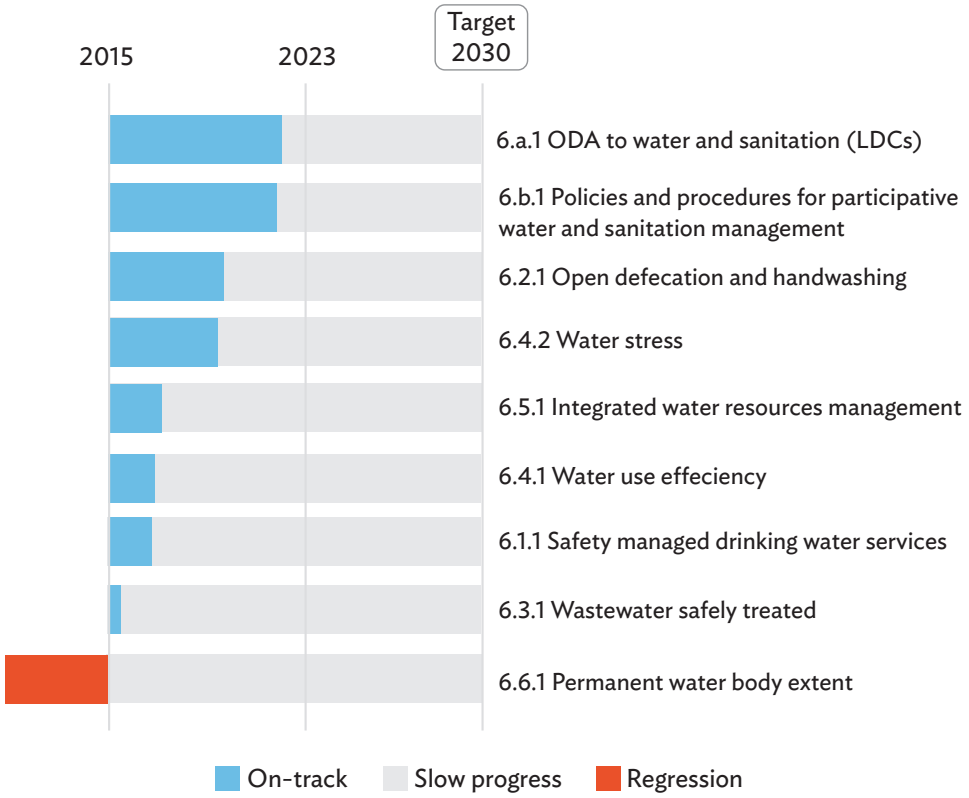


Source: Asian Development Bank. 2020. *Asian Water Development Outlook 2020.* https://www.adb.org/publications/asian-water-development-outlook-2020.

And here is the bad news: Asia and the Pacific, despite its economic progress, is not on track to meet the SDG 6 targets (Figure 2). In a region with over 4 billion people, there are enormous challenges in safe water and sanitation service delivery. Around 500 million people still lack access to a basic water supply and 1.14 billion lack access to safely managed sanitation. Around 80% of wastewater is untreated, contributing to persistent pollution and resulting in a regression in SDG indicator 6.6.1, which refers to water-related ecosystems.

Moreover, with climate change impacts and rapid urbanization threatening to undo or render obsolete the development work in recent decades, the water sector yet again faces a complex conundrum.

Figure 2: Progress of the Region on the Sustainable Development Goal 6 Targets as of 2023



LDC = least developed country, ODA = official development assistance, SDG = Sustainable Development Goal.
Note: Nine indicators measured out of 11 official SDG 6 indicators.
Source: United Nations Economic and Social Commission for Asia and the Pacific. 2023. *Asia-Pacific SDG Gateway, SDG Progress Snapshot.*

Figure 3: National Water Security

Source: Asian Development Bank. 2020. *Asian Water Development Outlook 2020: Advancing Water Security across Asia and the Pacific.* https://www.adb.org/publications/asian-water-development-outlook-2020.

Water Operators: Bearing the Brunt of SDG 6

Bearing the brunt of these compounded issues are, of course, the water operators. Already encumbered by financial and operational difficulties, water operators in Asia and the Pacific are hit with highly varied and context-specific problems in infrastructure and service delivery (Figure 3). This means that while challenges may be common—such as high NRW, poor sanitation coverage, or deteriorating systems—there is no panacea or silver bullet that can solve all issues at once.

The answer, it seems, to achieving long-term water security for the region necessitates implementing relevant, sustainable, customizable, and scalable solutions.

Water Tech: Why Water Technology and Innovation Matters in Achieving Water for All

It is no surprise that more and more water operators are turning to tech solutions. Digitalizing water systems helps reduce human error and offers tailored solutions that can be customized to fit the needs of specific countries or cities. To achieve water for all, accelerating the adoption of innovative solutions and fit-for-purpose technologies is crucial for several key reasons:

1. **Tackling the Issue of Water Scarcity:** Water scarcity is a growing global concern, made worse by climate change, natural hazards, population growth, and increased demand. Technologies like water recycling, desalination, precision irrigation, artificial intelligence (AI)-powered distribution systems, smart metering, and leak detection can help optimize water use, reduce NRW, and stretch limited resources further.

2. **Transforming Water Quality:** Contaminated water is a significant health risk. Advanced technologies have the power to revolutionize water treatment, eradicate harmful pollutants, and ensure that everyone has access to pure, safe drinking water. By accelerating the adoption of these technologies, we can dramatically reduce waterborne diseases and protect public health on a global scale.

3. **Supercharging Climate Resilience:** As climate change and disasters continue to disrupt water availability and alter precipitation patterns, causing floods and droughts, we need cutting-edge solutions that can help utilities, local governments, and

Transforming water management. To achieve water for all, accelerating the adoption of innovative solutions and fit-for-purpose technologies is crucial (photo by Amit Verma/ADB).

communities better adapt to these changes and ensure reliable water access even in adverse conditions. These smart water innovations could be game changers in safeguarding our future.

4. **Protecting Our Planet:** Protecting the environment begins with how we manage water. Innovative technologies can help reduce pollution, improve wastewater treatment, and promote conservation through nature-based solutions, all while preserving our planet's ecosystems and biodiversity. By adopting these technologies today, we are actively supporting the environment's future.

5. **Ensuring Equitable Access:** Technological advancements can help bridge the gap between urban and rural areas, ensuring that even remote or underserved populations have access to clean and reliable water sources. This is vital for promoting equity and improving the quality of life for all.

6. **Unlocking Economic Opportunities:** Water technology is not just about solving problems—it is also about creating opportunities. Investments in water technology can create new and thriving industries and jobs. Efficient water management can be the catalyst for economic prosperity.

Water Tech. Digitalizing water systems helps reduce human error and offers tailored solutions that can be customized to fit the needs of specific countries or cities (photo by Amit Verma/ADB).

Figure 4: Regional Overview of Water and Sanitation Infrastructure

WATER AND SANITATION

ACCESS	
Piped Water, Urban (%)	22.66 / **68.79** / 98.88
Piped Water, Rural (%)	2.50 / **33.69** / 83.73
Piped Water, Total (%)	14.90 / **50.20**/ 98.79

TARIFF AND COST	
Water Tariff ($/m^3)	0.02 / **0.49** / 3.87
Water Tariff, PPP-Adjusted ($/m^3)	0.10 / **0.81** / 5.80
Operational Expenditure,Water ($/m^3)	0.11 / **0.62** / 2.08
Operational Cost Coverage Ratio	0.39 / **1.25** / 2.57
Operational Expenditure, Water and Wastewater ($/m^3)	0.12 / **0.58** / 2.61

QUALITY	
Nonrevenue Water (%)	2.74 / **29.76** / 59.93
Water Quality (% passing chlorine test)	75.23 / **95.47** / 100

ACCESS	
Piped Sewerage, Urban (%)	1.73 / **22.43** / 79.36
Piped Sewerage, Rural (%)	1.00 / **8.94** / 38.50
Piped Sewerage, Total (%)	1.11 / **23.42** / 83.76

TARIFF AND COST	
Wastewater Tariff ($/m^3)	0.01 / **0.39** / 2.32
Wastewater Tariff, PPP- Adjusted ($/m^3)	0.02 / **0.49** / 2.11
Operational Expenditure, Wastewater ($/population served)	0 / **64.32** / 503.20

QUALITY	
Wastewater Treatment (%)	0 / **21.2** / 100
Wastewater Connection (%)	0 / **25** / 100

m^3 = cubic meter.

Note: Values are provided in the following format: minimum / **average** / maximum.

Source: World Bank. 2020. *Infrastructure in Asia and the Pacific: Road Transport, Electricity, and Water and Sanitation Services in East Asia, South Asia, and the Pacific Islands.* https://documents1.worldbank.org/curated/en/742271595404096928/pdf/Road-Transport-Electricity-and-Water-and-Sanitation-Services-in-East-Asia-South-Asia-and-the-Pacific-Islands.pdf.

ADB e-Marketplace for a Water-Secure and Resilient Asia and the Pacific

Several water operators in Asia and the Pacific have turned to *ADB e-Marketplace for a Water-Secure and Resilient Asia and the Pacific* to search for possible solutions. Since 2021, ADB's e-Marketplace has brought attention to technologies and solutions for the water sector. A knowledge-sharing initiative launched under the Asia and the Pacific Water Resilience Hub, ADB partners cohost each e-Marketplace webinar episode to showcase solutions from different countries, often focused on themes and topics relevant to ADB members. ADB e-Marketplace partners include government agencies from Australia, Japan, Singapore, the Netherlands, and Portugal, and have reached a cumulative audience of over 1,300 online participants.

High-Impact Innovation Opportunities Spotlighted in the ADB e-Marketplace

Over the past year, solutions presented in the ADB e-Marketplace converged on several high-impact areas: (i) data-driven efficiency, (ii) asset management, and (iii) climate-resilient infrastructure.

Data-driven efficiency and asset management

CHALLENGE
Inefficient operations and poor asset management lead to drained resources, increased costs, and compromised service delivery.

SOLUTION
Enable utilities to make swift operational and strategic decisions informed by robust, data-driven insights.

Effective asset management and operational efficiency depend on accurate data and analysis. However, many water operators lack the tools and capacity to collect and analyze data for informed decision-making. Digital tools for data acquisition, data cleansing, and big data analysis can significantly improve utility operations and resource management.

There is a strong financial case for investing in digital tools, particularly in the distribution network, which often comprises the bulk of a utility's asset base. A survey of 65 water utilities from 28 countries (including six from the Asia and Pacific region) revealed that digital technology penetration is, on average, highest for tools that can enhance distribution network operation such as data analytics, GIS, online sensors, automated controls, device failure detection, and leakage detection technologies.

The study further concluded that digital solutions for the water distribution network and operating systems is the entry point for further adoption of digital technologies in other aspects of the urban water cycle (e.g., treatment, wastewater and rainwater management, and customer and demand management). This suggests that water operators and regulators seeking to kick-start or incentivize digitalization could reap immediate gains in the distribution system.

Innovative sanitation

CHALLENGE
Centralized wastewater infrastructure, including treatment and sewerage systems, often fall short in delivering and sustaining sanitation services for all.

SOLUTION
Employing the citywide inclusive sanitation approach to achieve comprehensive, effective and sustainable sanitation services for all.

UNICEF estimates that around 40 million people in Asia and the Pacific still practice open defecation. This statistic shows the inefficiency of centralized wastewater systems in providing safely managed sanitation to disenfranchised groups. Moreover, without the proper containment, conveyance, treatment, disposal, and reuse of human waste—the elements of safely managed sanitation—people are vulnerable to increased risk of illnesses, malnutrition, and mortality. This problem is compounded by urban crowding in informal or semiformal urban settlements.

Citywide-inclusive sanitation is an approach that aims for universal access to adequate and sustainable sanitation services, ensuring that human waste is managed safely throughout the entire sanitation chain. Beyond implementing infrastructure and technology to ensure safe and reliable sanitation, a citywide inclusive sanitation-driven strategy also aims to ensure capable institutions, equity and inclusion, and sustainability (Figure 5).

Climate-resilient infrastructure

CHALLENGE
The escalating frequency and intensity of climate shocks are jeopardizing the long-term resilience of water and sanitation infrastructure, weakening service delivery.

SOLUTION
Boost the adaptive capacity of infrastructure and enhance its flexibility to ensure resilient and sustained service delivery in the face of unpredictable challenges.

As the region's climate bank focused on scaling up climate finance, ADB is committed to building resilience and adaptive capacity. However, resilience is a multidimensional concept, with a confluence of many factors and criteria that measure success beyond functioning physical infrastructure (Figure 6).

The solutions presented in ADB e-Marketplace have investigated the physical and ecological aspects of resilience. For example, nature-based solutions increase the robustness of fragile ecosystems, providing multiple benefits in terms of climate mitigation and adaptation. Advanced climate tools can provide data-powered foresight and

insight into flooding and water resources management.

Call to address emerging opportunities

ADB e-Marketplace has also become a platform for spotlighting emerging opportunities for Asia and the Pacific.

Future e-Marketplace sessions could focus on financial, social, and/or institutional resilience; last-mile solutions; and decarbonization.

Financial, social, and/or institutional resilience

CHALLENGE
Project design focuses on physical resilience and neglects opportunities for holistic and system-wide resilience.

OPPORTUNITY
Conduct more upstream work (e.g., comprehensive assessment of system resilience) to better inform project design.

Physical and ecological infrastructure must be supported by financial, social, and institutional resilience. Financial resilience typically takes the form of increased liquidity, enhanced insurability, or creditworthiness to account for disaster risk. Social and institutional resilience entails developing safety nets for vulnerable and at-risk communities. Holistic resilience requires a systemic view in project design and implementation. As such, there is a need for tools and solutions that can support the upstream engagement of ADB with DMCs to build their demand for water investments that incorporate holistic resilience.

