ISSUE #1

ADB

H2O DIGITALIZING

AN ANNUAL INTERACTIVE E-MAGAZINE

DIGITALIZING FOR WATER SECURITY AND RESILIENCE IN ASIA AND THE PACIFIC

SHOWCASING SOLUTIONS AND LESSONS FROM ADB'S E-MARKETPLACES ON WATER SECURITY AND RESILIENCE

EMBRACING DIGITALIZATION IN ADB'S WATER SECTOR OPERATIONS

SPEARHEADING DIGITALIZATION IN THE WATER SECTOR OF ADB: A LOOK AHEAD

MESSAGE FROM SUSTAINABLE DEVELOPMENT AND CLIMATE CHANGE DEPARTMENT

Welcome to the first edition of the annual e-magazine of the Asian Development Bank (ADB), *Digitalizing H_2O*, focused on:

Digitalizing for Water Security and Resilience in Asia and the Pacific

Water is fundamental to sustain economic growth, safeguard the environment, and improve the quality of people's lives. Water is the primary medium through which we will feel the effects of climate change. Here in Asia and the Pacific, the most disaster-affected region in the world, we experience more than 40% of the globe's climate change-related calamities and live among 84% of the people affected by them. We are acutely aware of the need to manage water better to become resilient.

We have no choice but to bypass old methods to get there faster, for a more water-secure and resilient Asia and the Pacific. Adopting appropriate technology and innovations can help us do just that. That's why accelerating digitalization is central to increasing our region's water security and resilience.

Our region, which arguably needs it the most, has been slow to adopt new technology in all subsectors of water. The coronavirus disease (COVID-19) has highlighted the glaring lack of technological advances in Asia and the Pacific—technologies that would help overcome many of the challenges we face. What many may consider basic for a water service provider or irrigation or water resource manager, such as a database of its assets and customers, digital billing, monitoring tools for quality and quantity of water, or simple warning systems, are not available to many of our clients.

At times it is a lack of resources that hinder adoption, but equally often it is a lack of awareness or a misunderstanding about what is available that creates resistance and stunts progress.

Many established companies as well as start-ups based in emerging economies are now developing digital solutions that are not only cheaper but also appropriate for our regional context.

Demystifying that technology and demonstrating that users can choose the speed at which they implement it is key to its adoption. That is why we have created this interactive annual e-magazine, ***Digitalizing H_2O***, to help our developing member countries digitalize for water security and resilience in Asia and the Pacific.

I thank the Water Sector Group for taking this initiative. It marks not only the debut of annual e-magazines for the Water Sector Group but also ADB's first foray into communicating with our clients and partners through this important medium.

This e-magazine represents critical work being done in the region and collates best practices from around the world. Digitalizing water management will propel us toward a water-secure and resilient Asia and the Pacific. I look forward to being part of this journey.

Best Regards,

Bruno Carrasco

Director General concurrently Chief Compliance Officer, Sustainable Development and Climate Change Department

MESSAGE FROM CHIEF OF WATER SECTOR GROUP

The Water Sector Group is committed to keeping colleagues and ADB clients informed of technological advances in water, through internal sharing of knowledge and best practices and connecting with external solution providers and innovators across all water subsectors.

That is why we are proud to present this first edition of our annual Water Sector Group e-magazine: ***Digitalizing H_2O: Digitalizing for Water Security and Resilience in Asia and the Pacific.***

We believe digitalization can help optimize the impacts and outcomes of ADB's water sector projects and programs, and help ADB achieve its Strategy 2030 goals of an inclusive, prosperous, sustainable, and resilient Asia and the Pacific.

We organized two e-marketplace events this year, collectively showcasing 116 digitalization solutions for water management. These ranged from small nongovernment organizations with information and communication technology-based solutions to large companies with remote sensing and space technologies, all shortlisted for their applicability to water stakeholders in our Asia and Pacific region. We also explored the digitalization solutions in use in ADB to understand the trends and trajectories within ADB-supported water operations for internal cross learning. In addition, we interviewed select ADB staff and water sector agencies who are implementing these technologies in their projects across all operational departments.

This first e-magazine on *Digitalizing for Water Security and Resilience in Asia and the Pacific* encompasses learning from the e-marketplaces, internal best practices, and interviews with ADB Water Sector staff, market representatives, and clients. Through the case studies and exhibitors' insights, it highlights practical solutions that have direct application to ADB operations. Through interviews with ADB project officers and clients, it underscores insights, lessons learned, and practical suggestions for applying smart water technologies in developing Asia and the Pacific.

2022 will be a good year to further catalyze and spearhead digitalization in the water sector.

The Water Sector Group will be operationalizing its new initiative called, "ARe YoU Water Resilient?" or RUWR, and the cluster technical assistance project on mainstreaming water resilience in the region, with digitalization as a key pillar. Through these new initiatives, ADB will foster collaboration with development partners, institutions, and private solution providers to expand digitalization efforts in all water subsectors in the region. We will also continue to connect ADB's water sector staff and clients with technology solution providers and will organize a series of invitation-only dialogues with project officers and experts on areas requested by clients.

We hope you enjoy the first edition of this interactive e-magazine. We look forward to continuing our dialogue and close collaboration with you all in our efforts to spearhead digitalizing water management for a water secure and resilient Asia and the Pacific in 2022.

Best Regards,

Neeta Pokhrel

Chief, Water Sector Group

E-MAGAZINE CORE TEAM

Neeta Pokhrel - CHIEF
Water Sector Group, Sector Advisory Service Cluster, Sustainable Development and Climate Change Department

Pia Corrina Reyes - WATER RESOURCES OFFICER
Water Sector Group, Sector Advisory Service Cluster, Sustainable Development and Climate Change Department

Fatima Bautista - OPERATIONS ANALYST
Water Sector Group, Sector Advisory Service Cluster, Sustainable Development and Climate Change Department

Ma. Cecilia Landicho - SENIOR OPERATIONS ASSISTANT
Water Sector Group, Sector Advisory Service Cluster, Sustainable Development and Climate Change Department

Gerardo Castro - CONSULTANT
Office of the Director General, South Asia Department

Marie Christelle Garcia -CONSULTANT
Water Sector Group, Sector Advisory Service Cluster, Sustainable Development and Climate Change Department

Lourdes Margarita Caballero - CONSULTANT
Water Sector Group, Sector Advisory Service Cluster, Sustainable Development and Climate Change Department

Ginojesu Pascua - CONSULTANT
Water Sector Group, Sector Advisory Service Cluster, Sustainable Development and Climate Change Department

Ricardo de Guzman - CONSULTANT
Water Sector Group, Sector Advisory Service Cluster, Sustainable Development and Climate Change Department

Analyn Dela Cruz - CONSULTANT
Water Sector Group, Sector Advisory Service Cluster, Sustainable Development and Climate Change Department

Robert Domingo - CONSULTANT
Water Sector Group, Sector Advisory Service Cluster, Sustainable Development and Climate Change Department

Joanna Mayhew Brewster - CONSULTANT
Water Sector Group, Sector Advisory Service Cluster, Sustainable Development and Climate Change Department

Water for All. ADB's Strategy 2030 commits to proactively seek ways to promote the use of advanced technologies to help developing member countries ensure there is safe and affordable drinking water for all (photo by ADB).

E-MAGAZINE CONTRIBUTORS

Neeta Pokhrel - CHIEF
Water Sector Group, Sector Advisory Service Cluster, Sustainable Development and Climate Change Department

Jingmin Huang - DIRECTOR
Urban Development and Water Division, Pacific Department

Norio Saito - DIRECTOR
Urban Development and Water Division, South Asia Department

Thomas Abell - ADVISOR AND CHIEF
Digital Technology for Development Unit, Sustainable Development and Climate Change Department

Thomas Panella - DIRECTOR
Environment, Natural Resources and Agriculture Division, East Asia Department

Geoffrey Wilson - SENIOR WATER RESOURCES SPECIALIST
Water Sector Group, Sector Advisory Service Cluster, Sustainable Development and Climate Change Department

Jelle Beekma - SENIOR WATER RESOURCES SPECIALIST
Water Sector Group, Sector Advisory Service Cluster, Sustainable Development and Climate Change Department

Christian Walder - WATER SUPPLY AND SANITATION SPECIALIST
Water Sector Group, Sector Advisory Service Cluster, Sustainable Development and Climate Change Department

Seok Yong Yoon - PRINCIPAL PUBLIC MANAGEMENT SPECIALIST (E-GOVERNANCE)
Digital Technology for Development Unit, Sustainable Development and Climate Change Department

Sunghoon Kris Moon - URBAN DEVELOPMENT SPECIALIST
Urban Sector Group, Sector Advisory Service Cluster, Sustainable Development and Climate Change Department

Okju Jeong- CONSULTANT
Urban Sector Group, Sector Advisory Service Cluster, Sustainable Development and Climate Change Department

Sarah Li - CONSULTANT
Urban Sector Group, Sector Advisory Service Cluster, Sustainable Development and Climate Change Department

Jade Marie Dumaguing - ASSOCIATE PROJECT ANALYST
Urban Development and Water Division, South Asia Department

Elvie Jane Tirano - SENIOR OPERATIONS ASSISTANT
Urban Development and Water Division, South Asia Department

Aritha Zel Zalamea - CONSULTANT
Urban Development and Water Division, South Asia Department

Phillip Gerard Day - CONSULTANT
Urban Development and Water Division, South Asia Department

Hans Enggrob - CONSULTANT
Urban Development and Water Division, South Asia Department

Catherine Fong - SENIOR PUBLIC–PRIVATE PARTNERSHIP OFFICER
Advisory Division 2, Office of Public–Private Partnership

Dhivya Ravikumar - PUBLIC–PRIVATE PARTNERSHIP SPECIALIST
Public–Private Partnership Thematic Group Secretariat, Office of Public–Private Partnership

Asad Ali Zafar - SENIOR PROJECT OFFICER (WATER RESOURCES)
Pakistan Resident Mission, Central and West Asia Department

Heeyoung Hong - PRINCIPAL URBAN DEVELOPMENT SPECIALIST (FINANCE)
Urban Development and Water Division, Central and West Asia Department

Sourav Majumder - SENIOR PROJECT OFFICER (URBAN)
India Resident Mission, South Asia Department

Anita Kumari - ASSOCIATE PROJECT ANALYST
India Resident Mission, South Asia Department

Mingyuan Fan - PRINCIPAL WATER RESOURCES SPECIALIST
Environment, Natural Resources and Agriculture Division, East Asia Department

Siti Hasanah - URBAN DEVELOPMENT SPECIALIST
Urban Development and Water Division, Southeast Asia Department

Junko Sagara - WATER RESOURCES SPECIALIST
Environment, Natural Resources and Agriculture Division, Southeast Asia Department