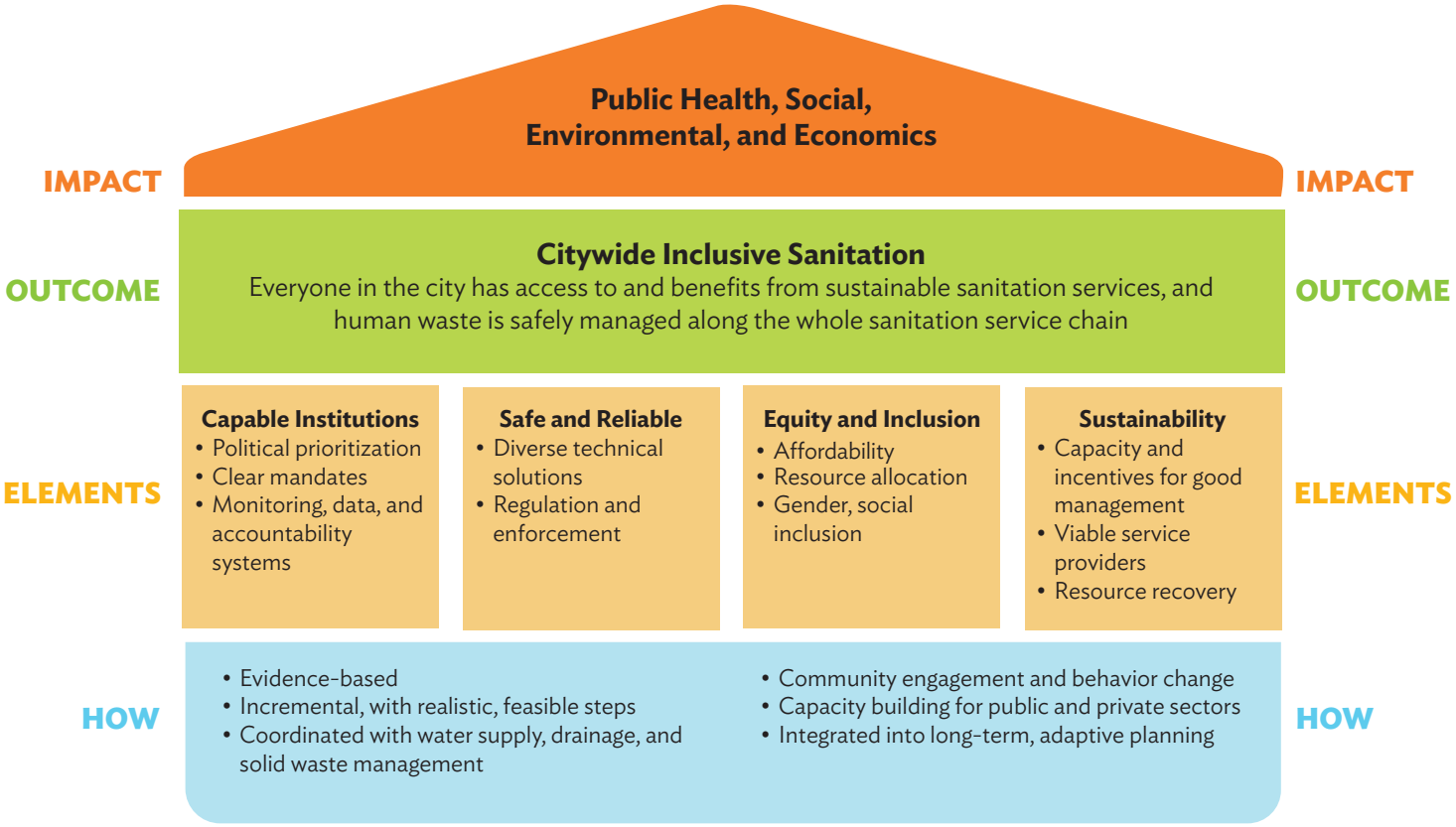
Last-mile solutions

CHALLENGE
Last-mile customers and communities (such as peri-urban, rural, or impoverished urban areas) remain underserved due to poor infrastructure and service delivery.

OPPORTUNITY
Equitable and rights-based services can be achieved with decentralized, scaled-down, and off-grid infrastructure solutions.

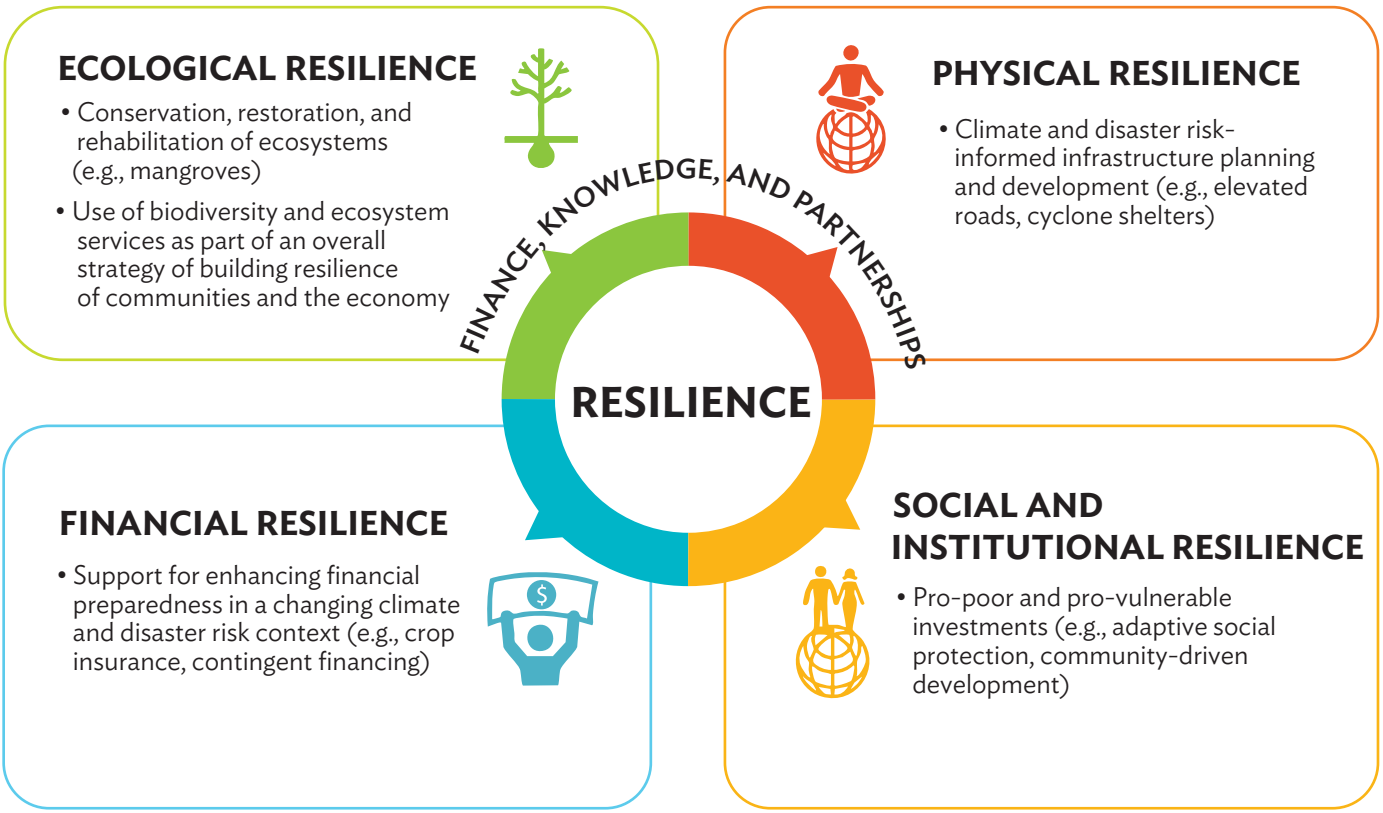
Despite significant gains within urban centers, last-mile connectivity is still a challenge in achieving universal access to adequate water supply and safely managed sanitation. Last-mile connectivity must become a key ingredient to achieve inclusivity and reduced poverty, thereby achieving multiple SDG targets (Figure 7).

Figure 5: Citywide Inclusive Sanitation House



Source: Asian Development Bank. 2021. *What Is Citywide Inclusive Sanitation and Why Is It Needed?* https://www.adb.org/publications/citywide-inclusive-sanitation-needed.

Figure 6: ADB's Holistic Approach to Resilience



Source: Asian Development Bank. 2019. *Building Resilient Infrastructure for the Future: Background Paper for the G20 Climate Sustainability Working Group.* https://www.adb.org/publications/building-resilient-infrastructure-future.

Solutions for last-mile connectivity may include decentralized, scaled-down or off-grid infrastructure (e.g., solar desalination and non-sewered sanitation) that enables equitable services (e.g., through socialized tariff structure).

Decarbonization

CHALLENGE

Water is not seen as a major player in carbon emissions reduction and offsetting, resulting in the lack of a concerted effort to decarbonize the water sector.

OPPORTUNITY

Demonstrate the efficacy and value of decarbonizing water and wastewater operations through scalable solutions.

As shown in Figure 8, Global Water Intelligence reported that Asia and the Pacific accounted for the largest electricity consumption for water, sanitation, and hygiene (35% of world total), thereby contributing the most carbon dioxide emissions (44% of world total).

Improving the decarbonization potential of water and wastewater assets can avoid carbon lock-in over the lifetime of long-term infrastructure projects. There are significant gains in reducing the power requirement of water and wastewater operations, particularly in treatment (e.g., energy-saving equipment and clean energy sources) and conveyance (e.g., reducing NRW). As such, operational efficiency is a strategy for both water security and decarbonization.

Decarbonizing the water sector also necessitates a closer look at the water–

Figure 7: Sustainable Development Goal Indicators Where Rural Communities Are Disadvantaged

SDG indicators	Indicator Name
1.4.1	Population using basic drinking water services
1.4.1	Population using basic sanitation services
6.1.1	Population using safely managed drinking water
6.2.1	Population with basic handwashing facilities
6.2.1	Population practicing open defecation

SDG = sustainable development goals.

Source: United Nations Economic and Social Commission for Asia and the Pacific. 2024. *Asia and the Pacific SDG Progress Report 2024: Showcasing Transformative Actions.* https://www.unescap.org/kp/2024/asia-and-pacific-sdg-progress-report-2024.

energy–food nexus to understand the dependencies, vulnerabilities, and opportunities for sustainable development of the region.

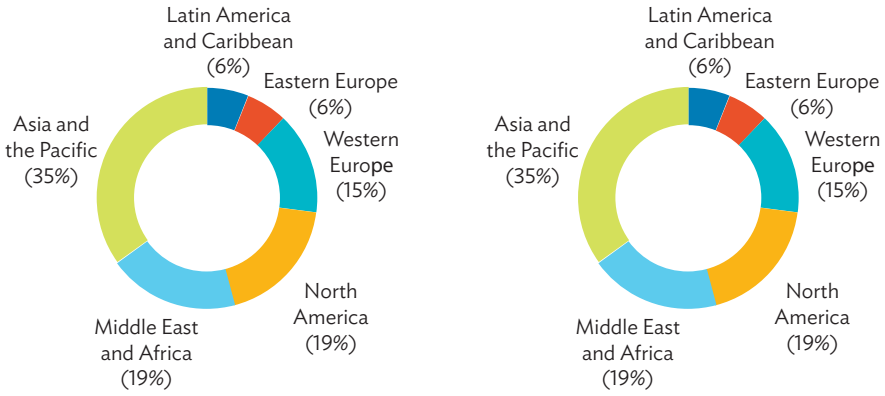
The Fight for Water Security and Resilience Continues

As the countdown to 2030 begins, ADB will double its effort in bringing sustainable answers to water issues through out-of-the-box financing models and grants. ADB will share knowledge by offering mentorship programs, such as the **Water Operators Partnership for Resilience**.

The ADB e-Marketplace will continue to advocate for the uptake of technology and offer a platform for water sector professionals and innovation solution providers for collaboration, and widen the scope to include irrigation authorities, river basin organizations, and regulatory agencies.

Accelerating the adoption of game-changing solutions is not just about improving water management. Smart water technology adoption is about revolutionizing how we live, thrive, and protect our planet for future generations in the face of multiple pressing challenges. It is an exciting journey toward a future where water challenges are met with creativity, resilience, and innovation. ■

Figure 8: Water, Sanitation, and Hygiene Electricity Consumption (left) and Resulting Carbon Dioxide Emissions (right) by Region



Source: Global Water Intelligence. 2022. *Mapping Water's Carbon Footprint: Our Net Zero Future Hinges on Wastewater.*

Water Future. Smart water technology adoption is about securing safe water access for the generations to come (photo by Dengjia/ADB).

Innovation-in-Action: Piloting Emerging Water Technologies in ADB Projects

Annamarie Martin
Manager, AID Coordinator
Imagine H2O Asia

Innovation remains underutilized in helping communities expand water access, mitigate pollution, and strengthen climate resilience. Despite a growing appetite across the region to embrace leapfrogging solutions to water management, the pathways available for utilities to test and adopt new technologies are often perceived as expensive, risky, or unavailable.

In 2022, ADB launched the *Accelerating Innovation and Digitalization* (AID) program as part of the Asia and the Pacific Water Resilience Hub to overcome the key barriers to technology adoption and make water innovation more accessible in the region. AID is a collaboration between ADB and Imagine H2O Asia, a Singapore-based nongovernment organization that mentors and funds emerging water technology entrepreneurs.

Designed as a knowledge and capacity-building platform, AID allows ADB Staff to learn about the latest water technologies, identify innovators of interest and partner alongside them to validate their solutions in the field.

AID leverages Imagine H2O's track record in piloting innovation. Since 2018, Imagine H2O has awarded $2.1 million in grants for technology deployments in 23 countries. Funding for demonstration projects is complemented by an end-to-end technical assistance (TA) program to help innovators and their customers navigate pilot design and implementation.