Eric Quincieu - PRINCIPAL WATER RESOURCES SPECIALIST
Environment, Natural Resources and Agriculture Division, Southeast Asia Department

Paolo Manunta - SENIOR INFRASTRUCTURE SPECIALIST (EARTH OBSERVATION)
Digital Technology for Development Unit, Sustainable Development and Climate Change Department

Jinqiang Chen - URBAN DEVELOPMENT SPECIALIST (CLIMATE CHANGE)
Urban and Social Sectors Division, East Asia Department

Yihong Wang - SENIOR INVESTMENT OFFICER
People's Republic of China Resident Mission, East Asia Department

Anqian Huang - SENIOR FINANCIAL SECTOR SPECIALIST
Public Management, Financial Sector, and Regional Cooperation Division, East Asia Department

Zhijia Rao - SENIOR INVESTMENT OFFICER
Infrastructure Finance Division 2, Private Sector Operations Department

Rajesh Yadav - SENIOR PROJECT OFFICER (NATURAL RESOURCES AND AGRICULTURE)
India Resident Mission, South Asia Department

Virinder Sharma - PRINCIPAL URBAN DEVELOPMENT SPECIALIST
Urban Sector Group, Sector Advisory Service Cluster, Sustainable Development and Climate Change Department

Laxmi Sharma - SENIOR URBAN DEVELOPMENT SPECIALIST
Urban Development and Water Division, South Asia Department

Ma. Victoria Antonio - CONSULTANT
Urban Sector Group, Sector Advisory Service Cluster, Sustainable Development and Climate Change Department

Bonapart Masangcay - CONSULTANT
Urban Sector Group, Sector Advisory Service Cluster, Sustainable Development and Climate Change Department

Alexandra Conroy - URBAN DEVELOPMENT SPECIALIST
Urban Development and Water Division, South Asia Department

Stephane Bessadi - SENIOR PROCUREMENT SPECIALIST
Procurement Division 2, Procurement, Portfolio and Financial Management Department

CONTENTS

Water Security and Digitalization in Asia and the Pacific

Clean water is a basic human need. Without clean water and proper sanitation, disease spreads and communities suffer. Hours are wasted trudging to the nearest source of water, and mere survival becomes everyone's top priority.

The United Nations (UN) Sustainable Development Goals rightly set a high bar when it comes to water: safe and affordable drinking water for all by 2030, through establishing adequate infrastructure, providing sanitation facilities, encouraging hygiene, and protecting and restoring water-related ecosystems.

That target date is fast approaching. Meeting the goal will be hard, especially for Asia and the Pacific. About 300 million people in the region do not have access to safe drinking water, 1.2 billion lack adequate sanitation, and 80% of wastewater generated by cities is discharged untreated into water bodies. Worse, while progress slowly advances in many countries to meet the goal, climate change effects are increasingly cutting into advances—and more than 80% of climate change impacts manifest through water.

If we are to have any chance of success, some of the world's oldest needs—moving clean water to communities and removing dirty water—must be met with the best that modern technology has to offer.

The Asian Development Bank (ADB) recognizes both the priority of addressing water and sanitation issues in Asia and the Pacific need to use technology to spur change.

ADB's Strategy 2030 commits to proactively seek ways to promote the use of advanced technologies across its operations and provide capacity building support to developing member countries (DMCs). ADB is dedicated to helping agencies strengthen their capacity to plan, design, finance, and implement ADB projects, including the application of advanced technology.

SAFE AND AFFORDABLE DRINKING WATER FOR ALL BY 2030

The adoption of technology has been frustratingly slow in the water sector, despite evidence of its success across a wide range of applications. Based on ADB's Digital Technology Unit research on digitalization projects or project components approved from 2010 to 2020, the water sector ranked one of the lowest in digitalization uptake.

At times it seems there is resistance to the idea of moving the water sector into the digital realm. Too often that resistance stems from a lack of awareness or misunderstanding about what is available. Demystifying the technology and demonstrating that users can choose the speed at which they implement it is key to its adoption.

The imperative to assist DMCs to improve water and sanitation remains urgent, even amid a pandemic that limits the ability of ADB to bring people together.

Introducing governments, utilities, and others involved in water and sanitation to the latest technology was the impetus for ADB's first e-marketplace, ***Catalyzing Innovations and Digitization for Safe, Sustainable, Resilient, and Inclusive Water Management,*** held on 15–19 March. The same thinking guided the second e-marketplace, held on 19–27 October. The e-marketplaces showcased a range of technological solutions that can be used in the sector.

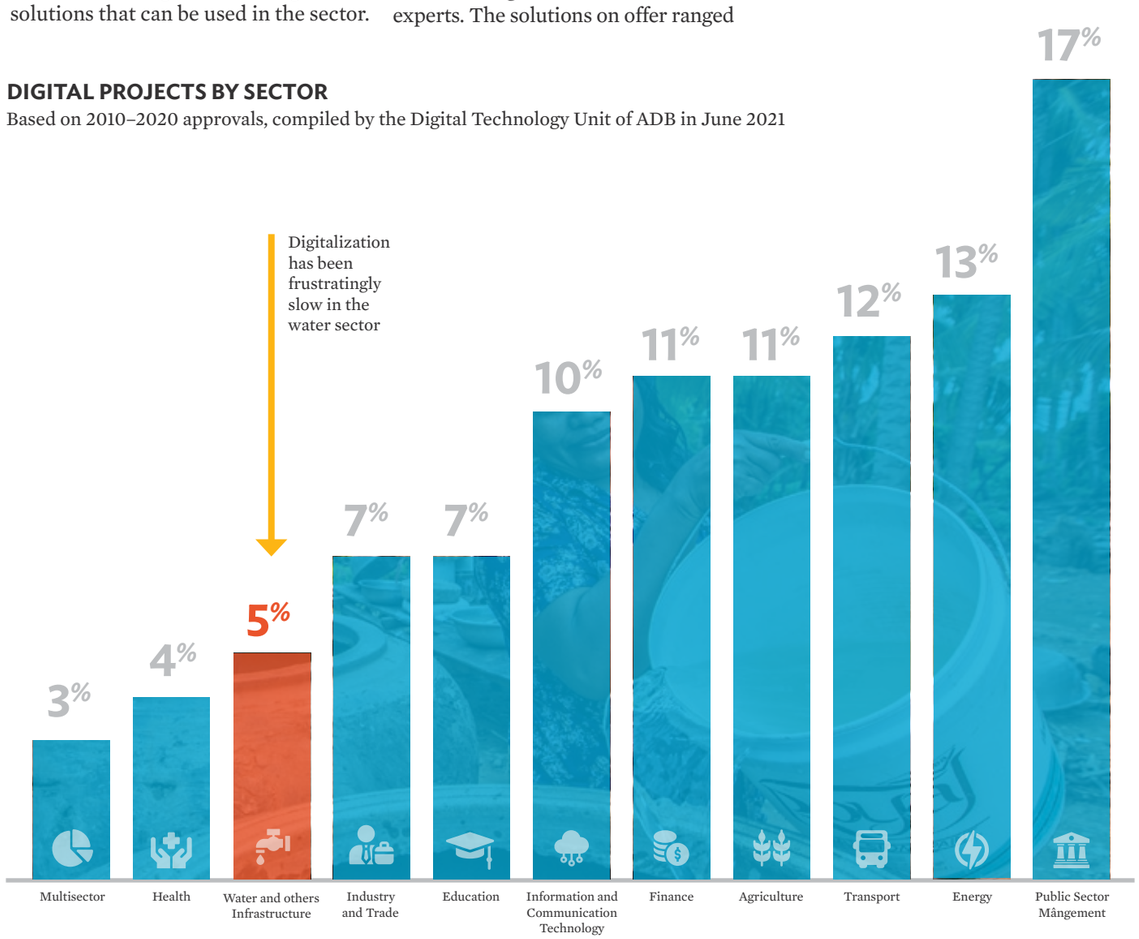
This e-magazine summarizes recent ADB-supported efforts and highlights the current technologies on offer from technology providers who attended the e-marketplaces.

More than 2,000 visits were made at each of the first and second e-marketplaces, with participants exploring virtual booths set up by technological innovators and advisors and attending online sessions with experts. The solutions on offer ranged from large scale, with satellite imagery to spot droughts or floods, to personal, with phone apps that allow consumers to test and report water quality at home.

This first edition explores the results of the two 2021 e-marketplaces, showcases technological successes of ADB and its partners in the water sector, and examines the future of digitalization for the water sector as seen by ADB's water sector stakeholders.

DIGITAL PROJECTS BY SECTOR

Based on 2010–2020 approvals, compiled by the Digital Technology Unit of ADB in June 2021



Source: Digital Technology for Development Unit database.

About

300M

people in the region do not have access to safe drinking water

1.2B

people lack adequate sanitation

80%

of wastewater generated by cities is discharged untreated into water bodies

Directing change. Staff work at the control center of the Tamavua Water Treatment Plant in Fiji, as part of ADB's Suva–Nausori Water Supply and Sewerage Project to improve the water supply and sewerage services for urban areas (photo by ADB)

Showcasing Solutions and Lessons from ADB's e-Marketplaces on Water Security and Resilience

In March 2021 and October 2021, ADB organized virtual e-marketplaces that brought together purveyors of the latest technological innovations in the water sector and those who most need to hear their stories—ADB's water sector staff and clients. The idea was simple: demystify the idea of smart water management and speed the take-up of the technology in ADB's DMCs. More than 2,000 visits were made at each of the events to the online sessions from 118 solution providers.

The solutions presented in the first e-marketplace were grouped under five categories: basins, utilities, assets, efficiency, and sanitation. The second e-marketplace grouped them under the following four categories: conserving water resources and building resilience, managing water and sanitation services, strengthening enablers for water security, and showcasing partnerships and projects.

MAIN TOPICS OR SOLUTIONS SHOWCASED INCLUDED:

Online booths were open 1 week prior to each e-marketplace. Interactive sessions by presenters were supplemented by panel discussions involving global experts. Participants were free to visit the virtual booths any time until the end of March 2021 for the first one, and mid-November 2021 for the second one, to see the presenters' submissions, which ranged from videos and PowerPoint slides to three-dimensional experiences.

Virtual booths of all solution providers from the first e-marketplace can be accessed here; and from the second e-marketplace can be accessed here.

This section describes the issues and solutions discussed at the e-marketplaces, including ideas on the best avenues for adopting digital smart water technology in ADB's DMCs. It also provides feedback from solution providers and a detailed look at select exhibitors and their technology in action.

FIRST E-MARKETPLACE:
CATALYZING INNOVATIONS AND DIGITIZATION FOR SAFE, SUSTAINABLE, RESILIENT, AND INCLUSIVE WATER MANAGEMENT

Page 14–15

SECOND E-MARKETPLACE:
A WATER-SECURE AND RESILIENT ASIA AND THE PACIFIC

Page 16–17

ADB

Japan Fund for Poverty Reduction

URBAN CLIMATE CHANGE RESILIENCE TRUST FUND

Catalyzing Innovations and Digitization for Safe, Sustainable, Resilient, and Inclusive Water Management

LAUNCH OF **E-MARKETPLACE**

15–19 March 2021

BASINS

Deltares Enabling Delta Life
esa
HKV
UNESCO IHE DELFT
JAXA Explore to Realize
MAITHRI AQUATECH PVT LTD
PHOENIX ROBOTIX
SMEC Member of the Surbana Jurong Group
SOURCE
TARU LEADING EDGE
Vassar LABS
veragon water makes the difference

SANITATION

ADBInstitute
BIOPOLUS The Living Technology Alliance
CSE
DESMI
DongYang Water Technologies
GRUNDFOS
HIYOSHI 株式会社日吉
Innovyze
MÖRK WATER
XUNP

UTILITIES

DHI
Link For Values
K water
MANILA WATER TOTAL SOLUTIONS
Maynilad
TORK
CuiTai
SUEZ
TATA
VEOLIA

EFFICIENCY

AquAffirm
Hiraya Water
IMAGINE H_2O
drinkwell
Dryp.
ECO
Royal HaskoningDHV Enhancing Society Together
Schneider Electric
smartterra
SUNTECH ENGINEERING
Wamasys
WI.Plat

ASSETS

AGUA Saving of Water Made Simple
红星阀门
FORBES MARSHALL
+GF+
Indian Institute of Technology Bombay
JAIN TECHNOLOGY
NOBEL SYSTEMS
s::can
SHINDONGA ELECTRONICS CO.,LTD.
ColiMinder rapid microbiology
xylem Let's Solve Water
Water Tech 华沃太科

Click on the logos

to view more details about each solution provider

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

18–27 October 2021

SHOWCASING PARTNERSHIPS AND PROJECTS

ATKINS Member of the SNC-Lavalin Group
CAREC INSTITUTE
CWAS CENTER FOR WATER AND SANITATION
CRDF CEPT UNIVERSITY
detektia
esa GDA
FREDsense
isle
Maynilad Higit sa tubig ang amin serbisyo
(주)엠아이제이 MIJ Hearing is Life, Life is ETEREO
Nature Awareness And Conservation Club, Inc (NACCI) http://philecotourism.wordpress.com
OSMOFLO
ROYAL Eijkelkamp Meet the difference
Royal HaskoningDHV Enhancing Society Together
SCREENING TOOL FOR ENERGY EVALUATION OF PROJECTS

CONSERVING WATER RESOURCES AND BUILDING RESILIENCE

CLEARFORD WATER SYSTEMS INC.
AUMSAT Sense and Solve
AquaShares Water resilience through transparency, trading & trust
Enggrob & Singh
ENPHO Creating Eco Societies
genaq
HKV
IWMI International Water Management Institute
MAITHRI AQUATECH PVT LTD
SOURCE Perfect drinking water for every person, every place.
suez
Vassar LABS
walter p moore
xylem Let's Solve Water

STRENGTHENING ENABLERS FOR WATER SECURITY

+GF+ Piping Systems
KROK-1 LTD
VWM Vienna water monitoring SOLUTIONS
sommer MESSTECHNIK
tracwater robotic water data systems
NXTLVL Water
OCEO Smart Water Purifier
Greenvironment clean earth, safe life
BuntPlanet DreamingMinds
MÖRK WATER www.moerkwater.com.au
PRIMUS LINE The prime solution for pipes.
ARUP
JAIN TECHNOLOGY
XDI CROSS DEPENDENCY INITIATIVE

MANAGING WATER AND SANITATION SERVICES

BHUMIJO
BIOMASS CONTROLS PBC
D.D. BUILDERS & Infrastructure Services
ECO for people and planet
hawle
IMAGINE H2O ASIA
innovative Solution (P) Ltd.
IoTivity
JECES
NOBEL SYSTEMS
sentryco
SNV
SOLARDEW CLEAN WATER SOLUTIONS
TRADEWORKS ENVIRONMENTAL

Click on the logos
to view more details about each solution provider

Takeaways at a Glance

DIGITALIZATION CAN OCCUR INCREMENTALLY

Technology changes quickly. The acceleration of upgrades and the spread of ever-faster, all-encompassing digital tools can be daunting, especially for those who spend their days scrambling to make do with already-overwhelmed infrastructure.

Technology changes quickly. The acceleration of upgrades and the spread of ever-faster, all-encompassing digital tools can be daunting, especially for those who spend their days scrambling to make do with already-overwhelmed infrastructure. That is why one of the main goals of ADB's e-marketplaces for digitalizing water management was to familiarize the potential consumers of digital technology with the tools available.

Local government and water utility staff can be forgiven if they feel their problems are too simple for the solutions on offer, or that they will not be able to afford those solutions. Giant control rooms with screens showing real-time satellite views and water quality monitoring sensors flashing second-by-second updates can seem like science fiction when they just need to find out which of their pipes is leaking.

But as many suggested during the e-marketplaces, the days are fading when local utilities need massive digital infrastructure to oversee smart water services. The watchword today is "servicization." More and more, services are delivered via mobile phone and managed by self-configuring, low-cost, "internet of things" devices.

Smart water implementation should start with simple and practical use cases with minimum functionality that demonstrate tangible and clear value for users. Systems can be gradually expanded with more functionality, in synchronization with steadily improving work processes within the local government or water utility.

Demonstrating, explaining, and demystifying smart water technology makes using digital tools more realistic and was key to the success of ADB's e-marketplaces in 2021.

"Water security underpins social and economic development and is crucial for achieving ADB's operational priorities and our Strategy 2030," said Shixin Chen, ADB Vice-President (Operations 1), during the opening session of the first e-marketplace. "Digitization is a key aspect of achieving resilience in water and sanitation management."

The e-marketplaces were not designed only for the ultimate users of digital smart water technology. They also provided guidance for technology providers, consultants, contractors, and others such as ADB who promote the use of digital tools.

Technology providers and their boosters need to be mindful they have a limited opportunity to suggest appropriate services. They must pick the right use cases from the start so their clients can take the first steps on a long digitization journey. If they promote services that fail to add value in the short term, this may discourage further development rather than lead to more efficient operations.

DIGITALIZATION PROJECTS MUST ALIGN WITHIN WIDER SYSTEM CHANGES

The transition to a digital architecture for water services will not happen overnight, and it will not be a simple switch from one system to another. Digitized services must operate alongside traditional water projects for years to come.

There are two types of water projects that must be implemented and maintained in tandem. The first are traditional infrastructure projects, or "waterfall" projects, with equipment purchase, implementation, training, and handover in a scheduled and finite process. The second are "agile" projects, where executing agencies and implementing agencies need assistance in the transformation of their organizations. They need long-term help with the continual development of organizational strategies, structures, and work processes as they adjust to a digital environment. Waterfall and agile projects need to work in parallel, which is a challenge for executing and implementing agencies, and others such as ADB who work with them.

Transitioning to smart water services requires rethinking by everyone involved, not just the ultimate technology users. For ADB and others who advise and assist in the process, there needs to be a change from the project-by-project mindset of typical waterfall project operations. The nature of digital tools and their operation requires a comprehensive plan from the outset. Each added component must improve the overall system and fit that plan. The build-out of smart water services cannot be encased within a typical design-and-build project.

Mobile monitoring. In Viet Nam, enumerators are trained to use maps or Global Positioning System software to locate sample mesh and to estimate planting area for crops (photo by ADB).

This will be an ongoing challenge for organizations such as ADB. If digitization is divided into individual projects, each with its own consultant and vendor, the strategy will need to be reinvented with each new project and progress will inevitably slow. A solution must be found to build ongoing and long-term relationships into the process.

DIGITALIZATION MUST SERVE THE MOST VULNERABLE

As several participants also pointed out, the distraction of exciting technology must not overwhelm the ultimate goal of improved water services—to help those who most need them.

> **"We need to ensure that the clear focus is on poor and vulnerable groups."**
>
> —Shantanu Mitra
> Senior Climate and Environmental Advisor, Foreign, Commonwealth & Development Office of the United Kingdom

"We need to ensure that the clear focus is on poor and vulnerable groups." said Shantanu Mitra, Senior Climate and Environmental Advisor, Foreign, Commonwealth & Development Office of the United Kingdom speaking during a roundtable session at the opening session of the first e-marketplace.

Paying attention to what those groups need and want will help in adopting new technology by allowing demand to shape solutions, rather than technology providers searching out problems to solve.

The simplicity and scalability of available smart water management tools can be more readily exploited by this focus. A key message of the e-marketplaces was that digitization does not mean a complete overhaul of every utility and service.

Not everyone can afford or necessarily needs a "Rolls Royce solution," or the best there is on offer; many areas can begin with a "bicycle solution." The "bicycle" version of smart technology is a mobile phone—a tool just as prevalent as the bicycle itself across developing Asia. India has about 1.2 billion mobile phone users, 750 million of whom use smartphones and whose use is increasing 10% a year. With the mobile phone as a building block, few communities in developing Asia would be excluded from basic available digital technologies.

Participants in the e-marketplaces had suggestions on the best way to start the journey of connecting digital technology providers with communities that might benefit from their offerings. "Smart water management is for the benefit of the people, and therefore such management cannot be effective without their participation," said M.N. Roy, President of India's SIGMA Foundation, one of the solution providers exhibiting at the first e-marketplace.

In his presentation, Roy suggested that since women bear the greatest burden from water service gaps, they should be approached as the mostly likely adopters of digital improvements. "Engage with the women," he said. "They suffer a lot if the water is not there. It is their problem, their suffering. That is the best way to engage with a community."

DIGITALIZATION REQUIRES CHAMPIONING, INCENTIVIZATION, AND LOCAL SUPPORT SYSTEMS

The e-marketplaces and other attempts to bring together users and providers of digital water solutions can help executing and implementing agencies narrow the choices available. As some users commented in a post-event survey, technology is advancing faster than can be absorbed by these agencies.

But simply introducing executing and implementing agencies to the technology might not be enough. Participants suggested ways in which local technology users could be assisted in acquiring and implementing smart water solutions, since adoption often depends on a single technology "champion"—a top manager in a local government or water utility who drives the process.

Commenters suggested that assistance from the private sector would help to maintain momentum for digital uptake, as well as using standards or goals that would publicly highlight local authorities who were succeeding in adopting smart technologies.