Projects supported by AID are designed to avoid resulting in one-off pilots. Success may entail an extended project, conversion into a commercial project, or in some cases, a parallel pilot in new communities facing similar challenges. In all cases, project performance will be documented and shared across ADB teams and clients through platforms like the Water Resilience Hub to encourage knowledge transfer and incentivize wider adoption.

AID is supporting two pilots in its first program cycle to improve the effectiveness and efficiency of active or future ADB projects in DMCs. ADB project officers play a key role as AID champions of these pilots—identifying relevant innovators, securing local buy-in, evaluating alignment with ADB projects, and co-designing the pilot project itself.

The two AID pilots are part of Imagine H2O's wider pilot funding program in which an additional 15 projects in emerging markets are being supported since 2023 with other funding partners. Eleven of the 17 pilots are in Asia and the Pacific. ADB Staff can connect with Imagine H2O to learn more about these pilots and their alignment with upcoming ADB projects.

Five Hurdles to Saying Yes to Water Innovation

What challenges hold water utilities and development partners back in saying "yes" to innovation? Common barriers to testing and adopting early-stage water technologies follow:

Access	Vetting	Risks	Funding	Localization
Where do I look for innovations?	How do I benchmark against other solutions?	How do I minimize risks to my team and customers?	How do I pay for demonstration projects?	How do I ensure the solution is suitable for local conditions?

Piloting Innovation Needs More Than Just Funding

Financing is just one part of the equation. Support also needs to come in at different stages of the pilot's life cycle to maximize the likelihood of the pilot's success. Imagine H2O provides hands-on guidance across the following stages:

Pilot design and customer buy-in	Pilot implementation and monitoring	Results evaluation and debrief
Imagine H2O engages industrial and municipal end users to understand and align their problem statements with vetted innovations	Imagine H2O and its partners deploy targeted grants and in-country advisors to support project implementation and monitor impact	As a neutral convener, Imagine H2O supervises feedback and final reporting to identify opportunities for scale-up

Improving access to safe drinking water through decentralized water kiosks or "ATMs" in Narayanganj, Bangladesh

- Low-income communities in Narayanganj that live beyond the reach of centralized piped water systems are unable to benefit from the city's investments in improved piped water supply.
- Two decentralized water ATM systems serviced by Drinkwell, a Bangladesh-based startup, have been deployed to demonstrate to the city corporation their solution's efficacy and observe local feedback before potentially committing to 50+ more systems as part of an upcoming ADB loan.

Water ATM. Urban residents in Dhaka (photo by Imagine H2O).

> **"AID has created a more efficient channel for project officers to engage with emerging technologies and demonstrate their value to our clients through pilots before exploring ways to incorporate them into ADB projects.**
>
> **Momoko Nitta (Tada)**
> Senior Urban Development Specialist, ADB

Reducing agricultural water consumption while improving farmer productivity and crop yield in Uzbekistan

- Farmers in Uzbekistan are struggling with their agricultural output due to dwindling water resources exacerbated by climate change and are searching for affordable water-saving technologies.
- A biodegradable water-saving hydrogel polymer developed by Eco-Friendly (EF) Polymer, an India-based startup, has been deployed across 10 hectares of land with the support of the National Center for Knowledge & Innovation in Agriculture (AKIS). The pilot will test the polymer's ability to reduce water consumption in local soil conditions.

Water Conservation. The EF Polymer team (photo by Imagine H2O).

Become an AID Champion

Since AID's launch, Imagine H2O has led sharing sessions and one-on-one consultations with ADB staff to explore potential pilot concepts. Imagine H2O invites more project officers to participate in AID.

Activity	How to Engage
1. **Problem Statement Sourcing**	Share your innovation priorities from projects by scheduling a consultation with the AID team.
2. **Solution Sourcing**	Identify innovators of interest from the AID Pilot Proposal Catalog. To access the catalog of shortlisted solutions, please reach out to the AID team.
3. **Matching and Validation**	Initiate pilot scoping and design through consultations with the AID team, implementing/executing agency, and ADB project officer.
4. **Scale-Up**	Document key learnings after pilot completion, explore expanded pilot scope, and share case study with ADB staff and DMCs.

Water Future. On 7 October 2024, ADB and Imagine H2O hosted an event at ADB headquarters, Future of Water: Transforming the Sector with AI, Robotics, and Analytics. The event explored cutting-edge innovations in the water sector through the ADB AID program. Bringing in five water startups from Singapore, Australia, India, and Viet Nam, ADB project teams discovered digital solutions that tackle water scarcity, climate change, and water-related crises in scalable ways. ADB's Leonard Leung and Momoko Nitta (Tada) also highlighted inspiring success stories from AID pilot projects in Uzbekistan and Bangladesh, demonstrating the program's impact (photo by ADB).

LEARN MORE

about how you can engage with AID at the Asia and the Pacific Water Resilience Hub

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A Call to Help Make Water Innovation Succeed

Nimesh Modak
Managing Director, Imagine H2O Asia

"Has anyone come across a water startup before?"—I was greeted with a puzzled silence. It was 2016. Having recently joined Imagine H2O, a global nonprofit that mentors and funds water entrepreneurs, I was presenting to a group of undergraduate students about the opportunity for water innovation. They were familiar with all the newly coined startup industries. FinTech, EdTech, HealthTech, AgriTech, and the list went on. But WaterTech? That left them scratching their heads.

Fast forward to today and I am often confronted by a frenzied array of responses, from solar-powered desalination to flood risk analytics. What changed?

First, the supply of water entrepreneurs increased. During 2016–2023, we evaluated over 2,000 water technology applicants for our annual startup accelerators. Year-on-year the number of applicants ticked up and diversified. More startups applied from emerging markets, particularly Asia. More startups featured interdisciplinary teams from outside the water industry. Crucially, there were more female startup founders.

Secondly, and perhaps as a result of the first observation, the quality of these entrepreneurial solutions also improved. More than three-quarters of the estimated $1 billion in early-stage investment raised by our startups since 2010 was actually only raised in the last 5 years. But investors are not the only ones taking notice. Our utility and industry partners, the customers of innovation, are trialing more Imagine H2O portfolio companies than ever before. Solutions are getting market-ready faster, particularly those where data and analytics are a primary feature.

This rapidly changing entrepreneurial landscape gives us reason for optimism. But more innovation and better innovation only matters for communities in Asia and the Pacific if we can get it deployed and scaled commercially. Only then can these solutions be sustained to deliver lasting impact.

Like other regulated sectors, the barriers to adoption are formidable for early-stage innovators. Drawing from Imagine H2O's decade of experience supporting nearly 200 startups, I will share a few time-tested learnings which are shaping our ongoing effort with ADB to accelerate innovation and digitalization in the region.

Everything starts with stepping into your customer's shoes

EF Polymer's founders didn't just learn about their customer's problem; they lived it. Growing up in a village of fewer than 50 smallholder farming families in the Indian state of Rajasthan, the threat of water scarcity was pervasive. The founders witnessed their neighbors shifting to lower value crops to save water or renting expensive pumps to drill ever deeper groundwater wells. Many were forced to sell their cattle and migrate to cities. Chemical fertilizers commonly used by some farmers were simply out of reach for most in their village.

Women in Water. Imagine H2O Asia is a Singapore-based nongovernment organization with a mission to make innovation more accessible to water and climate-stressed communities in Asia and the Pacific. The last 5 years saw an increase in females in C-suites of water startups (photo by Imagine H2O).

Imagine H2O Asia's Startup Demo Day in 2023. It showcased a diverse group of water entrepreneurs of which 80% were based in Asia and the Pacific (photo by Imagine H2O Asia).

Experiencing these challenges inspired EF Polymer—a biodegradable, super absorbent hydrogel using discarded fruit peels that can absorb 100 times more water than its weight. The company, registered in both India and Japan, calls it "drip irrigation in a granule" because the product enables the slow release of water to maintain soil moisture. It also doubles as a highly effective fertilizer. To date, 20,000 farmers are using EF Polymer to cut their irrigation cycles by half.

EF Polymer returned to Rajasthan in 2019 to conduct its first field trials with farmers from their community, demonstrating this long-standing commitment to making farmer input intentional and continuous since day one. Whether the customer is a smallholder farmer or a large water utility, this bottom–up customer-centric approach is a win–win. The end result is a more valuable solution for the end-user at a price point they can afford.

Understanding what the customer values is a collaborative, learning process that never stops

SmartTerra is helping utilities recover revenue from water losses. Using meter readings and consumer data, MeterCity tackles commercial losses without the need for investing in expensive sensors upfront. NetCity, their second product, analyzes the root causes of physical losses; from pinpointing abnormal flow or pressure behavior to predicting the likelihood of pipeline failure.

As SmartTerra piloted its product suite across India and Southeast Asia, the team discovered that utilities' perception of value was more expansive and diverse than they had previously imagined. An Indian water utility transitioning from intermittent to 24/7 water supply benefited primarily from forecasting water demand as well as helping sensitize its customers to a recently rolled-out volumetric billing scheme. In the Philippines, a larger private operator prioritizing network expansion focused on the tool's ability to analyze maintenance hot spots.

Embracing this learning process did not mean adding or customizing features that would hinder future scalability. Instead, this experience empowered SmartTerra to build a more robust and relevant solution uniquely adapted for a wider range of different use cases in emerging markets. Startups like SmartTerra succeed because they proactively manage an open channel to receive and deliver feedback with their early adopters.

Pilot support helps utilities say yes to innovation testing faster

Over the past 12 months, Drinkwell has launched an additional 22 new water ATMs serving over 20,000 households in Dhaka. The company is now dispensing over 30 million liters of safe drinking water monthly via 300+ ATMs across the megacity. Driving this growth is an innovative cofinancing model with Dhaka Water Supply and Sewerage Authority (Dhaka WASA) where Drinkwell is incentivized to operate and maintain the pay-as-you-go enabled ATMs as a service.

As Drinkwell seeks to replicate Dhaka WASA's partnership, new municipalities regularly ask to first pilot their system. Question first, believe later is the norm for many end users. In this case, it is not the technology that needs to be de-risked. Elected city officials want to assess community feedback before agreeing to a larger deployment. Funding, however, is often not available for these trials.

Real-Time Monitoring. A biosensor unit designed by EnvironSens, a Singapore-based startup, installed at SAWACO's pumping stations in Ho Chi Minh City for river water toxicity monitoring (photo by Imagine H2O).

As part of Imagine H2O's regional pilot cofinancing facility, we provided Drinkwell with a grant to reduce the up-front costs for a demonstration project. This triggered in-kind support and a commitment to scale up many more ATMs if the project met performance goals. Imagine H2O's pilot support for Drinkwell and many other water startups is designed to help remove the financial barrier that so often prevents customers in emerging markets from saying yes to testing innovative water solutions.

The right, local partners will make or break market entry

Since 2019, over 200+ Environsens units have been deployed across Singapore in partnership with PUB, Singapore's National Water Agency. The Internet of Things (IoT)-enabled biosensor provides real-time warning of heavy metals in illegal discharge in waterways and sewer networks. When electrochemically active bacteria in the system are subjected to certain contaminants, the voltage signal drops. An integrated autosampler is triggered and an alarm is sent to the relevant authority for validation.

As regulations and enforcement intensify across Southeast Asia, Environsens searched for opportunities beyond Singapore's shores. Viet Nam was identified as a next target given utilities' concerns about the adverse effects of pollution on downstream water treatment plants. After designing a pilot with a utility, Imagine H2O identified a trusted, local partner for Environsens that was similarly invested in the project's success. The selection reflected Environsens' needs for hands-on support with commissioning and potential troubleshooting.

As early-stage startups like Environsens enter new markets, the margin for error is razor thin as the stakes are high. A successful first pilot provides a much-needed local case study to unlock more opportunities. An unsuccessful one, however, drains a startup's already limited resources. What makes or breaks these high-profile projects is selecting the wrong local partner—often by choosing too quickly without fully understanding market dynamics and incentives.

Innovation Sharing. Visiting ADB staff and delegates meet with Imagine H2O Asia's innovators to learn about emerging water solutions at Singapore International Water Week 2024 (photo by Imagine H2O).