Since digital change needs to be managed over the long term in agile projects, as mentioned, it makes sense to develop a local digital ecosystem to support it. Water utilities and local governments need information technology services, data management services, and instrumentation management and repair services with linkages to experts when needed. Without a local support network, water utilities would need to depend on consulting and expert services from overseas or from large urban centers, which would be more costly and time consuming and less efficient.

DIGITALIZATION SOLUTIONS MUST BE PILOTED AND TESTED

Another suggestion was that ADB support small projects needing minimal investments as demonstration projects. Local authorities could be given funding options along with the outcome of these pilot projects, providing concrete examples of how smart water solutions have worked in similar jurisdictions. Pilot projects are not feasible for large, traditional waterfall projects. But for agile projects, small pilot projects can also be used to test and adapt solutions to local conditions. Results can then be shared with others.

Testing ideas was, of course, also a goal of the e-marketplaces. Participants were able to get a sense of the range of solutions on offer, ask questions, and gather contacts for future queries that should lead to further adoption of smart water services.

DIGITALIZATION CHALLENGES

Challenges remain, but more solutions are arriving every day. Some of the main challenges in digitalizing the water sector, as detailed by participants in post-e-marketplace surveys—and which the solutions in the following sections are designed to address—include:

CLIMATE CHANGE

Water is the primary medium through which we will feel the impacts of climate change. Water systems are already being affected, and authorities and operators will need to embed appropriate adaptation tools to address future changes.

UNSYNCHRONIZED DEVELOPMENT AND FRAGMENTED RESPONSIBILITIES

Within many jurisdictions, water and sanitation systems are overseen by several different authorities and operators, making logical and planned development even more of a challenge. Digitalization can help bridge the divide but getting buy-in from multiple parties creates hurdles.

DATA LITERACY

Local stakeholders, managers, and operators need to overcome barriers to incorporating real-time and widespread data into their planning and operations. Data are valuable, both for local use and to share with others who can benefit from the example, however human resources in the water sector need to be agile and reskilled to fully benefit from it.

WATER PRICING

Pricing water correctly creates a sense of ownership by consumers and allows the system to thrive. Until we get the pricing right, digitalizing for demand management does not work.

NONREVENUE WATER

Tracking and fixing leaks and water wastage within the system is a major issue.

(photo © Maximus256/Shutterstock)

Learning More from the Exhibitors through Selected Interviews

Using natural resources allows us to lower the capital and operational expenses of our technology. We at NXTLVL take advantage of the seawater, which the Philippines has a lot of, and the never-ending energy provided by the sun."

—NXTLVL Water
>> Read more

The monitoring of water resources and subsequent data analysis underpins sound decision-making and optimal design of solutions to water challenges facing the globe. Adequate water information systems drive sustainable water management, and the long-term value of this data should be completely realized."

—Xylem Analytics
>> Read more

Collaboration among all stakeholders is key to safe, sustainable, and resilient water management solutions in water-stressed and developing countries. We work closely with our clients and partners, as well as the broader industry and communities, for global excellence in water security, climate resilience, and sustainability."

—SMEC
>> Read more

Water sector challenges are becoming more difficult every day. Governments need more information at hand. With digitalization, you can have an overview of different aspects of water in both quantity and quality for better understanding and decision-making."

—Advanced Center for Integrated Water Resources Management

Access to safe drinking water is fundamental, and we are on a mission to make drinking water an unlimited resource."

—Source Global, PBC
>> Read more

Imagine H_2O Asia is the first accelerator exclusively focused on scaling water technology startups across Southeast Asia and the wider region. We've developed 150 start-ups and raised $550M in 11 years of operation. Participating entrepreneurs receive mentorship, industry visibility, pilot funding awards, as well as access to a dedicated network of regional customers and investors."

—Imagine H_2O
>> Read more

The world faces huge challenges in water management: climate change, increasing natural hazards, floods, droughts, water scarcity, etc. With populations growing, demand for food increasing, and the global climate becoming more unpredictable, the water challenge is becoming ever more critical for society. The built environment should become more sustainable, using less scarce resources, running at a lower capital expenditure and operating expenditure costs, with more agility. Data and digital create many new opportunities to improve, work smarter, and more efficiently."

—Royal HaskoningDHV
>> Read more

Innovation doesn't always come in the form of a new product or technology; sometimes it's about a new way to address a problem."

—European Space Agency
>> Read more

Water is a woman's issue. We're proud to have a strong team of women—and men—on our side. We're all united by this common goal to develop and implement new and innovative methods to treat the toughest wastewater challenges."

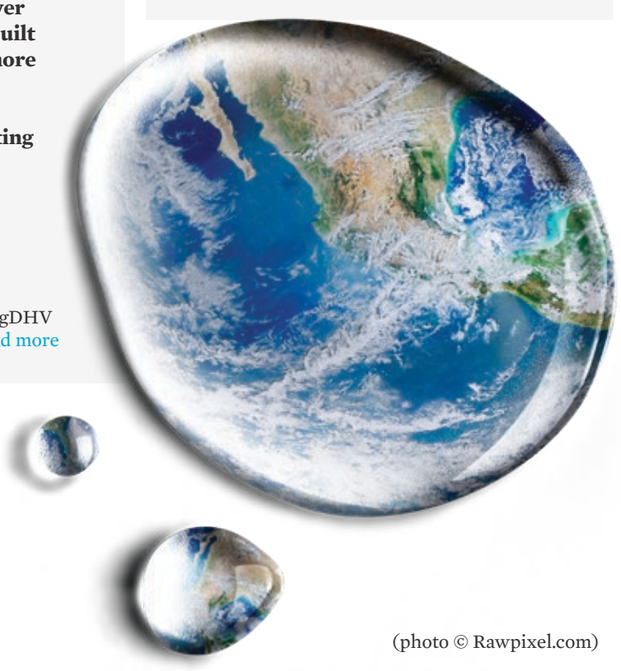
—Tradeworks
>> Read more

Our focus is to have one authoritative system for all water supply, demand and environmental factors, with a vision of making water-related data accessible transparently on a real-time basis to different stakeholders through an online geographic information system and management information system web portal, as well as seamlessly available through mobile, tablets, etc."

—Vassar Labs
>> Read more

We sincerely hope ADB's e-marketplace will develop into a series of events to enforce even closer exchange between institutions, industry, and innovation."

—Vienna Water Monitoring Solutions
>> Read more



(photo © Rawpixel.com)

ORGANIZATION:

INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

What are the challenges and market gaps addressed by your digital technology?

- "Internet of things" solutions need to be low-cost and affordable to be relevant for the water sector in developing countries. This is a major challenge. Maintenance needs to be factored into any plan, and seamless data and parts compatibility across the products and brands is another challenge.

How does the digital technology address those issues?

- Digital technology providers have to match the costs of their solutions to the revenue generation that is possible for a given project. There have to be defined service-level improvements for each digital technology or solution.
- Our research is focused on linking service levels with digital solutions. Recognizing the need for an open-source platform to enable widespread usage in academic institutions, government offices, and other institutions, the JalTantra system was developed at the Indian Institute of Technology Bombay. It has been adopted as one of the software systems to be used in the design of water supply schemes by many government departments in India. The JalTantra system was developed considering the choices across the different disciplines involved in planning and designing water distribution systems, as well as for cost optimization to address the high prices and complex platforms associated with conventional commercial software products that make such digital platforms prohibitive to use.
- The JalTantra optimization framework not only covers the pipe cost but also includes the energy cost of pumping water, as well as the capital costs of pumps and storage tanks. The current system is designed for branch networks only, but it is being expanded to optimize loop-type networks as well. The next version will also have geographical information system-based demand allocation, data management, and result visualization.

What is the speed of uptake, and how can this be improved?

- Digital technology adoption in India is quick but many projects have not seen that initial enthusiasm sustained. The focus needs to be on the sustained use of implemented digital solutions, which will happen when service improvements are attributed to the digital solutions.

Technology on display. Electromagnetic flowmeter detector and water pipeline (photo © Sergey Ryzhov/Shutterstock).

ORGANIZATION:

SIGMA FOUNDATION

What are the challenges and market gaps in digital technology?

- The use of water and its wastage depends on the knowledge, attitude, and practices of the people, and their socioeconomic situation as well as cultural context need to be considered. As such, the issues to be covered are not only supply of water but also conservation measures for augmenting availability and reuse of wastewater for reducing the pressure on supply.
- Tech-based solutions have their advantages from an efficiency point of view, but use depends on affordability and adoptability. While the issue of affordability can be met through state funding, equipping the community to adopt the technology requires meticulous training at the community level. The technologies that are easiest to adopt will be more effective.

How can those issues be addressed?

- Water is a gift of nature to which the entire community has equal rights. Involvement of the community from the beginning helps them own the entire supply infrastructure, and they will not only own the water available in nature but also the entire supply infrastructure and its maintenance.
- Internalizing the right to water allows every member of the community to enjoy the right without affecting others' rights. When water comes from a service provider and is delivered to the premises, people tend to think the water belongs to the provider and may use it irrationally, leading to wastage and negatively affecting other consumers.
- Training is extremely important at all levels, and the focus should be on learning and competence building. For that purpose, the training needs have to be assessed, then organizing training provided, followed by support.

How can local buy-in be assured?

- The best way to approach the community is not with a solution as an engineering design but to patiently listen to their problems and understand the possible solutions as they see it. The availability and use of water have a lot to do with the social aspects of its conservation, management, and use. People need to be asked to articulate those aspects and how the available water can be best used by everyone. Once their views are known, the technical solution will be better owned by the people as their decision, and the system will also better fit their needs.
- Getting women onside the project is the only way to fully benefit the community. Women, once empowered, have demonstrated taking part in water supply management activities with commitment, which improves water management and improves gender justice at the same time.
- SIGMA Foundation documented two case studies on the critical role of women in the water sector. The inclusion of women in ADB projects in the Bajora and Nabashan villages in Bankura district of West Bengal are an example. There, women received training to maintain the water supply system. This was not a trivial step and should be seen as a good road map for future projects.

COMPANY:

MAITHRI AQUATECH

What are the challenges and market gaps addressed by your digital technology?

- Global warming, climate change, industrialization, and growing populations have severely reduced the quantity and quality of water sources.
- Many countries, especially those in South America, Africa, the Gulf, and Southeast Asia—the global south—face frequent water shortages due to either aging or limited infrastructure.
- Contamination of available freshwater sources has become a severe issue, especially when considering the fact that 80% of all diseases are water-borne, according to the World Health Organization.
- Global water solutions are exclusively dependent on ground and surface water resources to provide clean drinking water. Most conventional water solutions contribute to water wastage.

How does the digital technology address those issues?