Join us in making water innovation more accessible

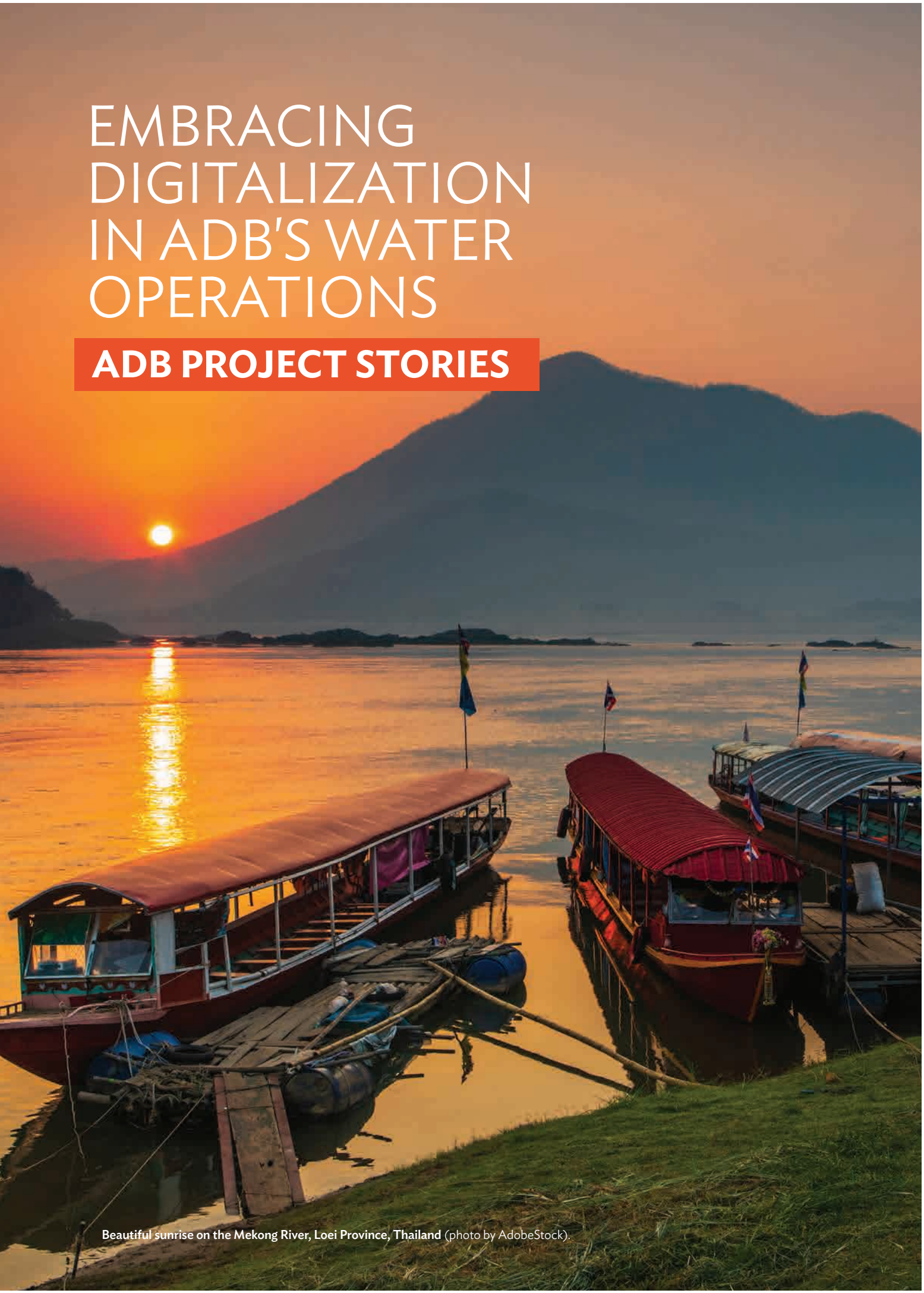
The goal posts have shifted. The world needs less convincing about the need for water entrepreneurship. Awareness about WaterTech's links with climate disruption and its place within the medley of ClimateTech is going mainstream. We must now set our sights higher to get innovation accessed and deployed faster.

ADB is on the front lines of this effort. Through partnerships like AID with Imagine H2O Asia, ADB project officers are helping water entrepreneurs understand communities' needs and design meaningful technology pilots which align with ADB projects. Funding and TA from ADB and other public and private partners is then utilized to get the projects off the ground. The tent is big enough for more to join us as we try to give innovation the best chance to succeed.

Water for All. Making water innovation more accessible is crucial for achieving SDG 6 (photo by Imagine H2O).

EMBRACING DIGITALIZATION IN ADB'S WATER OPERATIONS

ADB PROJECT STORIES



Beautiful sunrise on the Mekong River, Loei Province, Thailand (photo by AdobeStock).

OPTIMIZING WATER INFRASTRUCTURE

A GIS-Based Asset Management System for Enhanced Efficiency and Sustainability

Shiva Paudel
Urban Development Specialist, ADB

Geoffrey Wilson
Senior Water Resources Specialist, ADB

Located 180 kilometers (km) west of Kathmandu, the city of Lekhnath in Nepal is known as "the garden city with seven lakes." As the eastern gateway to the Pokhara Valley, Lekhnath serves as a popular destination for visitors from around the globe seeking that Himalayan experience of grand peaks and pristine water.

The Lekhnath Water Supply User Committee (LWSUC) is responsible for delivering safe and reliable drinking water to these visitors and Lekhnath's 85,000 residents. The core of every water supply system is its infrastructure: a vast network of pipes, pumps, tanks, and valves that collect, treat, and distribute water to serve their community.

In January 2023, Nobel Systems delivered a fully functional GIS-based asset management system (AMS) to support LWSUC in operating and maintaining its water assets and ensure they meet their service quality goals. The AMS was grant-funded by the ADB-managed **High-Level Technology Fund** as part of the **Third Small Towns Water Supply and Sanitation Sector Project**.

> **"Water underpins so much of what makes a city livable and sustainable. Many cities still face difficulties in ensuring sufficient water supply to their customers.**
>
> **Shiva Paudel**
> Project Officer,
> Nepal Resident Mission, ADB

> **"ADB finances a lot of water infrastructure throughout Asia and the Pacific. All this infrastructure needs to be adequately maintained to ensure it's working properly and to prolong its life.**
>
> **Geoffrey Wilson**
> Senior Water Resources Specialist, ADB

The Nobel team worked with LWSUC staff to identify data sources and data gaps. They converted all available paper and electronic data into a GIS-based asset register, supplemented by knowledge elicitation from field staff and complemented with field-based mobile data collection systems to acquire data that remained missing or incomplete.

The final product was a fully populated GIS-based asset register of the water supply assets of the city, including a field collection app, works-order app, a public/citizen reporting app, connection to IoT data collection sensors, and connection to cloud-based supervisory control and data acquisition (SCADA).

Field staff were trained in remotely accessing the GIS database and in data entry using mobile data collection field devices provided by the project. Once trained, LWSUC meter readers collected customer data (i.e., location and meter numbers for all customers) while undertaking their usual meter reading job. Data collection allowed the end users' water usage data and LWSUC's billing system to be connected to the asset data. This was completed in a few months without the need for external consultants. Furthermore, extensive training and capacity building on how to use Nobel's GeoViewer system (desktop and mobile devices) was given to LWSUC staff. The Public/Citizen Reporting portal currently receives "notices" that are automatically turned into work orders for immediate action and tracking.

Nobel's GeoViewer was officially launched on 24 January 2023 and attended by representatives from ADB, LWSUC, and the Department of Water Supply and Sewerage Management. GeoViewer is now in routine operation at LWSUC and used on a daily basis, with interactions occurring both from office-based users as well as crews in the field. The project was deemed a resounding success.

> **"The benefits of addressing nonrevenue water are threefold: (i) environmental benefits through reduced impact on the environment; (ii) important economic and financial benefits that result from the reduction of the volume of water sourced, treated, and pumped; and (iii) the reduction of energy consumption and carbon dioxide emissions. A triple win.**
>
> **Neeta Pokhrel,**
> Director, Water and Urban Development, ADB

This demonstration of the power of advanced AMS technology shows how utility managers can generate useful information for effectively operating and maintaining their water system. LWSUC hopes to continue their pathways toward maintenance works and budget planning, NRW reduction, water demand management, and improved workflow processes like works orders used in the day-to-day activities under direction and guidance of the management.

> **"We are proud to be the first utility in Nepal to have implemented a dedicated GIS-based asset management system for our water supply network. Nobel Systems have been very responsive to our needs and our staff have found GeoViewer so easy to use.**
>
> **Shiva Amatya**
> Office Chief of LWSUC

> **"Asset management planning allows "needs" to be prioritized over "wants" and ensures that the right investments are made at the right time. Obtaining buy-in and support from senior management and key stakeholders is critical for ensuring the success and sustainability of these digital systems. The LWSUC chairperson and CEO were on-board right from the start and this filtered down to the entire organization.**
>
> **Michael Samuel**
> CEO Nobel Systems

NOBEL SYSTEMS

Decision-making data. Asset management is an important tool that gives a utility service provider the data they need to make well-informed, confident decisions that can yield significant long-term benefits (photo by Eric Sales/ADB).

Asset management is an important tool that gives a utility service provider the data they need to make well-informed, confident decisions that can yield significant long-term benefits, including the following:

- **Improving financial performance, efficiency, and effectiveness** by making better operational and maintenance decisions in terms of understanding network (connectivity, pressures, and flows rates); faster and more efficient emergency response; a shift from reactive to proactive rehabilitation and replacement planning; improved maintenance and workload allocation; and improved communication, both within the utility and with customers.

- **Informing asset investment decisions** through asset investment planning, sound operational and financial planning, budgeting around activities critical to sustained performance, prolonged asset operational lifespan, and paving the way for improved capital investment programs that meet the system's actual requirements.

- **Managing risk and improved reputation, compliance, and sustainability** by helping reduce NRW loss, securing water availability, and managing water stress.

- **Providing the necessary data to build hydraulic and risk models for design** and offering detailed insight about assets and their operational importance and value.

If there was greater pressure from regulators to implement AMSs, then many utilities around the world would be forced into realizing these benefits. ■

> **"Aging infrastructure is a concern for many water utilities. Lack of knowledge about the asset and its performance and lack of comprehensive planning leads to a reactive maintenance where the utility is responding to emergency situations due to asset failures rather than proactively planning to prevent asset failure in the first place. With asset data we can start looking at likelihood of failure, consequence of failure, and business risk which are the fundamentals of proactive pipe replacement and rehabilitation planning.**
>
> **Geoffrey Wilson**
> Senior Water
> Resources Specialist, ADB

HARNESSING PUTIAN'S MOTHER RIVER

An Integrated Digital Management System for the Mulan River

Xueling Cai
Senior Water Resources Specialist, ADB

Kang Hang Leung
Principal Infrastructure Finance Specialist, ADB

Managing a river like the Mulan involves various components. ADB introduces an integrated multisector digital platform for the environmental management of the Mulan River Basin.

Nestled in the mountainous province of Fujian, on the southeastern coast of the People's Republic of China, the Mulan River is a vital source of water for cities, agriculture, transportation, and trade. With a length of about 105 kilometers, and a basin area of 1,732 square kilometers, the river has been crucial for life in the region for thousands of years.

Integrated systems. Interconnected, consistent, and unified data resources are needed for efficient decision-making (photo by Lu Guang/ADB).

Challenges and Government Intervention

Government interventions in the Mulan River Basin have focused on flood protection, ecological preservation, and enhancing water quality. Innovations introduced by the Water Conservancy Department have greatly improved the river's condition, safeguarding it from 20- to 50-year return floods and enhancing wastewater treatment to maintain class III water quality (on a scale of I–V). Despite these efforts, the basin still faces increasing water supply shortages, ongoing flood risks, declining ecosystem functionality, and severe environmental degradation.

Water supply capacity remains a challenge as well. In 2021, the basin provided 34.67 million cubic meters of water annually, which is just enough to meet current demands, but falls short of the backup requirements outlined in national policies. Additionally, water demand in the country is expected to rise by 38.6% by 2035.[1]

Climate Change and Environmental Degradation

Climate change is intensifying floods and droughts, resulting in significant economic and environmental harm. Between 2013 and 2017, nine major floods, primarily caused by typhoons, led to a combined direct economic loss of CN¥582 million. Much of the basin's natural forests and wetlands have been lost or degraded, threatening biodiversity and reducing water quality. In Xianyou, only 22.5% of urban households are connected to public sewer systems, and solid waste management is inadequate, posing serious risks of secondary pollution. The deteriorating environment increases public health hazards, particularly for women, worsens living conditions, and harms the health of the Mulan River.

"The government has developed very advanced technologies to solve water supply shortages, flood risk, loss of ecosystem services, water quality, environmental degradation, and other

[1] ADB. 2019. *People's Republic of China: Guangxi Regional Cooperation and Integration Promotion Investment Program (Tranche 1)*. Report and Recommendation of the President. Manila: Asian Development Bank. https://www.adb.org/sites/default/files/project-documents/53051/53051-001-rrp-en.pdf.

Nestled in the mountainous province of Fujian. On the southeastern coast of the People's Republic of China, the Mulan River is a vital source of water for cities, agriculture, transportation, and trade (photo by Lu Guang/ADB).

problems that plague the Mulan River," says Xueliang Cai, ADB senior water resources specialist for East Asia and project officer for the **Fujian Xianyou Mulan River Basin Integrated Ecological Improvement and Environmental Management Project**. "But the challenge lies in being able to get the players together, share data and information, and sustainably improve and manage the Mulan River Basin, which is increasingly impacted by economic development and climate change."

One-Mulan: An Integrated Management System

ADB approved a $200 million loan in August 2022 to address ecological and environmental challenges in the Mulan River Basin. The initiative seeks to create a One-Mulan smart environmental management digital platform that will integrate the management of water resources, disaster risks, wastewater, drainage, solid waste, and forests across the entire catchment area.

Components of the Integrated System

Several digital systems are already in place in the Mulan River Basin, including a flood early warning system, an urban water supply management system, and a reservoir monitoring and management system. However, these existing systems are not interconnected, leading to a lack of a unified data resource environment for decision-making, and communication between them is inconsistent.

The integrated system, known as the "one-Mulan digital environment system," comprises five components: one comprehensive platform (the Mulan River Basin environmental management information platform) and four specialized industry systems (smart water conservancy, smart wastewater and drainage, smart sanitation, and smart forestry systems).

Each system incorporates existing digitalization efforts with advanced technologies. For example, the smart wastewater and drainage system includes automatic sensors monitoring water connection pipe networks and plants, a whole set of sensors and decision support systems to monitor wastewater and stormwater, real-time drainage support from the urban centers feeding information on volume and quality. The forestry system, in turn, can monitor forest fires, biodiversity, and even tree species and other biodiversity elements.[2]

Unified Data and Decision-Making

The platform is designed to provide unified integration capabilities, scalability, and a modular architecture. It features standardized data interfaces and communication portals, allowing for the rapid integration of IoT sensing devices and industry application systems. From a vertical perspective focused on business logic dependence and a horizontal perspective emphasizing business independence and integrity, the entire platform is structured in layers with submodules. This design enables the flexible and swift addition of new functional modules as system capabilities expand

Rural innovation. In one of ADB's rural projects, mountain rainwater stored in a pool and used for irrigation or drip irrigation of tea trees during drought (photo by Lu Guang/ADB).

[2] ADB. 2019. *People's Republic of China: Guangxi Regional Cooperation and Integration Promotion Investment Program – Climate Change Assessment*. https://www.adb.org/sites/default/files/linked-documents/53051-001-ld-08.pdf.

while maintaining the stability of the existing system, which is essential for seamless connectivity to the planned digital Xianyou big data center.

The integrated management platform has three key components: an intelligent supervision system, various industry application systems, and foundational application service support. Specifically, (i) the supervision system covers business oversight, command and coordination, public services, comprehensive assessments, application maintenance, data exchange, and data aggregation; (ii) the industry application systems include water allocation, hydrological and hydraulic modeling, drainage management, solid waste monitoring and real-time management systems, as well as forestry and biodiversity monitoring; and (iii) the foundational application service support consists of GIS services, workflow engines, algorithm models, and mobile applications.

"The goal is to have one digital platform to serve one decision-making body, which is the county government," says Xueliang. "We have different subset systems developed, but all will have common data, common geographic information system layers, such as social, economic, and infrastructure information that will be useful for decision-making by county government with efficient and accurate inputs from different departments and sectors."

Collaboration and Implementation

When asked about the challenges faced in the project, Xueliang shares that it is not technology development and adaptation. "The key is when the different constituents involved say 'OK, let's do this together.' Our biggest contribution is to help put together what the government already has for the Mulan River, identify the gaps and ways to fill them, sit people in one room and start collaboration to design a shared system, the one-Mulan system." ■

DEVELOPING A DIGITAL WATER UTILITY

The Timor-Leste Story

Tiago de Jesus Ribeiro
Urban Development Specialist, ADB

José Perreira
Project Officer, ADB

Water utilities across the globe carry a significant responsibility to deliver good quality and reliable water services to their customers. Effective utilities capture and utilize data to manage performance, deliver operation and maintenance (O&M) activities, and manage financial processes.

The deployment of an integrated management system (IMS) in Timor-Leste's new water utility, Bee Timor-Leste (BTL), as part of **ADB's Strengthening Water Sector Management and Service Delivery** is a perfect example of where digitalization has been successfully implemented, allowing ready access to transactional and operational data and offering the opportunity to continuously improve service provision over time.

ADB through the **Water Financing Partnership Facility** is providing TA support setting up BTL, including a small team of experts with deep experience in information management and service delivery within water utilities.

Implementing Bee Timor-Leste's Integrated Management System

When BTL commenced its operations, it inherited from the previous government directorate a poorly performing water network with significant water losses, poor water quality, and unreliable supply. It also inherited unreliable transactional and operational data, undocumented business processes, and some outdated stand-alone information systems. These challenges were exacerbated by a generally low level of digital literacy among BTL staff.

The BTL leadership recognized the need for an IMS to address these systemic shortcomings. Implementing an IMS was understood to be a long-term process which would necessitate disruption: a change in the way business is conducted and strengthening digital literacy among staff. The chosen system had to cater to both the BTL business needs and the capacity and functionality of existing IMS systems available on the market. A decision was made to implement an off-the-shelf proprietary system which was user friendly, configurable, data-secure, readily upgradable, with minimal data interfaces, and cost-effective.

The structure of the BTL IMS was established specifically to deliver the main functions required by a water utility. It included critical functionalities such as finance and accounting, human resources and payroll, asset management, customer relationship management, and metering and billing. It also included tools such as email, analytics, and reporting. Importantly, it includes GIS that maps BTL assets and customers and provides an intuitive (visual) interface for BTL users. The remote monitoring of asset operations through a SCADA system was excluded from the IMS structure. It was felt that since SCADA systems generally require significant customization and integration with IMS systems, SCADA integration should be deployed and integrated only after the IMS has been operating satisfactorily and only if it can be achieved quickly and cost-effectively.

Water delivery. ADB's water supply projects aim to improve the delivery of safe drinking water to more people in Timor-Leste (photo by Luis Enrique Ascui/ADB).

Through a competitive procurement process, Netsuite, an Oracle IMS product specifically designed to support small and medium-sized utilities such as BTL, was chosen. Netsuite provides full enterprise resource planning functionality across all of the organization's operations, while providing world-class security and support. Netsuite is integrated within the Arc-GIS platform (supplied by Esri), one of the most powerful and well-supported GIS platforms available.

Cost-Effective Solutions

The provision of IMS systems is a highly competitive market, and bidders were keen to provide cost-effective solutions for BTL. This competition benefited BTL, which acquired the IMS for under $1.3 million. This includes system deployment (around 25% of the cost), software licensing (around 50% of the cost), a 5-year service support contract (20% of the cost), with the remainder 5% covering minor hardware and connectivity upgrades to support the IMS. After the fifth year, 10%–15% of the IMS total cost will be paid each year by BTL to cover the licensing and support costs for its entire organization.

A significant cost determinant of the IMS was the number of user licenses—the more licenses, the higher the cost. BTL chose only to purchase online licenses considered essential to run its business. Because the Netsuite Arc-GIS IMS supports both licensed users and mobile app users, licenses were purchased for a small group of personnel (executives, managers, finance, and Human Resources staff) who regularly access data stored in Netsuite to approve key business activities (e.g., payroll, procurement processes, and bill authorization) and perform certain business-critical functions within the IMS. Other staff will use a mobile app specifically designed to support day-to-day activities such as water meter reading, water quality testing, and customer registrations. Using the mobile app, users can easily fill in the various forms to record work completed, even with a low level of digital literacy. All information generated in the mobile app is brought back into Netsuite to update the operational and transactional data of BTL.

The ability to support both licensed on-site users and mobile app users will ensure that the IMS remains the single source of truth of transactional and operational data and will ensure the sustainability of the system. The option to extend the service support contract beyond 5 years and to increase the number of licensed users will also help ensure sustainability of the system as BTL matures.

Cloud-Based vs. On-Premises Solution

As countries are diligent in protecting their national sovereignty, including the security of their data, a cloud-based solution was selected over an "on-premises" solution. Although an "on-premises" solution that would store data within Timor-Leste was BTL's initial preference, it was determined that even if information is stored outside of Timor-Leste, the security protocols for the cloud solution provided better data security. Furthermore, an on-premises solution would require significantly more onsite hardware and local information and communication technology capacity and could have cost more than 10 times the cloud-based solution.

The deployment of BTL's IMS revealed that much historical data were of poor quality. Inaccuracies and inconsistencies in the data meant that data migration to the IMS was technically challenging and time

consuming. Notwithstanding these challenges, BTL's asset and financial data are now well-structured within the IMS and are aligned with leading global utilities. The IMS data structure allows the allocation of costs and work orders to specific capital projects, O&M programs, and ensures that revenues can be easily reconciled in the financial accounts and against individual customers and suppliers. As the dataset grows, this structured data will allow BTL to analyze where costs are being incurred and where action can be taken to improve performance.

Key Deployment Challenges

What became evident during the IMS deployment was that the vendor was too optimistic in the level of uncertainty, language barriers, and the digital literacy ability of BTL staff. This led to delays in scheduled deployment milestones, with the initially planned 6-month deployment period extended to 18 months.

One of the key deployment challenges that resulted in delays was the low level of digital literacy within BTL. During deployment it became evident that few people within BTL had ever seen or used information technology (IT) systems other than to browse the internet or social media. Another challenge to be overcome was the translation of technical elements of the IMS solution (prepared in English) to Tetum, the national language in Timor-Leste. To respond to these deployment challenges, the vendor modified each software module deployment to include more frequent, short duration (1–2 hours) "on-the-job" training sessions over the course of a 4-to-6-week period. These sessions were reinforced by multiple face-to-face refresher sessions. Training was tailored to each level of the business, with managers and executives receiving training specifically to support their role in the review and approval of business processes, and operational staff receiving on-the-job training in their day-to-day use of the IMS. User manuals and videos are now being prepared to ensure skill levels can be sustained.

KEY LEARNINGS ON SUCCESSFUL INTEGRATED MANAGEMENT SYSTEM DEPLOYMENT

Fetching water. Mother and daughter carry water to their home in the Municipality of Manatuto, east of Dili in Timor-Leste (photo by Luis Enrique Ascui/ADB).

Several factors have contributed to the successful deployment of the IMS for BTL, which should be considered when contemplating the deployment of similar systems across the region.

- **Choose the IMS that suits the utility.** There are numerous IMS solutions on the market. Each has unique features, which need to be reviewed and assessed against the specific needs and capabilities of the utility and its country context. Selecting an IMS that already has the required functionality, and that may already have been implemented in a similar utility will improve the likelihood that the solution will be suitable and sustainable.

- **Engage external resources with both utility and IMS knowledge.** Engaging experienced consultants that understand the operations of a water utility, and how to implement the functionality of the selected IMS will improve the likelihood of success. In the BTL case, experienced consultants were able to bridge the gap between BTL and the IMS vendor, ensured clear specifications were prepared, provided strong communication and reassurance, and ensured that BTL staff understood how the IMS should be used to perform their roles.

- **Allow sufficient time and flexibility for business change and improvement in digital literacy.** Ensure the deployment program allows sufficient time and resources to accommodate change in business processes, availability of key staff, shifting priorities, and the need to strengthen digital literacy of utility staff. Allowing freedom for some functionalities and IMS modules to be deployed earlier and faster than others will facilitate overall deployment.

- **Demonstrate success and benefits early and regularly.** An IMS is most likely the most complicated IT system that many stakeholders will have ever seen. Rapid deployment of the entire IMS is not realistic, and expectations need to be managed with frequent demonstration of progress. Small steps are powerful, like the ability to request petty cash, the ability to report on meter reading, or the ability to generate financial reports. These are all small, but valid success steps that should be regularly communicated to the utility staff and key stakeholders.

Safe water supply. Village women collect drinking water from an Arsenic Free Tubewell, Narail (photo by Abir Abdullah/ADB).

Benefits BTL gained in terms of service levels and financial performance:

1. Customers now have their water meters read and their bills issued through the metering and billing module of the IMS. Over 5,000 customers have been verified and their personal information loaded into the system. This is important to support the ongoing work of BTL in improving revenues, which have already increased by more than 300% from pre-IMS (2021–2022).

2. Customer feedback/complaints are being used by the IMS to prioritize and schedule maintenance work orders. The O&M team is starting to report on work order costs and time to complete work orders. The data will be used to make informed decisions on maintenance and capital investment programs, further improving O&M capability to fix water leaks and bursts, eliminate illegal connections, and repair sewer blockages/spills.

3. The financial accounting module has eliminated all manual financial processes, allowing BTL to pass all financial audit requirements. In fact, running the payroll through the IMS detected and eliminated several minor systemic errors in the previous manual payroll system.

4. Over 100 purchase orders have been completed via IMS, with associated speed, accuracy, transparency, and cost efficiencies. Inventory processes to manage warehouse store and ordering via the IMS has also been established, ensuring that spare parts and equipment are always available to support O&M teams.

5. Data structures have been aligned with leading global utilities allowing more effective reporting and analysis of BTL performance.

With continuous and ongoing efforts and support, a solid digital foundation is being built. BTL is fully funding the IMS deployment (including software licenses and service contract) from their own resources. This demonstrates the organization's appreciation of the benefits of digitalization. Such buy-in and commitment is necessary to ensure the sustainability of the IMS investment. BTL is well placed to continue its digitalization journey beyond the initial 5-year support period and prepare for large-scale infrastructure development over the coming decade to 2030. This digitalization is essential to improve service delivery to its customers across Timor-Leste, ensure its business remains financially viable, and move closer to achieving the water supply and sanitation goals of Timor-Leste's Strategic Development Plan 2011–2030. ■

A Decision Support System for Managing Equitable Water Distribution for the Cauvery Delta in India

Vikas Goyal
Water Resources Specialist, ADB

A decision support system (DSS) connected to real-time data sensors helps the Water Resources Department (WRD) officials of the Cauvery Delta effectively manage equitable water distribution and avoid water deficits in the lower reaches.

The Cauvery Delta in southeast India faces several water-related issues. Disputes among neighboring states have resulted in the Tamil Nadu State Government's inability to mobilize any significant water infrastructure investment, leading to water scarcity, high levels of water stress from population demand, declining agricultural production, and increasing water security risks due to climate change. Furthermore, dilapidated agriculture drainage systems and the flat delta terrain has led to recurrent flooding, exacerbated by high salinity and limited fresh groundwater due to malfunctioning of aged tail-end regulators intended to prevent seawater ingress into the delta's lower reaches.

Climate Adaptation in the Vennar Subbasin Project

The Climate Adaptation in Vennar Subbasin in Cauvery Delta Project aims to protect coastal districts from the anticipated impacts of climate change, primarily cyclones and flooding. The project has delivered improved water and flood risk management

Water distribution. The inability to mobilize significant water infrastructure investment leads to water scarcity, high levels of water stress from population demand, and declining agricultural production (photo by Amit Verma/ADB).

systems with climate-resilient hydraulic infrastructure for irrigation and drainage. This includes re-sectioning and strengthening embankments of six main channels, new irrigation and drainage structures, and upgraded pump stations.

Innovative Digital Solutions

Vikas Goyal, water resources specialist for ADB's South Asia Department, is enthusiastic about the innovative digital solutions and tools being adopted in the project, which includes the establishment of a DSS, a comprehensive digital system for making collective, informed, and effective decisions on irrigation management. The DSS helps improve conveyance efficiency, increase reliability of structures, monitor groundwater recharge, and convey flood flows to the sea.

Components of the Decision Support System

- **Automated Real-Time Data Collection:** water-level sensors, water velocity and flow sensors at irrigation head sluices to regulate irrigation water to channels/ distributaries, automatic weather parameters for crop management decisions and to minimize water losses, gate position sensors to quantify the irrigation water supplied, and groundwater level conductivity–temperature–depth sensors.
- **Remote Transmission Units:** using Global System for Mobile Communication/General Packet Radio Service connectivity for real-time data transmission to DSS servers.
- **Manual Data Collection:** transmitted using smartphones via a mobile app to optimize the investment cost.

DSS Software Application

The DSS software application allows for the following:

- planning seasonal demand forecasts and rotation schedules;
- optimizing crop water planning and monitoring rotation effectiveness;
- creating demand plans and capturing water demand requests;
- aggregating for analysis and decisions;
- capturing visual evidence (photographs) through the mobile app;
- submitting grievances and maintenance requests;
- tracking instrumentation assets, ongoing works contracts, and maintenance activities; and
- storing basin reference data for common usage (e.g., maps and drawings) in digital form.