- Water from air technology, known as atmospheric water generation or AWG, is one of the only technologies that is capable of generating water. There is enough water in the air to fill all the rivers on our planet with water six times over, with the amount being recycled 40 times each year. This makes it a renewable resource.
- Our MEGHDOOT—Sanskrit for "messenger of the skies"—AWG taps into this renewable resource to generate water on demand, even in remote locations. No other water sources are required, and they can run on renewable energy.
- By integrating our solution with "internet of things," it is also possible to gather data on the amount of water that is generated and dispensed by the system, at which location, and at what temperature and humidity conditions.
- With its modular architecture, and with each machine functioning as a water source, the solutions can be scaled to meet requirements from tens of liters to millions of liters per day, or more.
- Among AWG solutions, MEGHDOOT is also one of the most economic solutions, capable of generating a liter of water at a cost as low as $0.02.

What is the speed of uptake, and how can this be improved?

- With growing water demands, and the global pursuit for sustainability, it is estimated that the AWG market will be $11 billion by 2026.
- With conventional water solutions contributing to water wastage, paired with depleting water resources, there will continue to be a rapid shift toward alternative water solutions, especially AWG as a dependable source.
- AWG solutions can be scaled down to meet the smaller domestic requirements of households, potentially capturing the household water purifier market. We have seen success in this market in the water-scarce Indian city of Chennai. The system can also help large companies build more sustainable ecosystems.
- With water being a universal requirement, not just for humanity but for the entire planet, we have been approached by individuals and organizations and have provided water solutions for fauna—refilling dried up waterholes, fisheries, and shrimp farms—and for flora—hydroponic farms and aeroponic farms.

Working smart. Digital devices allow for measuring water content (photo © Sergey Ryzhov/Shutterstock).

ORGANIZATION:

XYLEM ANALYTICS

What are the challenges and market gaps addressed by your digital technology?

- There are differences in the communications protocols used around the world that make the implementation of "internet of things" devices more difficult to achieve than is desirable. The devices and monitoring systems used need to be able to communicate, and a mishmash of communications protocols does not work.
- Advanced digital technology should not be equated with complexity of operation for the user. While the digital technology can be complex and integrated with a state-of-the-art monitoring system, at the user end the system must be simple to operate and devices must be intuitive. Ease-of-use needs to be paramount.

How does the digital technology address those issues?

- Digital technologies need to provide complete solutions that are tightly integrated from the measurement sensor end to the operational, display, and backend. Advanced digital technology is integral in Xylem instrumentation. Xylem Analytics is well positioned to enhance water resources management through "internet of things" systems given the incorporation of industry-leading technologies and brands across the water measurement, data acquisition, and communications fields. Combined with our Integrated Systems and Services group, Xylem can provide "internet of things" solutions for the water industry that will work across the region.
- Advanced digital technology should not be equated with complexity of operation for the user. The hallmark of Xylem instruments is that functionality, such as taking a discharge measurement, calibrating a water quality sensor, or setting up a Real Time Unit, is made efficient and easy for the end user. By manufacturing state-of-the-art systems that incorporate the user experience as one of the key design criteria, the challenges of implementation across a region with diverse languages and cultures is minimized.

What is the speed of uptake?

- Unfortunately, long-term hydrological data, which underpins most science around flooding, climate change, and state planning are typically underfunded and undervalued. While communications and digital infrastructure are generally well developed, there is a slower adoption rate around the technologies that can leverage off that infrastructure and use it to enhance the management of water resources. However, given the continued growth and development of countries and the accelerating effects of human-induced impact on the environment, there is an expectation that the speed of implementation will increase in the future.

What is the best way forward?

- Getting our instruments and solutions into the hands of customers and demonstrating the value of the system have been the cornerstones of the success Xylem has had globally. The current pandemic has been a real challenge in fulfilling this and has highlighted the need to adapt and develop innovative ways to give customers the information and experience to enhance the way they manage water resources.

Linked in. The Ebeye Water Supply and Sanitation Project is linking all households in Ebeye, Marshall Islands to upgraded freshwater and sewage facilities that reduce water leaks and sewage overflows (photo by ADB).

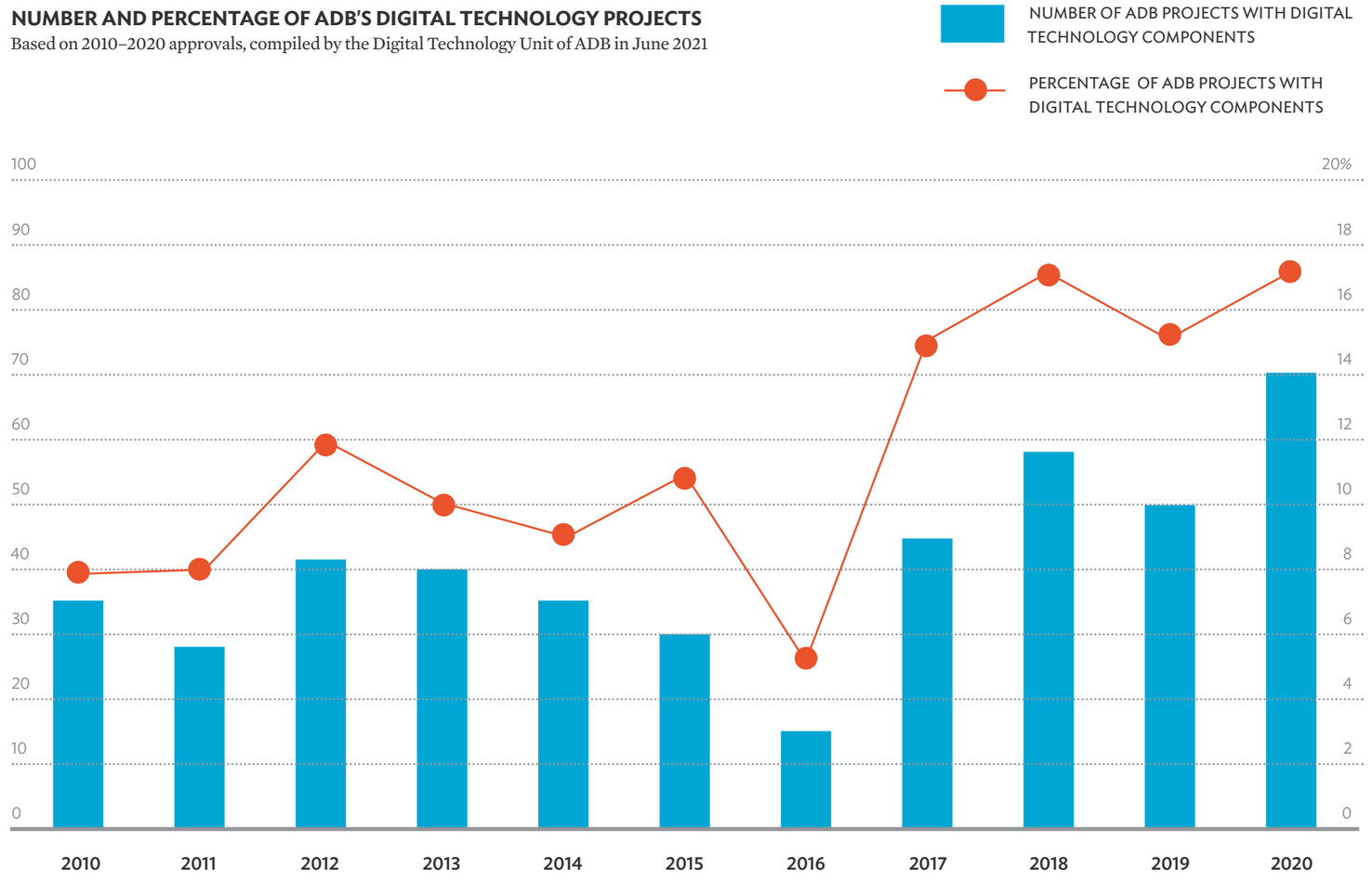
Embracing Digitalization in ADB's Water Sector Operations

ADB has increased its support over the last decade to its DMCs in the digitalization of infrastructure in all sectors. Data from ADB's Digital Technology for Development Unit show that digitalization support across the bank's entire project portfolio (2010–2020) increased to 17% in 2020 from 15% in 2019. Though adoption of digitalization in ADB's water projects over the last decade was one of the lowest, significant increase was seen since 2016. Between 2016 until 2020, 51% of ADB's water projects had a digitalization component. Though much needs to be done, it is evident that ADB's water sector staff and clients are steadily increasing efforts to include smart technologies and tools in project design, delivery, and upkeep.

Knowing which technology to apply and designing them into projects or programs is only part of the battle. Ensuring that clients have the capacity to sustain technological solutions and reap their benefit long-term is the more important part of digitalization efforts.

This section showcases some of the digitalization efforts in ADB's water sector from 2016 to 2021. These examples provide important learning on how various technological advances should be applied, what challenges may be faced, and how capacity can be built.

NUMBER AND PERCENTAGE OF ADB'S DIGITAL TECHNOLOGY PROJECTS
Based on 2010–2020 approvals, compiled by the Digital Technology Unit of ADB in June 2021



Source: Digital Technology for Development Unit database.

OVERALL FINDINGS INCLUDE:

1.

Communities, governments, and operators need to buy-in to the solutions before they are put in motion. Their needs have to drive the solution or the technology.

2.

Technology can be flashy, but sometimes simple is best. A solution that involves little maintenance and simple operation may succeed where a more complicated technology fails, if the demands of operating that technology are too cumbersome.

3.

The approach of stand-alone projects needs adjusting. Smart water solutions need to be harmonized with overall water resource management needs and infrastructure, and upkeep and long-term maintenance need to be part of the planning. The entire system is important, not just the single issue being addressed by the project.

4.

Projects need to involve local people in the upkeep and maintenance of smart water solutions so that problems can be addressed locally, which also helps with buy-in for the appropriate solution. By the time "experts" can be contacted to fix a problem, the issue may have multiplied, so training local people who are close at hand is key.

PROJECT 1:

A Green, Smart, Resilient City: New Clark City Development, Philippines

Catherine Fong
Senior Public–Private Partnership Officer, Advisory Division 2, Office of Public–Private Partnership

Dhivya Ravikumar
Public–Private Partnership Specialist, Public–Private Partnership Thematic Group Secretariat, Office of Public–Private Partnership

The goal of the New Clark City Development was to make a green, smart, resilient city.

A planned community owned and managed by the Bases Conversion and Development Authority (BCDA), the 9,450-hectare property is being developed to be a large metropolis like Cebu or Davao. On 17 December 2018, a consortium of Prime Water Infrastructure Corp., Prime Assets Ventures, Inc., MGS Construction Inc., and Israel's TAHAL Group signed a joint venture agreement with BCDA to deliver smart waste and wastewater facilities for New Clark City.

As the transaction advisor to BCDA on the water and wastewater project, ADB identified that one of the major water infrastructure problems with cities such as Cebu and Davao was excessive exploitation of aquifers.