Scheme Operations Center

The project includes a Scheme Operations Center, which brings together all stakeholders to use the DSS data and develop strategies, and provides the following:

- a centralized portal for receiving and accessing all data;
- state-of-the-art servers and software for processing large datasets on a 24/7 basis;
- video conferencing capability and a discussion area; and
- operational forecasts and dissemination of reports and alerts both via mobile app and SMS.

Benefits

The DSS helps WRD officials in managing equitable water distribution effectively, avoiding water deficits in the lower reaches. This digital solution strengthens inclusiveness, resilience, and sustainability, benefiting the community. For example, water-level sensors installed at selected flood-prone locations provide flood alarms, helping officials decide on evacuations

Limited fresh groundwater. Heavy reliance on groundwater puts most of the rural population at risk from arsenic and fluoride contamination that can lead to health problems (photo by Amit Verma/ADB).

to prevent crop and livestock losses. Conductivity–temperature–depth groundwater sensors play a major role in determining long-term effectiveness of the project by providing real-time groundwater salinity information, which will show the benefit of moving the tail-end regulators further toward the sea and making the land between less saline and more cultivable. Multiple benefits can be assessed in future years as the system is engaged more by farmers and officials.

The DSS will be supported over a 5-year O&M period after which the WRD will take over. The DSS services shall be extended to remaining channels in the Vennar subbasin and the adjoining Grand Anicut command area. The continued O&M will ensure the system is resilient and sustainable. ■

LISTENING TO PIPES

Intelligent Water Leakage Management System

Na Won Kim
Country Operations Head, ADB

We know that AI can listen to us. What if it can listen to water pipes?

The advent of AI has transformed various industries including health care, finance, education, transportation, and manufacturing. But what about AI applications in the water sector?

In Dehradun, India, ADB is piloting a project to manage NRW by using AI technology to detect pipe leaks.

Dehradun's Water Challenges

When Na Won Kim, principal urban development specialist for ADB's South Asia Department, first visited Dehradun for the **Uttarakhand Integrated and Resilient Urban Development Project**, she was struck by the city's water condition. Dehradun is the capital city of Uttarakhand state in northwest India. While Uttarakhand is a relatively new state that was carved out of Uttar Pradesh just in the year 2000, it did not take long for Dehradun to become the most populous city in the region.

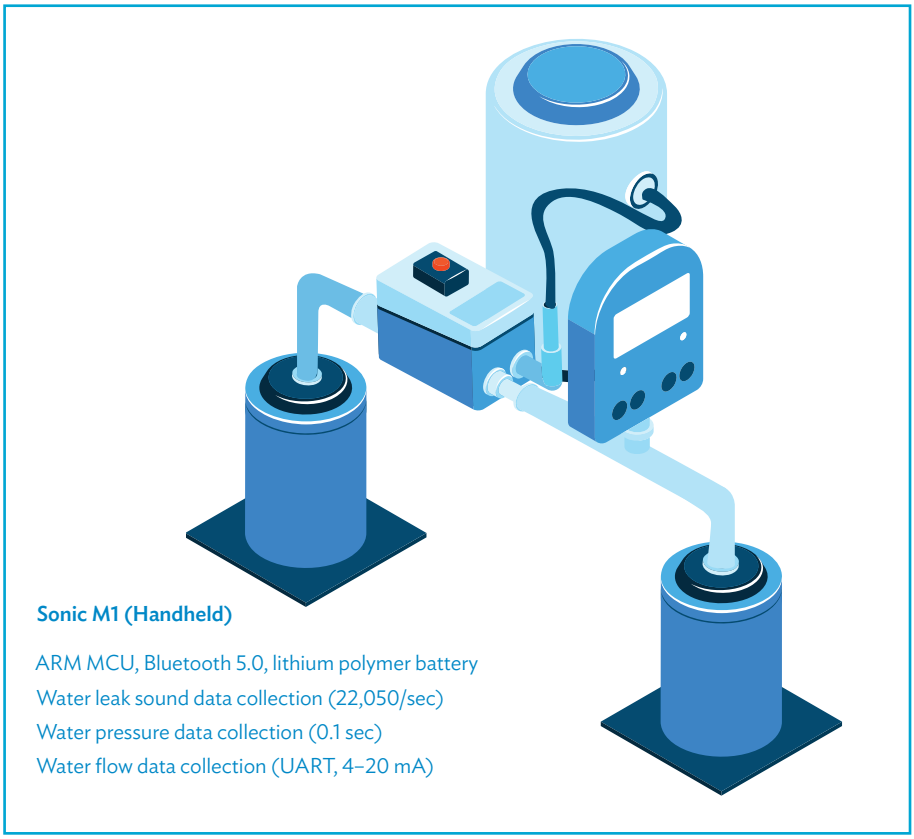
In recent years, water shortage has been a big issue in the city. "Because the perennial rivers from the Himalayan glaciers run through Dehradun," Kim shares, "one would think water supply would be abundant. I was surprised to see that there was not much water in the rivers even outside the summer months."

Leaky pipes. Nonrevenue water creates a loss of about 40%–50% (photo by Ariel Javellana/ADB).

Kim explains that the factors leading to the water shortage are many and complex. Climate change, rapid development, and unplanned urbanization entailed massive adverse impacts. As more frequent and intensified climate-related and natural hazards in Uttarakhand have endangered agricultural activities in upland areas, people from hilly areas left their villages and flocked to Dehradun looking for jobs and opportunities. These urban migrants led the demand for public services to skyrocket. Dams were constructed upstream to divert water for the increasing and competing demands of irrigation, industries, supply, and sanitation. Without holistic and well-planned watershed management, and with climate change worsening

the already stressed environment, the city struggled with water retention, detention, and storage capacity.

Rapid population growth, urban sprawl, aging and insufficient water infrastructure and management, and limited resources led to serious challenges to meeting drinking water demand. Like many developing countries in Asia and the Pacific, Dehradun faces a number of challenges in water infrastructure and management, such as low tariffs on public services and an unwillingness to pay for services, leaving utilities with little money to operate and adequately maintain and monitor systems. To complicate things further, illegal connections to water pipelines and the digging of private wells are prevalent in India, making systematic water supply management an even bigger challenge. Moreover, NRW remains the biggest challenge, particularly physical water loss by pipe leaks.



Sonic M1 (Handheld)

ARM MCU, Bluetooth 5.0, lithium polymer battery
Water leak sound data collection (22,050/sec)
Water pressure data collection (0.1 sec)
Water flow data collection (UART, 4–20 mA)

"NRW creates a serious loss of about 40%–50% of water or sometimes even higher," emphasizes Kim.

"This is really a capital loss and must be addressed, especially in countries already burdened by water scarcity, lack of access to water and sanitation, and poverty."

Introducing an Intelligent Water Leakage Management System

WI.Plat, a startup founded within K-water in the Republic of Korea, developed an Intelligent Water Leakage Management System using the IoT, AI, and cloud technologies to reduce water leakage without requiring highly skilled technicians and at a lower cost. The system comprises four parts:

- **Sonic M1:** a portable device for collecting water leak sound data from meters and valves.
- **Sonic M2:** a stationary device transferring water pressure and flow data using GSM or LTE modem.
- **Nelow App:** embedded with functionalities like GIS management, water leak management, and maintenance management.
- **Nelow Web:** the system's processing hub, managing information using AI models for data analysis.

How It Works

Nontechnical users can collect leakage sounds with Sonic M1, which transmits data to the Nelow App via smart phone Bluetooth. The data are then sent to the cloud server of Nelow Web using mobile communications networks, where AI distinguishes leak sounds from background noise, determines the leak scale, and informs users of the leakage location on a GIS-based map.

Pilot Implementation and Benefits

Funded by a $1 million grant from the Republic of Korea e-Asia and Knowledge Partnership Fund of ADB, the system is being piloted in Dehradun and Jodhpur, India. Early results show significant water savings, with major leaks identified in small pilot areas covering around 9,000 households with an estimated water loss of 87,600 tons per year.

Empowering Local Communities

One of the notable benefits is employment of locals, specifically women, for data collection, reducing O&M costs while providing job opportunities. "We didn't have to bring in highly trained and expensive technicians. With minimal training, local women were ready to work on data collection using Sonic M1," shares Kim.

Conclusion

The Intelligent Water Leakage Management System offers a simple yet effective solution to manage NRW, especially in water-scarce regions. "Finding the solution doesn't need to be a complex process. Sometimes you need to think out-of-the-box and choose a simple digital solution that's easy to run and creates a big impact with minimal costs," says Kim. ■

Bird's-eye view. Bustling city life in Peshawar, Pakistan (photo by Rahim Mizra/ADB).

TRANSLATING TECHNOLOGY TO THE LOCAL CONTEXT

The Khyber Pakhtunkhwa Cities Improvement Project

Kiyoshi Nakamitsu
Principal Urban Development Specialist, ADB

Syed Umar Ali Shah
Principal Project Officer, ADB

When it comes to utilizing technology in the urban development context, going "high-tech" is not always the answer. In developing countries, limitations in resources, capacity, financing, and even regulation can make the adoption of complex digital solutions challenging.

According to Kiyoshi Nakamitsu, principal urban development specialist for ADB's Central and West Asia Department, assessing whether a technology can be adaptable in a specific country and translating it into the local context should be the first and most important step in the digitalization process. "Introducing new technology is a big decision for our client. Instead of forcing them to adopt it, ADB should let our client see and experience these technologies," Nakamitsu says.

Khyber Pakhtunkhwa, Pakistan

Khyber Pakhtunkhwa (KPK) is one of Pakistan's four administrative provinces, situated about 130 kilometers (km)

northwest of Islamabad. From 2000 to 2017, KPK contributed around 11% to Pakistan's gross domestic product and experienced the fastest annual growth rate among the four provinces.

KPK is facing challenges due to its rapid urban population growth rate of approximately 3.4% per year, which is putting pressure on its cities. Insufficient infrastructure and limited capacity to manage municipal water, sanitation, and solid waste services are posing significant health risks for residents and undermining the cities' resilience to climate change.

Currently, only 42% of the urban population has access to piped water, and this is usually available for only 6 hours a day. Poor maintenance and high leakage rates lead to substantial losses and contamination of the water supply, adversely affecting households' access to clean water and placing an additional burden on women who must gather, store, and purify water.

Only 5% of urban areas are served by operational sewer systems, and where networks do exist, they are poorly maintained and often overflow. There are no functioning wastewater treatment plants, and most wastewater flows through open drains. Untreated wastewater and sewage are discharged into surface water drains or agricultural lands, where they are used for irrigation, posing significant health risks to local farmers and communities. Solid waste management is inadequate due to a lack of proper infrastructure, equipment, management, and technical capacity. With less than 30% of municipal solid waste collected, uncollected waste is often burned, disposed of in drains, or used to fill low-lying areas.[3]

Moreover, KPK province shares its border with Afghanistan, making it a haven for many Afghan refugees, further stressing services and infrastructure.

The ADB Khyber Pakhtunkhwa Cities Improvement Project

In 2021, ADB approved the **Khyber Pakhtunkhwa Cities Improvement Project** aimed at enhancing the livability of five cities: Abbottabad, Kohat, Mardan, Mingora, and Peshawar. The project focuses on increasing investments in urban water, sewerage, solid waste management, and green infrastructure, while also offering institutional support to improve service delivery and overall performance, as well as promoting gender-friendly municipal services.

Co-funded by the Urban Climate Change Resilience Trust Fund and the Cities Development Initiative for Asia, ADB plans to establish a 1,200 km water supply distribution network, a 200 km sewerage network, four new wastewater treatment plants, and five integrated solid waste management facilities in KPK.

Simple Solutions Make a Difference

ADB promotes new technology to its clients through knowledge products, exhibitions, and events, but translating these technologies into actual projects is crucial.

"We brought a client and an engineer from Pakistan to the Philippines for a 3-week Maynilad Water Academy training. There, our client learned about using activated sludge for wastewater treatment. This technology is no longer so 'high-tech,' but it is relevant to the Pakistan urban context. The KPK team agreed to adapt activated sludge for their own facilities. This technology requires no footprint and is more environmentally friendly than other conventional technologies. The Government of Pakistan highly appreciated this exercise. And as a result, Maynilad is now consulting with the Pakistan municipal company to improve its operations."

Empowering Women Through Technology

The project is the first urban project in Pakistan being categorized as Gender Equity Theme. Lack of access to water and safe sanitation disproportionally affects women and girls, who often bear the brunt of fetching and boiling water, depriving them of an education or pursuing a career. Despite the many impacts that lack of access to water and sanitation has on women and girls, they are also the least represented in the sector. In KPK, 50% of the 32 million population are women, and yet only one to two women are recruited even at the junior administrative level positions in water and sanitation service companies.

The project will sponsor over 200 women from the five cities in KPK to pursue postgraduate degrees in science, technology, engineering, and mathematics fields to nurture female engineers. A women's business development center is also being built to become a venue for water, sanitation, and hygiene (WASH) groups where women can come together to learn and promote WASH and community-based activities.

"KPK is one of the very conservative provinces in Pakistan," says Nakamitsu. "We believe this project will nurture future leaders of the urban operations in the five cities, benefiting the entire society."

When asked what makes the KPK project successful, Nakamitsu goes back to translating technology to the local context.

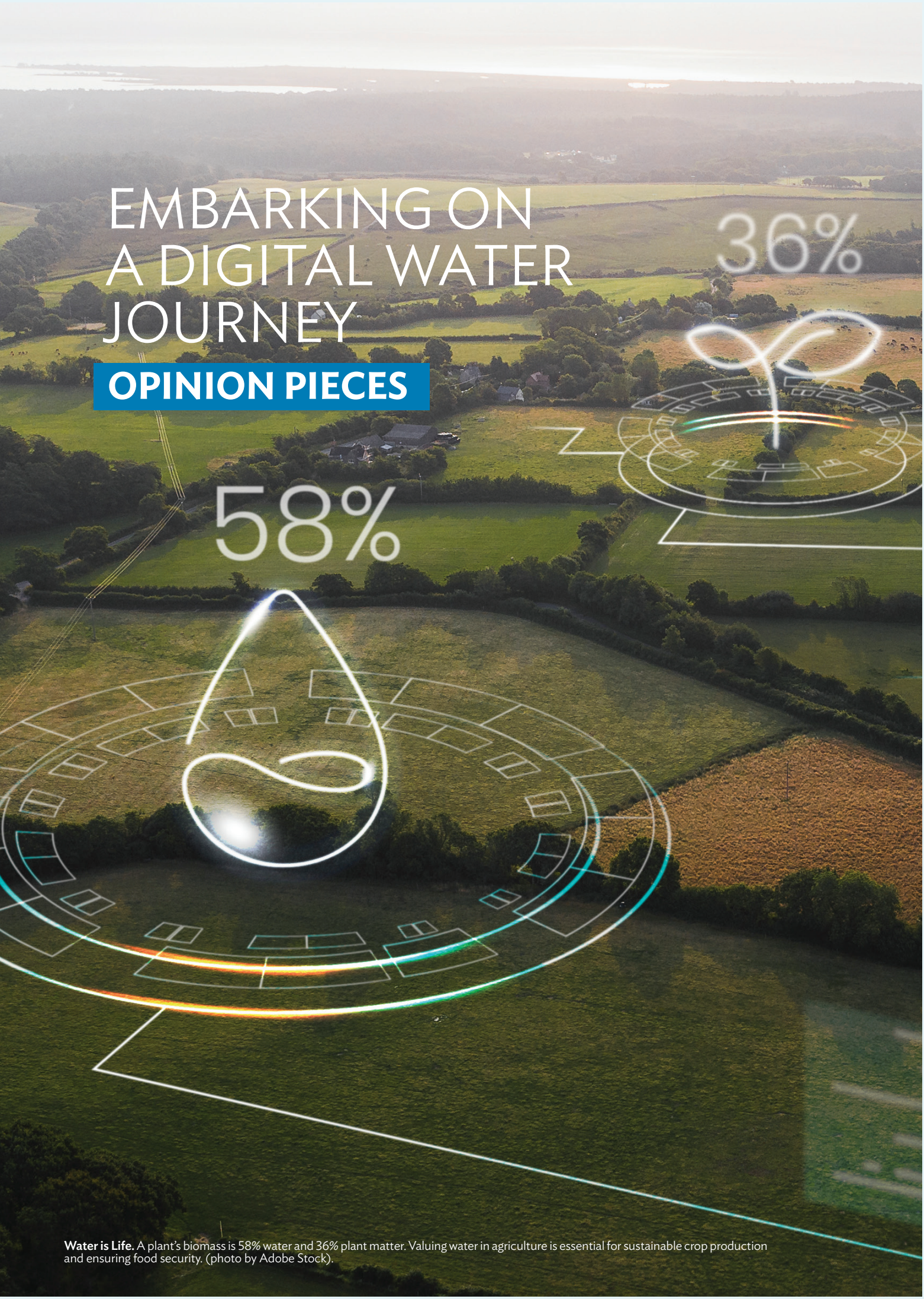
"We do have a very long menu of high technologies in ADB. However, we need to choose the best and most relevant technologies for our client."

The project is expected to benefit up to 3.5 million people across the five target cities in KPK, aligning with the government's key development priorities as outlined in the KPK Water Act (2020), the amended Local Government Act (2019), the Integrated Water Resource Management Strategy for KPK, and Pakistan's nationally determined contributions. ■

[3] ADB. *Kazakhstan: Irrigation Rehabilitation Project* (accessed 23 October 2024). https://www.adb.org/projects/51036-003/main.

EMBARKING ON A DIGITAL WATER JOURNEY

OPINION PIECES



Water is Life. A plant's biomass is 58% water and 36% plant matter. Valuing water in agriculture is essential for sustainable crop production and ensuring food security. (photo by Adobe Stock).

Four Tips on Adapting Water Solutions in the Pacific Context

Maria Tran
Urban Development Specialist, ADB

The world is currently facing development challenges such as climate change, water security, and inequality. In the Pacific region, these challenges are made more complex by poverty, lack of or aging infrastructure, and lack of depth in human capacity resources, making it hard for institutions to sustain change among many competing priorities. In Nauru, the smallest island nation in the world, development challenges are even more unique.

While the island is only approximately 21 square kilometers, at present, Nauru does not have a piped water supply network. The Nauru Utilities Corporation supplies desalinated water to consumers via water tanker trucks that deposit the drinking water into storage tanks. These storage tanks are also used to capture rainwater—a system that has become more unreliable with increased rainfall fluctuation and drought events. Some households have access to shallow groundwater wells, but these sources are not often used for drinking as they are often contaminated or brackish.

Sanitation services in Nauru are equally under stress. Many households rely on on-site sanitation systems which are often damaged, leaking, or improperly maintained, risking both human and environmental health impacts.

Collection and transport of household solid waste to landfill is not comprehensive across the island, with many households disposing of their own solid waste through burning or dumping.

Due to phosphate mining across the majority of the island, Nauru's urban areas are densely populated, putting additional pressure on already stressed essential services like water supply, sanitation, and solid waste.

In August 2020, ADB approved a $5 million grant to prepare a project to expand and improve water supply, sanitation, and solid waste management services in Nauru. The grant will partly fund the assessment, planning, and capacity building needed to implement the proposed **Nauru Resilient and Sustainable Urban Development Project**. The planned $37.5 million project will increase access to, and improve, the quality and safety of essential urban services for about 2,150 households.

As part of the project and funded by TA, the ADB project team is looking to introduce innovative solutions to help build capacity and efficiency for water supply and sanitation in the island nation.

"The project has currently hired a consultant to look at developing an asset management system for a small island state utility," shares Senior Project Officer (Urban Development), Maria Tran. "This asset management system will be a very important component of the project because utilities in the Pacific have a lot of assets to maintain. Operations and maintenance have been a struggle for utilities, particularly after the partners are finished with capital investments".

1. **Fit for purpose**
   "It has to be a fit-for-purpose AMS tool that can be used within the context of small island developing states," says Tran. "A lot of the off-the-shelf programs available have too many features or you're locked into a service. We need a solution that is technology agnostic. Small utilities don't need a lot of bells and whistles. What's crucial is to find the most suitable technology for each use case."

2. **Reactive to proactive solution**
   Now, due to low human resource capacity, a big challenge the Nauru Utilities Corporation faces is that asset management is currently managed reactively, with assets maintained and repaired when they break down. The ADB project team is looking for an AMS that will help the utility transition from being merely reactive (fixing what is broken) to being proactive. This means having the capacity to do maintenance preventively on a scheduled time frame, or being able to plan when assets need replacement, and having information on how all those inform financial decisions.

3. **Clear institutional direction**
   "In Nauru, government policy or building guidelines have not yet been set on how a sanitation facility should be constructed or operated," shares Tran. "Helping the Government of Nauru create policies and institutional direction around their water supply and sanitation is definitely something

ADB is looking into. Once there is clear institutional direction, then we can start finding which technology is most suitable for each use case."

4. **Find a champion within the utility**

"Finding a champion within your implementing agency is a huge step to making sure the project succeeds. Not just because you have someone in the country with passion to drive the project forward and continue on after you've left, but also because someone within the agency will know what is needed there, so solutions can be tailored to a specific context."

"Technology is not always the most complicated part. Many solutions can apply. Considering the context of where you're working and trying to make it work within that context is the trickiest part. That is why working in partnership with government, and finding a champion is critical: often ADB is an expert in the technology, but it is the local expertise that will make sure that technology can succeed." ■

Effective service delivery. Nauru Utilities Corporation (NUC) staff delivering water to households (photo by Eric Sales/ADB).

MODERNIZING WATER UTILITIES THROUGH DIGITALIZATION

Three Critical Steps to Propel Operations Forward—and Make It Last

Guillaume Féry
Founder and Senior Water Sector Specialist, VILVIC

Making theory a reality: embarking on a digital journey

Digital transformation can be defined as the development of an enterprise's practices, procedures, and skills to align with the increasing footprint of digital technology in various business domains. It is a journey that involves multiple activities, IT deployments, and different levels of change. Water utilities are no exception to this trend. Some have already integrated cutting-edge digital technologies in their routine operations to enhance efficiency, improve customer satisfaction, conform to regulatory requirements, tackle pressing issues to safeguard water resources, and enhance service quality while optimizing costs.

While the technology offering is broad, practitioners still need help to integrate and realize the potential of technology to move from a planned and reactive business to a data-driven and proactive entity. GSMA and the World Bank surveyed nearly a hundred water utilities worldwide to understand the experiences of adopting digital solutions. The three main business priorities of water utilities are (i) guaranteeing access to water (27%), (ii) ensuring level and quality of service (19%), and (iii) ensuring water quality (19%).

Answers show that expectations on digital technologies focus on (i) modernizing ways of working and automation (27%), (ii) optimizing interactions with clients (new and existing) (15%), and (iii) improving financial performance (12%). At the same time, two-thirds of the respondents still need to document their digital vision, and two-thirds still need to appoint a committee to orchestrate the digital transformation of their entity.

If the expectations and the outcome seem clear, why do water utilities find it so difficult to ride the digital wave? What does it take to deliver a series of company-wide projects and sustain the change? The following three-step approach proposes a path to effective digital modernization and presents critical success factors.

Step 1: Assess digital maturity

Digital transformation requires new capabilities that organizations must acquire and develop. A question remains for business leaders: Where does my entity sit in this journey today, and what should be the next step? To answer this question, assessing the current level of modernization is a crucial milestone.

A digital maturity model is a framework used to understand an organization's digital maturity and help build a road map for the future. A series of visuals (Cobweb, matrix, and Strengths, Weaknesses, Opportunities, Threats analysis journey maps) can be documented as guidelines for a clear path throughout the transformation journey.

Key pillars of digital transformation include (i) strategy and vision, (ii) people and culture, (iii) processes and governance, and (iv) technology and IT capabilities. Conducting a preliminary digital maturity assessment is a practical step to mobilize stakeholders, identify strengths and weaknesses, and elaborate a clear digitally oriented strategy based on the utility's vision and priorities.

Step 2: Build a comprehensive strategy for unleashing the power of a lasting change

Deploying new technology components associated with adjusted or new business processes requires a robust business readiness approach. The minimum prerequisite for successful adoption includes a precise business impact assessment, a clear communication plan for the change, and a comprehensive training curriculum. To maximize the buy-in for the long term and guarantee that benefits are realized over time, it is crucial to embrace the entire project life cycle at inception, from design to operations. If not, the risk is to erode the transformational dimension of using digital technologies with a limited, unfinished, and unsustainable change of the organization. Table 1 shows essential areas to consider early in developing digital projects to ensure sustainable change.

Table 1: Areas to Consider in Developing Digital Projects

Fine-tune the planning stage	Calibrate at the design stage	Anticipate a smooth and effective handover to operations
• Document your plan • Build a shared a vision • Develop a road map • Be inclusive • Establish the right governance • Align the organization • Focus on priorities of the local context • Quantify the benefits/ outcomes • Build the case and secure funding	• Mobilize the technology ecosystem and vendors • Prioritize and build on technology prerequisites • Select the right solution with wise criteria • Be frugal—avoid over-specification • Involve end users and stakeholders • Adapt/create processes • Think end-to-end data integration • "Futureproof" the system • Consider cybersecurity and data policy	• Empower people • Assure data accountability • Maintain systems • Measure the impacts • Learn and improve • Keep innovating

Source: Author.

Step 3: Track your progress and measure the impact of digitalization

"You can't manage what you don't measure," said management guru Peter Drucker. And this applies to the digital journey as well. The digital imperative does not mean companies need to seek how to best deploy cutting-edge technologies for the sake of it. Prioritization is critical, and this should be based on both technological prerequisites and, more importantly, the value created by IT and data-enabled projects. With that in mind, establishing and following a series of indicators is a crucial success factor to maximize the impact, mobilize teams and customers, and sustain the change across the transformational journey. There are no standard indicators, but we could suggest starting with this split into three categories (Table 2).

Table 2: Indicators for the Impact of Digitalization

Measure of the deployment of technology components and digital enablers	Measure of the direct impact of the digitalization of key processes	Global performance indicators
• Number of smart meters • Numbers of training on smart operations in the curriculum • % employees trained on cybersecurity • % assets in the GIS • % completion of a computerized asset register	• % revenue paid online • % meters read remotely • % customer complaints closed in 7 days or less • % invoices from suppliers sent digitally • Number of early detection failures (network) • Average delays in interventions (hours)	• % NRW • Operational costs/ revenues • Energy consumption produced (kWh/m^3) • Continuity of service (hours/day) • % satisfied customers

GIS = geographic information system, kWh/m^3 = kilowatt hour per cubic meter, NRW = nonrevenue water.
Source: Author.

And, of course, indicators should be reliable, meaning the production of the numbers should be easy and repeatable. In some cases, building the capability to issue the indicators and publish a dashboard can be seen as the initial digital move. These indicators should be reviewed periodically by senior executives and sponsors to trigger actions.

Conclusion

The digital transformation of water utilities is a reality. With that in mind, companies need to be proactive to seize the opportunities that lie with the technologies available. They need to know where they stand in this journey that has a profound and transversal impact on various business functions. More importantly, they must adopt a holistic approach throughout the delivery cycle, from design to operations, to make the change last. Otherwise, the risk is that all the effort and investment end up with just another series of sophisticated pieces of technology and gigabytes of data—without transforming the organization. ■

The Digital Water Journey

Geoffrey Wilson
Senior Water Resources Specialist, ADB

The water industry faces numerous challenges, including increasing demand and variability, declining water quality, poor operational performance and governance, institutional inertia, regulatory constraints, rapid urbanization, aging and underfunded infrastructure, public health threats, and other global change pressures like biodiversity loss and disasters triggered by natural hazards and exacerbated by climate change. These challenges drive the need for innovation and technological advancement, compelling service providers to turn to digital water solutions or "smart water."