One of the main goals was therefore to prevent this aquifer exploitation from happening in New Clark City, where the primary source of water was underground.

"To ensure that New Clark will be a truly green, smart, and resilient city, nature-based principles need to be followed in designing the city," shares project officer, Catherine Fong.

In the original masterplan, a river was to be rechanneled into a straight line on which buildings could be constructed to the edge of the river. ADB sponsored a river study and recommended that BCDA reconsider re-channeling the river as part of nature-based planning.

> **"ADB was involved early in the project planning. Our client, BCDA wanted to ensure that New Clark City would be the Philippines' first smart, green, and resilient smart city. We sponsored a river study to identify nature-based solutions for the river. Based on the study, we recommended solutions where the river is given space to be a social and economic asset central to New Clark City. Now New Clark City will be a city with a beautiful river park running through it."**
>
> —Dhivya Ravikumar

DIGITALIZATION SOLUTIONS USED

Smart meters for water conservation and monitoring was written into the minimum performance standards and specifications. These standards outlined the technical guidelines with which the private sector would need to comply.

Supervisory Control and Data Acquisition (SCADA) system allowed for online collection, monitoring, and processing of city data for better management, decision-making or automation. In the Philippines, flow meters are usually outdated mechanical stand-alone meters that are not connected to a system. The advantages of connection to a cloud-based SCADA system included detecting when the system is down, monitoring the critical points, and getting an overview of the key indicators.

Spatial Data Analysis Explorer (SPADE) satellite technology was applied, with the help of ADB's Sustainable Development and Climate Change Department (SDCC), to sense ground-level subsidence to indicate overexploitation of the aquifer.

LESSONS LEARNED

Receive client buy-in. It was easy to agree on solutions with the client, as they were very invested in the green and smart features included in the contract. Without that buy in, it would have been difficult to move forward. It was crucial to explain that though digital technologies come at an additional cost now, it will pay off in the long term for the city.

Collaborate with other sectors of the bank. The transaction advisers needed help from water experts. SDCC approved a grant to make this happen.

Get involved early. ADB's early involvement in the project was valuable. Because ADB had already completed another project with the client, the constituents were open and willing to listen to the project officers' advice. The trust was there because the relationship had been built.

Identify lasting digital trends. There are many digital trends out on the market. It's important to be able to identify what a project truly needs and weed out technology that may be trendy but might not last over a 30-year contract or the long-term development of a city.

Remain creative, adaptive, and realistic. The way the contract was written was that the bidders would need to adapt to meet the demand. The infrastructure needs will be built as the city grows, and not all at once. The team decided that a centralized plant would be better able to treat wastewater for this project. However, this technology is not even required by Philippine law yet. As a workaround, the team suggested the central plant be built once a certain demand is reached. Another example of practicality is separating the grey water, clean water, and dirty water. This method is ideal but not always cost-efficient.

> **"To ensure that New Clark will be a truly green, smart, and resilient city, nature-based principles need to be followed in designing the city."**
>
> —Catherine Fong

City living reimagined. ADB helps to ensure that nature-based principles guide the development of water and wastewater solutions in the New Clark City Development (photo by ADB).

PROJECT 2:

Irrigation Canal Management: A Pilot Demonstration Activity in Lower Bari Doab Canal, Pakistan

Asad Ali Zafar
Senior Project Officer (Water Resources),
Pakistan Resident Mission, Central and West Asia Department

Pakistan, especially in Punjab Province, has a vast contiguous irrigation system, with each river and canal joining the next. In the past half century, groundwater consumption has increased, especially in farming areas. As surface water resources have gradually become limited, farmers have had to rely more on groundwater to increase crop production. ADB's project area is one of the irrigation systems in Lower Bari Doab Canal, Punjab Province, covering about 700,000 hectares of land with 300,000 farming families.

This system is managed by the Punjab Irrigation Department, which is responsible for providing water from rivers via the canals to the farms. The department distributes the water on a rotational basis for equitable distribution. However, a major issue observed by Senior Project Officer Asad Ali Zafar and his team was that canal managers only had control of the surface water and therefore lacked a broad view of the irrigation system.

> **"While water for crops in the project area is sourced from a combination of canal water, groundwater, and rain, the canal operators are only able to plan, control, and measure just the canal water flows."**
>
> —Asad Ali Zafar

"There is no data on how well the overall system is performing, where the water-stressed areas are, or whether the water is sufficient to meet crop demands," said Asad Ali Zafar.

To address the irrigation system information gap, ADB is helping Pakistan improve water resource management and increase productivity of irrigated agriculture under the multitranche financing facility (MFF).

DIGITALIZATION SOLUTIONS USED

Free Landsat and Sentinel satellite images. Satellite images were used to measure irrigation information, such as irrigated land, main cropping patterns, actual and potential evapotranspiration, soil moisture in the root zone, and dry matter crop production. A grid-level detail of 30 meters x 30 meters was used, and data was produced for every 8 days of the water rotation cycle. The Surface Energy Balance Algorithm for Land model was used as the core calculation engine to process the observed biophysical parameters.

Remote sensing and earth observation of the crops. The model and earth observation data quantified the water requirement by providing information on crop water demand and on which areas need more or less water. This data enables the Punjab Irrigation Department to make more informed decisions based on assessments of the overall water supply system performance.

Decision support system tool model. Used to analyze the data, the model helps identify areas for improvement in the water supply system.

Forecasting tool model. Another fund was approached to finance the development of a forecasting model.

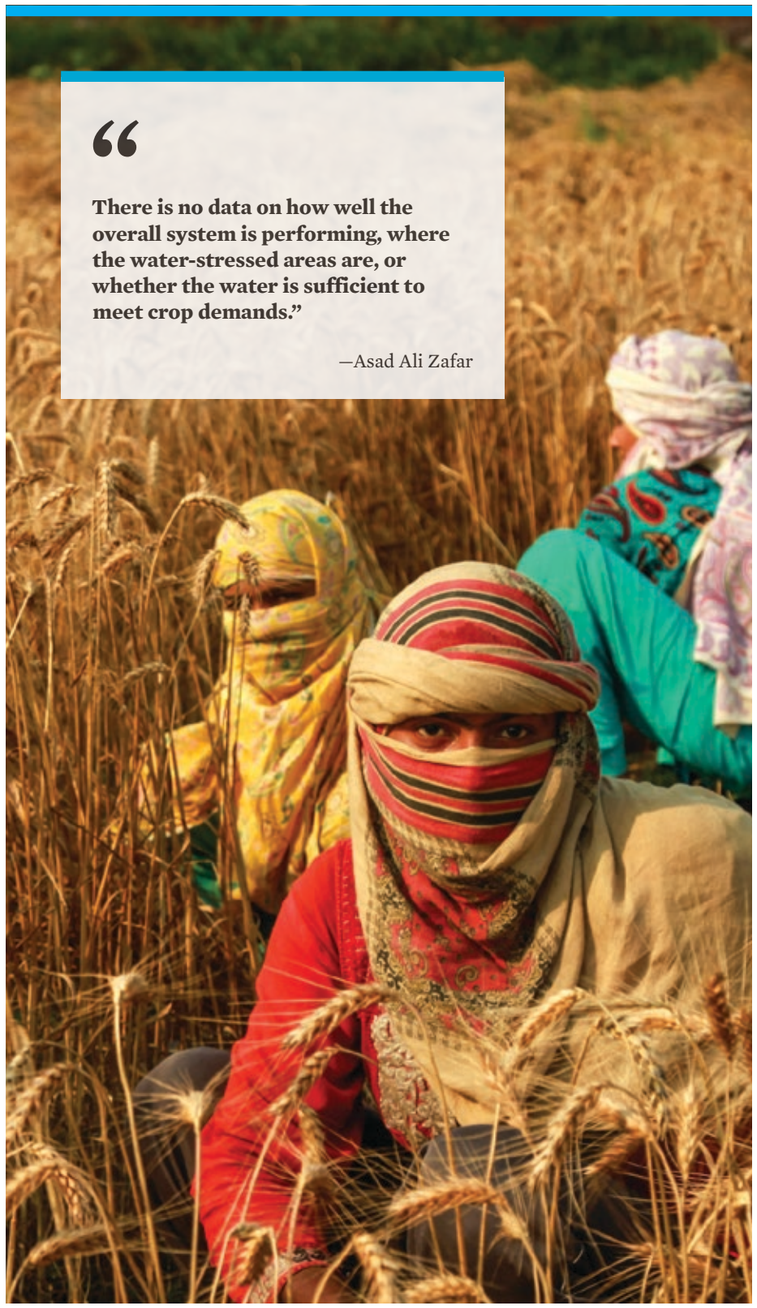
Farmer advisory mobile phone application. The ADB team is preparing an IOS- or Android-based farmer advisory mobile phone application. With this application, the Punjabi Irrigation Department can provide subscribed farmers with real-time updates.

LESSONS LEARNED

Buy-in and implementing agency capacity is essential to adopt digital solutions. As there was a strong demand for improvements from the irrigation department, local buy-in occurred with executing and implementing agencies. Decision makers from the water distribution unit to the ministry were supportive. However, when it came to technology knowledge transfer and implementation, the department faced challenges in fully operating the technology independently. Fortunately, external experts were hired through support from Water Financing Partnership Facility to work closely with the operator.

Gradual adoption is preferred over a sudden overload of digitalized solutions. Continual awareness and outreach should occur at an agency's various tiers to promote successful adoption. Small steps are needed to ensure absorptive capacity is intact. Technology knowledge transfer will not be successful if rushed. Replication and scale up are easier if done one phase at a time.

Continuous outreach and advocacy for better infrastructure is needed. In the Lower Bari Doab Canal, 700,000 hectares are dependent on a 100-year-old irrigation system. If it malfunctions, 300,000 farming families will be deprived of water. Aging infrastructure and climate change were the two pillars of the MFF infrastructure upgrade. Continuous actions by the provincial government and outreach to ensure participation by stakeholders will help maintain the infrastructure.



Work flow. Since the construction of the Lower Bari Doab Canal, the production of crops has increased, which ensures more work for the farmers and laborers (photo by ADB).

Capacity development support and water resource management information system is required for water operators. At the MFF's close, a capacity development technical assistance project was approved to help operators become better water resource managers. The technical assistance established the water resource management information system framework and is educating water operators on holistic views of water use across the province.

PROJECT 3:

Sustainable Water Supply and Sanitation Sector Development Program, Georgia

Heeyoung Hong
Principal Urban Development Specialist (Finance),
Urban Development and Water Division,
Central and West Asia Department

Geoffrey Wilson
Senior Water Resources Specialist, Water Sector Group,
Sector Advisory Service Cluster, Sustainable Development
and Climate Change Department

Many DMCs in the Asia and Pacific region face the challenge of creating a unified and efficient utility asset management system. Without a good record of geographical information and attributes of underground assets, a utility will struggle with delivering sustainable water supply and sanitation services.