Digital Water Solutions

Digital water is an ecosystem of data and analytics solutions, including hardware, software, and services, which are used to support more informed decision-making across the water sector by implementing systems and equipment for collecting and communicating, storing and managing, visualizing and analyzing those data. It includes such systems as GIS, SCADA, customer information, human–machine interface, computerized maintenance management, enterprise asset management, smart metering, hydraulic modeling, and related aspects.[4]

People-Centric Transformation

If data are at the heart of decision-making, people are at the heart of the digital transformation journey. Digital water is not about replacing people, but automating repetitive tasks to allow staff to focus on more critical activities. Successful transformation requires support from upper management and investment in the culture and workforce of the organization.

Digital Transformation Strategy

The adoption of digital water to digitize products, services, and operations and increase value through innovation, invention, customer experience, and efficiency is called digital transformation. Digital transformation is not an ad-hoc application of some new technology, it is an intentional, planned, and well-organized implementation of a strategy. It is a path from the current level of digital maturity onwards, in steps, without destination. With vast digital offerings and opportunities available, having a digital strategy is critical and the best place to start is where you already are. The first step must be to assess the organization's current level of digital maturity. Then the digital transformation road map can be prepared—following a short-, medium-, and long-term strategy—upon which the organization can base its digitalization journey and guide investments. The key is to find ways to maximize the value of existing investments and to build incrementally from there—learning, adjusting, and improving as you go.

ADB Structured Approach to Digital Transformation

ADB has been promoting a structured approach to digital transformation in the water sector by undertaking upstream analysis, including the assessment of a water service provider's digital maturity followed by the development of a digital improvement plan tailored to their maturity and goals. Boxes 1 and 2 give some examples.

Conclusion

Digital transformation in the water sector is essential for addressing current and future challenges. A structured, people-centric approach, supported by robust strategies and continuous improvement, is key to successful digitalization. ■

[4] "Digital water" may include, but is not limited to the following: asset and timeseries data acquisition/collection/archive; smart sensors/meters and advanced sensors; SCADA; remote sensing; drones; GIS; big data; data analytics; IT; AMSs and asset/customer databases; sophisticated modeling tools; machine learning; AI; augmented and virtual reality technologies and visualization tools; IoT, 5G wireless network, cloud, mobile, and intelligent infrastructure; software-as-a-service applications; hydraulics models, digital twins, and building information modeling; real-time tools for operation, maintenance, and planning; digital services and apps; digital billing and payment; distributed ledgers (blockchain); digital transactions and financial services (credit, financial training, insurance investments, savings, and subsidy); and public/citizen/customer reporting (e.g., customer complaints app).

1 Digital Maturity Assessment and Digital Improvement Plans

Under TA 6854-REG: Improving Water Security and Resilience through Digitalization (Subproject 2) financed by the Japan Fund for Prosperous and Resilient Asia and the Pacific, several water utilities are being supported following a structured approach, starting with the preparation of digital maturity assessment and digital improvement plans.

- Bangladesh—Dhaka Water Supply and Sewerage Authority (DWASA): A digitalization panel expert has been to the site to assess DWASA's level of digital maturity and has prepared a road map for digitalization. Support also includes twinning with Tokyo Sewerage Bureau, climate mitigation/decarbonization advice, and pilot testing of Transcend's automated wastewater treatment plant concept design.
- Sri Lanka—the Sri Lankan National Water Supply and Drainage Board (NWSDB): A digitalization panel expert has supported production of a nonrevenue water report. Another digitalization panel expert assessed NWSDB's level of digital maturity and prepared a road map for digitalization. Climate change adaptation support was also provided under Technical Assistance (TA) 6841-REG: Integrating Climate Resilience in the Water Sector.
- India—Chennai Municipality Water Supply and Sewerage Board (CMWSSB): A digitalization panel expert has been to the site to assess CMWSSB's level of digital maturity and prepared a road map for digitalization. Climate change adaptation support was also provided under TA 6841-REG: Integrating Climate Resilience in the Water Sector.
- Samoa—Samoa Water Authority (SWA): A digitalization panel expert visited SWA to assess their level of digital maturity and prepared a road map for digitalization.

Source: Author.

2 The High-Level Technology Fund—Supporting Digitalizing H2O at ADB

The High-Level Technology Fund (HLTF) is a trust fund providing grant financing to promote the integration of high-level technology and innovative solutions into ADB-financed and -administered projects throughout the project cycle from identification to implementation and operation. Funded by the Government of Japan, HLTF encourages more widespread adoption of high-level technology to address development challenges in ADB's developing member countries.

The HLTF has been supporting ADB's water sector with the amount of approximately $1 million to $2 million each year. The fund's resources may be used in the form of grants to finance Technical Assistance (TA) projects, investment projects, direct charges, and other ADB products and instruments.

- Viet Nam: Climate Adaptive Integrated Flood Risk Management Project, $400,000 toward the development of integrated multiple reservoirs operation regulations with forecasting inflow from upstream countries.
- Azerbaijan: Irrigation and Drainage System Development in Nakhchivan Autonomous Republic, $200,000 toward adopting Supervisory Control and Data Acquisition (SCADA) system and water productivity accounting (remote sensing) and other on-farm climate smart water management.
- Georgia: Climate Smart Irrigation Sector Development Program, $150,000 toward increased crop water productivity and measurement with application of suitable innovative technologies.
- Mongolia: Strengthening Capacity on Disaster Risk Assessment, Reduction and Transfer Instruments in Mongolia, $300,000 toward drone-based LiDAR technology to develop high-resolution digital elevation models for flood modeling in urban centers.
- Sri Lanka: Integrated Water Productivity Improvement Project, $200,000 toward a SCADA system to enable the project to support high-efficiency irrigation systems connected with drip and sprinkler irrigation of high-value crops.
- India: Meghalaya Small Multipurpose Reservoirs Project, $200,000 toward technology for climate change adaptation (flood and drought risk management) and near real-time DSS for water resources management.

Source: Author.

CAN SMART WATER SYSTEMS OUTSMART THE CLIMATE CHALLENGE?

High Hopes and an Army of Nerds to Fight the Coming Water Crisis

Eduardo Garcia Alonso
Water Consultant

In this day and age, there is growing evidence that the feedback loop between humans and the natural world around them is overstressed and in danger of spiraling out of control, after several centuries of apparent stability. The water cycle, with its human, ecological, and economic dimensions, is one of the first and most notable casualties. Once a natural resource, water has now become a critical economic commodity, and its management has evolved alongside human progress. However, we are now facing an unprecedented environmental crisis, with water at the center of multiple global challenges, including climate change, pollution, and resource depletion.

Technological innovations, particularly in the digital realm, are transforming the way we manage water resources. Concepts like the IoT, digital twins, earth observation, DSSs, and AI are no longer just buzzwords—they are becoming essential tools in addressing water-related issues. These technologies can help us monitor, predict, and manage water systems more effectively, but they also highlight the urgency of our current environmental crisis.

It is hard to say whether it is mere coincidence or historical teleology, but unlike past technological revolutions, this one coincides with the greatest environmental crisis our world has ever known. It is not just human-induced climate change, perhaps the most daunting problem facing our species: it is compounded by other major challenges

Digitizing water. Technological innovations in the digital realm are transforming the way we manage water resources (photo by Dreamstime).

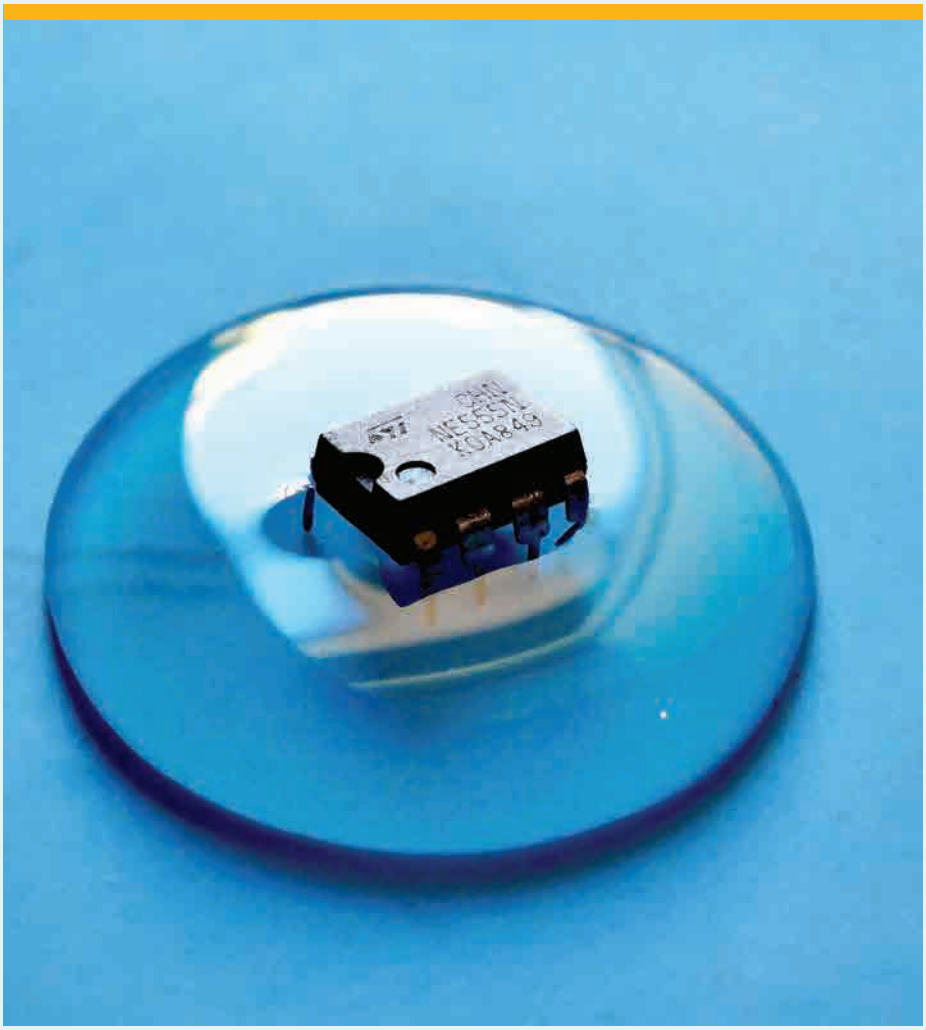
such as water and air pollution, plastic and toxic waste management, large-scale extinctions of animals and plants, depletion of nonrenewable fossil aquifers, large-scale loss or degradation of agricultural soils, and many others. Water is at the heart of many of these processes.

For the first time, humanity is grappling with the cybernetic nature of our relationship with the world: The impact of our actions is coming back to us in ways we can no longer ignore. The notion that the earth is an infinite resource has been debunked, and we must now act with the understanding that our planet's limits are real and imminent.

From this perspective, new digital advances, along with other scientific and technological innovations, such as gene editing, green energy, and geoengineering, must not simply trigger another industrial leap forward. This time, they must bring about a different kind of revolution, one of reckoning, of paying off our debts to future generations, and of coming of age as a species. New technologies are not only an opportunity to reignite productivity and material prosperity, but they are also our last resort to avert an existential threat.

To launch the new revolution, our economic mindset will need to be overhauled: compound interest, which makes distant cash flows irrelevant, hampers intergenerational considerations in project evaluation; so-called externalities become internal and critical; nonmarket goods and ecosystem services, beyond the valuation methods used, are the enabling conditions for the rest of the goods and services, which become secondary; defensive expenditures (such as protective technologies and increased health costs due to environmental problems) are the wrong kind of wealth and make gross domestic product figures utterly deceptive.

All of these considerations have clear implications for the water sector. The potential of digital water technologies is vast. Remote sensors and drones can collect real-time data on water quality, which can be fed into predictive models to inform decision-making. This facility is real and may be operating now or soon in a reservoir near you, but it is only one example of many similar systems for water utilities, agriculture, flood and drought early warning systems, ecosystem management (fisheries, forests, and wildlife), and other areas. Both the application opportunities and the transformative potential of new technologies in the water sector are vast and relatively untapped. However, there are several important, mostly nontechnical, barriers to their full deployment. These barriers include the perennial debate about who should pay the bill; another problem is that we must deal with competing nation-states whose artificial boundaries have little in common with watersheds or climatic regions.



Integrated circuit. An integrated circuit in a blob of water placed on a silicone mat (photo by Unsplashed).

Ultimately, it seems reasonable to conclude that while smart water holds great potential, it does not imply smart human behavior and effective use of available technology. It will certainly take more than gadgets and AI systems to avert the looming water and environmental crisis. We need more than just advanced tools; we need smarter, more sustainable human behavior. However, it is also true that digital technologies could help create a more open, connected, and empathetic world, bring education to remote places, and create the conditions for further advances in each sector. The stakes are extremely high, the clock is ticking, and the nerds are wishing for their finest hour. ■

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National Center for Knowledge & Innovation in Agriculture AKIS

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Nobel Systems

Sri Lanka National Water Supply and Drainage Board

Dhaka WASA

Government of Dehradun

Samoa Water Authority

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This e-magazine was prepared to provide a compendium of case studies across developing member countries of the Asian Development Bank (ADB) highlighting the use of digital technology in water operations. It also showcases solutions, lessons, and knowledge shared from ADB e-Marketplaces on Water Security and Resilience. The e-magazine aims to create an awareness of how smart water solutions can be harnessed to improve water security and resilience in Asia and the Pacific.

About the Asian Development Bank

ADB is a leading multilateral development bank supporting inclusive, resilient, and sustainable growth across Asia and the Pacific. Working with its members and partners to solve complex challenges together, ADB harnesses innovative financial tools and strategic partnerships to transform lives, build quality infrastructure, and safeguard our planet. Founded in 1966, ADB is owned by 69 members—50 from the region.

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