In Telavi, Georgia, ADB seeks to address this problem by providing technical assistance to introduce high-level technology into asset management systems to enhance efficiency and effectiveness of the operation and maintenance (O&M) capacity of the United Water Supply Company of Georgia (UWSCG) and services delivery of water supply in select cities.

"Being typically an infrastructure bank, ADB funds a lot of infrastructure but not necessarily the asset management systems that go with that infrastructure," says Principal Urban Development Specialist Heeyoung Hong. "The plan for this project is to complement infrastructure investment with a management system so it makes that infrastructure more sustainable."

The project seeks to implement an asset management system that will identify on a geographic information system (GIS) all the underground assets a utility owns.

> **If you don't know what you own, you cannot manage it. What we are managing are the operation and maintenance of utility assets, with a special focus on maintenance. The approach to asset maintenance can be reactive—fixing them after they break—or preventive—predicting when and where assets will fail and routinely checking up on them before they break or burst. It is more cost-effective to do preventive than reactive maintenance."**
>
> —Geoffrey Wilson

Both local and international consultants will be hired because asset management systems are not commonly used in Georgia. The team needs both international experts and locals to upskill those involved in water utilities and make the project sustainable. Capacity building is a crucial part of the process so the local community can continue working on sustainable water supply and sanitation after the project is completed.

DIGITALIZATION SOLUTIONS USED

- **Geographic information system-based asset management system.** This digital system identifies utility assets, and the contractors locate them in space, and provide attributes such as diameter, material, pipe thickness, and depth of cover.

LESSONS LEARNED

Many organizations prefer not to fund maintenance systems with loans Grants present an incentive for technology uptake.

Client buy-in is important. Asset management systems need to be sustainable. This will only happen if top management at the utility adopts and drives an asset management culture.

High-level technology for the asset management system should be adopted in the context of wider sector reform. This includes improving the utilities asset management system through policies. The client has agreed to carry out 20 policy actions and one is for state-owned utilities to develop and roll out an asset management policy. The high-level technology asset management system is a tool to help implement the policy across the utility.

Extracting tacit knowledge and data can be a challenge. The asset management system needs to be populated to be useful. However, sometimes data is not available. Other times it takes the format of shape files, spreadsheets, paper copies, or AutoCAD files. This makes it difficult to know how much work is required to fully populate the system and prepare the terms of reference. It may be necessary to do a survey or make inferences or assumptions in the data.

An asset management system can help mitigate crisis impacts on utilities. The coronavirus disease (COVID-19) pandemic prevented consultants from making field visits to identify bottlenecks and challenges. A lack of recorded data makes the situation especially difficult. This reality highlights the need for a digitized management system, which allows for less in-person tracking and for the work to continue.

Identifying appropriate asset management software systems is a challenge. All solution providers and their marketers will champion the features and benefits of their own software systems. It is crucial to do a proper survey of what systems are available and match those to the utility's requirements.

Technology needs to respond to local needs. For this project, a language option was crucial, as the software needs to be used by technicians who speak Russian and/or Georgian. Therefore, a nonnegotiable for the utility was that the software be provided with a user interface in their local Georgian language.

An asset management system has wide application. Although the project focuses on water assets, an asset management system provides value to other assets, such as road assets and energy assets. An infrastructure project should be complemented by a digitized asset management system, as many of a utility's downstream processes (e.g., customer grievance, billing, SCADA) can be linked to this system.

Going underground. In Georgia, ADB's project uses Geographic Information System systems to identity and detail underground assets owned by utilities to improve overall water supply and sanitation management (photo by ADB).

PROJECT 4:

West Bengal Drinking Water Sector Improvement Project, India

Sourav Majumder
Senior Project Officer (Urban), India Resident Mission, South Asia Department

Anita Kumari
Associate Project Analyst, India Resident Mission, South Asia Department

Alexandra Conroy
Urban Development Specialist, Urban Development and Water Division, South Asia Department

Neeta Pokhrel
Chief, Water Sector Group, Sector Advisory Service Cluster, Sustainable Development and Climate Change Department (Project officer during design and early implementation stages)

In West Bengal, people living in predominantly rural areas are deprived of basic necessities such as clean drinking water. Through the West Bengal Drinking Water Sector Project (WBDWSIP), ADB is supporting the state government of West Bengal to provide safe, sustainable, and inclusive drinking water services to about 1.65 million people in the districts of North 24 Parganas, Bankura, and East Medinipur.

However, the WBDWSIP is not a typical rural drinking water supply project. People from the three districts are also affected by arsenic, fluoride, and salinity problems. Moreover, they are exposed to natural hazards such as riverine flooding and storm surges, as well as the effects of climate change. WBDWSIP's introduction of innovative approaches through digital technology-driven smart water management recognizes these issues and strives toward addressing them in an organized way.

According to the team consisting of Sourav Majumder, Anita Kumari, Alexandra Conroy, and Neeta Pokhrel, information and communication technology (ICT) interventions were essential. From the planning and implementation aspect to the post-project phase, the project team recommends that ICT should remain key during the project's life cycle.

To improve system efficiency, strengthen customer service, build resilience, and secure public participation, WBDWSIP introduces many innovative approaches to digital-technology-driven smart water management and service delivery.

DIGITALIZATION SOLUTIONS USED

- **"Internet of things" technology.** The source of water upstream of treatment plants will be monitored using inexpensive sensors easily connected to a central database. Data are then further analyzed and applied for low flow (or flood) and salinity forecast early warning. This will help the Public Health Engineering Department (PHED) manage water intakes to ensure overall water quality and security (e.g., from the estuaries with shifting freshwater and saline water by means of pumps and intermediate storage).

- **Salinity modelling.** This is integrated for cyclone-exposed regions to monitor flooding and salinity ingress, specifically for highly vulnerable coastal areas. Short-term, mid-term, and long-term impact mitigation has been identified. Options for enhancing the coastal community resilience against salinity ingress in cyclones have also been recognized. In the short term, the priority is to identify areas with flood-stagnant water and make sure these areas are drained quickly.

- **Geographic information system, management information system, web geographic information system-based monitoring tools.** These applications are used mainly at the PHED central level.

- **Supervisory Control and Data Acquisition and sensor for real-time monitoring at remote locations.** Real-time monitoring is used mainly at the PHED district level, within the purview of each district-level water treatment plant (WTP). Required water data parameters will be monitored by use of sensors connected online to the district-level WTP and a central database, where data are further analyzed and applied for forecasts. This also includes early warning of droughts, floods, and salinity ingress. In general, flow meters, pressure sensors, and other devices within the transmission and distribution network will be installed for monitoring via SCADA rooms at WTPs and optimized where necessary.

- **Flood forecast and early warning system.** Integrated as part of the water supply and customer service system, PHED uses this system to forecast and issue early warnings to their operators and customers, and to cooperate with disaster management authorities in the state responsible for disaster management. This component is important because the area is regularly affected by cyclones.

- **Computerized maintenance management software, billing and water accounting software, customer relation management software.** Applied for all *gram panchayats* (rural governing bodies at the village level), these digital tools include household survey application, grievance redressal application, and asset maintenance.

- **Water accounting systems.** Currently under development, these systems will be used by the new Water Management Centers in the villages using computers and mobile phones connected to cloud servers. A central PHED control center will collect data from all levels for overall monitoring of system performance and decision support. These systems will aid in providing continual water supply to rural areas and can be used to reach out to consumers if there are problems.

- **Satellite imagery tool.** Conducted through a parallel initiative, this tool is a collaboration with the European Space Agency (ESA) to use satellite imagery to examine water storage. The final output that the ESA supports may be applied in the project.

LESSONS LEARNED

Transparency through performance indicators incentivizes operators to avoid intermittent water supply. In this project, water supply information will be shared via apps and dashboards at different user and managerial levels. Leakage detection, water quality monitoring in the network, and reporting via smart devices among operators and consumers enhances efficiency. Grievance apps on smart phones and basic mobile phones for improved services and asset management support local operators in villages and strengthens consumer communication.

Sufficient sources of undisrupted data flow for sensors and analyses will make the smart water systems more attractive. It is important to factor in the cost of monthly or annual charges for keeping smart solutions operative.

Long-term maintenance of sensors, data connectivity, databases, and analysis systems will require careful planning and management. It is also crucial to propose risk-mitigation measures such as a security provision to protect the sensors against theft and vandalism.

Buy-in from local government, managers, and operators fosters appreciation for data sharing. The initiative of the local *gram panchyat* in adopting smart water solutions was helpful in mobilizing managers and operators. The contribution of local government, utility managers, and operators is essential to establishing smart water management.

Identify clear boundaries on responsibilities of stakeholders during operation. Many of the project's design elements were being done for the first time. It is helpful to use a modularized approach to planning and execution.

Incentivize people and organizations to adopt smart water technologies and take responsibility for solutions to emerging needs. Smart water technology is readily available in all categories and price levels. Smart water technologies provide cost-effective and fast solutions to address the needs of beneficiaries; opportunities to mobilize local resources and create local jobs (for this project, 50% of those recruited for implementing smart systems will be women); climate-resilience; and easy replication for scaling.

Technology for health. ADB uses digital-technology-driven smart water approaches to promote long-term health solutions in West Bengal, where heavy reliance on groundwater puts rural residents at risk of arsenic and fluoride contamination, and related diseases (photo by ADB).

PROJECT 5:

Sichuan Ziyang Inclusive Green Development Project, People's Republic of China

Mingyuan Fan
Principal Water Resources Specialist, Environment,
Natural Resources and Agriculture Division, East Asia Department

Located in the Yangtze River Economic Belt, Ziyang Municipality in the People's Republic of China (PRC) is home to 3.6 million people. It spans both sides of the Tuo River, a major tributary of the Yangtze River. Heavy industries have dominated Ziyang's economy, leading to ecological damage of the Tuo River and the surrounding wetlands. ADB's Sichuan Ziyang Inclusive Green Development Project provides support to the Ziyang municipal government to improve Ziyang's urban environment and livability and shift to a more inclusive green development path.

One component of addressing the issues of the Tuo River and surrounding wetlands was to identify digital solutions to determine river quantity, analyze water quality, and manage floods with an early warning system.

> **"We employed a 'smart city' concept that integrates high-tech smart management solutions in urban areas."**
>
> —Mingyuan Fan

"It is an industrial area and urban city area integration," says Principal Water Resources Specialist Mingyuan Fan. "We proposed to have smart communication, smart transportation, smart water resources management—including an early warning system—and a smart office set up under one platform. The platform is then set up in high-tech commission buildings so they can manage everything digitally."

The project was approved in 2018 and is still in the preliminary design stage. The project aims to build a three-level Smart Information System, consisting of a district-level supervision platform, oral equipment and materials, transportation equipment, and electronic information industry functional area and enterprises. It will also be an innovative initiative to transform a landfill site into a green park, the Ziyang High-Tech Industrial Park, and introduce a monitoring and evaluation system to quantify the progress of urban development.

DIGITALIZATION SOLUTIONS USED

Advanced and mature technologies such as the "internet of things," big data, artificial intelligence, cloud computing, digital twin, and mobile internet. These technologies were employed to complete full-factor connection, real-time acquisition, on-demand use, intelligent analysis, and other capabilities of data sources.

Cloud integration platform. The core competitiveness of Ziyang High-Tech Industrial Park will be achieved by integrating its cloud platform with Ziyang Big Data Bureau. This cloud integration allows for the sharing and exchanging of information resources, such as small programs and environmental monitoring already built into the park's system.

Three-level Smart Information System. The goal of this project is to achieve value by maximizing investment attraction through the three-level information system. Through smart communication, smart transportation, smart water resources management, an early warning system, and a smart office, the Smart Information System can make the city more livable and climate resilient. People can get data such as early warnings and make better decisions to act before the actual emergency happens. It can also shift the local economy from its reliance on heavy manufacturing to service-based jobs.

LESSONS LEARNED

Recruit experts who can provide independent, unbiased, and non-obsolete solutions. During the feasibility study's appraisal stage, ADB worked with advisers from the private sector. It is helpful to work with different advisers to have varying perspectives. As technology changes quickly, it is also beneficial to hire information technology experts who are familiar with the new advances in the market.

Data acquisition, data security, and data application are important. Data is crucial to drive park investment promotion, park management, enterprise services, and sustainable development. However, technical means and policy measures are also needed to ensure data security. Data acquisition and sharing services are inseparable from the full support of the government, businesses, and locals.

Set up operations and maintenance teams. Some similar smart park projects in the PRC emphasize construction over transportation and operation. This results in a high equipment failure rate and poor equipment use. It is important to introduce professional services and repair systems to ensure the reliable operation of equipment and systems. It is also crucial to build an operating company or team to provide precise services for data acquisition, data mining analysis, data operation service, and other processes. This enables real-time data acquisition, accurate algorithm iteration, and intelligent business applications. It also ensures that the system is simple, fast, safe, and accessible.

Prioritize cost planning. Updated technology knowledge requires spending. It is hard to keep up with necessary technology updates when budget constraints exist. For this project, ADB first set up the platform with the provision to later add in elements. This makes the platform flexible to grow and accommodate changes.

> **"We proposed to have smart communication, smart transportation, smart water resources management—including an early warning system—and a smart office set up under one platform. The platform is then set up in high-tech commission buildings so Ziyang's government can manage everything digitally."**
>
> —Mingyuan Fan

Green in motion. Under a government initiative, public bicycles can be hired for free to promote green commuting (photo by ADB).

PROJECT 6:

Third Rural Water Supply and Sanitation Service Sector Development Program (Project), Cambodia

Siti Hasanah
Urban Development Specialist,
Urban Development and Water Division,
Southeast Asia Department

ADB has been one of the largest contributors to Cambodia's water supply and sanitation infrastructure development. Water supply and sanitation services projects supported by ADB in the Tonle Sap Lake region alone have provided 1 million people with improved water access and 500,000 people with better sanitation services.

The Third Rural Water Supply and Sanitation Service Sector Development Program aims to continue the expansion of water supply and sanitation services in rural areas. The project covers eight provinces (Banteay Meanchey, Battambang, Kampong Chhnang, Kampong Thom, Kampong Speu, Kampot, Pursat, and Siem Reap) and 600 villages.

The program will provide policy support for rural water supply and sanitation planning systems, private sector involvement, service delivery, and asset inventory and management systems. It will also administer a grant from the High-Level Technology Fund, financed by the Government of Japan, to pilot a project to install air-to-water generation units in seven locations with limited access to safe drinking water.

DIGITALIZATION SOLUTIONS USED

▶ Pilot Project: Air-to-Water Generation Units

"The project will help villages that have problems accessing clean water during the dry season," explains Urban Development Specialist Siti Hasanah. "During the rainy season, they have access to community ponds and rainwater jars. But during the dry season, because of the conditions of the villages, some households do not have access to clean water and end up using unclean water for daily consumption."

The air-to-water generation units convert humidity to water by replicating the natural process of condensation, even if the humidity level is low. This pilot will be the first of its kind in Cambodia.

> **"Because of the limited capacity of this unit, we are trying to provide it for drinking water only, not for washing. There were some people who did not believe that water could be produced from air. So we talked to the producers of this technology and brought in local government officials to discuss it.**
>
> **Due to COVID-19, we couldn't travel to the village, so we did online meetings [and] invited some of the suppliers of this technology to attend the first ADB e-marketplace. We also invited some Cambodians to participate. It was a very good opportunity for all the constituents to virtually get together and understand the technology behind the air-to-water generation units."**
>
> — Siti Hasanah

LESSONS LEARNED

Get buy-in from clients on innovative technology. The air-to-water generation units do not use any chemicals. Condensed water from the air is already clean, but the units add minerals naturally occurring in drinking water that are not already in water condensed from the air. It is crucial to build understanding of this type of technology among stakeholders for program success.

Encourage the idea that infrastructure does not have to be big to work. Most local authorities believe they need to build big infrastructure, but this is not always the case. Small systems, with the help of innovative technology, can be effective and efficient if implemented and operated correctly.

Creative solutions ensure a water system's affordability and sustainability. Water needs to be purchased by users to make systems sustainable, particularly to cover costs such as water bottles, distribution, and operation and maintenance. However, even low costs for water present a challenge to poor households. Projects need to address this issue by cutting costs and introducing creative solutions. The pilot project will introduce a new business model that provides a cross-subsidy for poor households, including female-headed and single-parent households. This is to ensure everyone has water access, especially poor people. Water user groups will also be paid to ensure profit. Accumulated profits can then be used for other projects such as financing schools, health centers, or toilets.

Flexibility is needed during preparation of bidding documents, especially for new technology. In a process of learning by doing, it is important to stay open-minded and listen to the advice of those with experience in the technology. Make sure, however, that technical specifications are not restrictive and that the advice from suppliers is not biased.

Work closely with local officials and communities. Support from local officials and communities is needed for successful project implementation. Their assistance is also required to ensure the close monitoring and observation of the new system.

From air to water. In Cambodia, a pioneering ADB pilot project allows rural communities to continue accessing clean water during the dry season through innovative air-to-water generation units (photo by ADB).

PROJECT 7:

Integrated Flood Resilience and Adaptation Project, Philippines

Junko Sagara
Water Resources Specialist, Environment, Natural Resources and Agriculture Division, Southeast Asia Department

The Integrated Flood Resilience and Adaptation Project aims to reduce flood risks in six river basins in the Philippines (Apayao–Abulog and Abra in Luzon, Jalaur in Visayas, and Agus, Buayan–Malungon, and Tagum–Libuganon in Mindanao). The project is in the preparation stage.

> **The digital component will be a vital part of the project to improve flood risk management planning, data acquisition, and infrastructure management.**
>
> — Junko Sagara

For flood risk reduction, information needs to be gathered on rainfall, river basin characteristics, and river flow (i.e., hydrological and meteorological or "hydromet" data). Only with this data can an adequate flood risk management plan be formed.

In the project area, however, there is limited ground-level data. "There are quite a few rain gauges and water level stations, but some are not operational especially during extreme weather events when the data is most needed," says Sagara.

Moreover, there is currently no nationwide inventory database on flood protection infrastructure, and asset information is managed in a scattered and fragmented manner.

DIGITALIZATION SOLUTIONS USED

▶ **Hydromet monitoring for improved early warning.** The proposal includes installing Acoustic Doppler Current Profiler flow meters and X-band radar systems that will enable flood discharge measurement during flooding and capture real-time rainfall over a wide area. These measurements can be used for early warning and for future planning.

▶ **Asset management system.** There is currently no nationwide inventory database on flood protection infrastructure. The project proposes to develop a GIS-based asset management system for flood risk management. This system can support efficient and sustainable management of flood risk management asset inventory across the country, monitor asset conditions to identify those with risks of failure, and schedule proactive maintenance and repair works with corresponding budget.

▶ **Flood modeling supported by surveys and earth observation information.** This project's biggest component is the construction of flood protection infrastructure. To identify the priority interventions, basin-wide flood risk management masterplans were developed for the target river basins with rigorous hydrological/hydraulic/flood modeling. The modeling used wide range of information including historical rainfall data, bathymetry and Light Detection and Ranging (LiDAR) survey data, and earth observation information. The project preparation benefited from the support from ADB's Sustainable Development and Climate Change Department (SDCC) and the European Space Agency's (ESA) climate resilience cluster for earth observation.

LESSONS LEARNED

Disasters and pandemics, such as COVID-19, impacts data collection. Flood risk management planning requires various information and data covering basin-wide areas, and the COVID-19 pandemic complicated data collection on the ground. The team preparing the project maximized the use of existing data depositories and satellite images which complemented rigorous data collection in the field.

Consistent field data collection needs to be supported. Flood risk management projects are designed by considering the long-term historic data on rainfall and flood-risks in the project areas as well projected changes in future risks. Satellite imageries are helpful in giving a sense of what happened during a past extreme weather event. But for flooding in rivers that are fairly steep and have very quick runoff, satellite images might not be able to capture the full extent of the flooding; there may be time lapses as well. The river and basin characteristics such as river morphology and land use also change over time. Remote sensing data should be combined with consistent and continuous data collection from the field.

A knowledge- and data-sharing system is needed among agencies. As water and river related information are often required and used by multiple agencies and stakeholders, an information-sharing system is crucial to break down silos and exchange valuable knowledge and data.

New technology needs to be integrated into existing systems and processes. While new technology can lead to a radical transformation, adoption of new technology should be accompanied by a careful assessment of the existing systems, buy-in from stakeholders, and continuous support and effort for operationalization and improvement.

> **There are quite a few rain gauges and water level stations, but some are not operational especially during extreme weather events when the data is most needed."**
>
> —Junko Sagara

Need for resilience. Poor communities in high flood risk areas in river basins are more vulnerable to disasters hence they need help to strengthen their resilience so they can cope with these events. (photo by ADB).

PROJECT 8:

Emergency Assistance for Rehabilitation and Reconstruction, Indonesia

Eric Quincieu
Principal Water Resources Specialist, Environment,
Natural Resources and Agriculture Division,
Southeast Asia Department

Paolo Manunta
Senior Infrastructure Specialist (Earth Observation),
Digital Technology for Development Unit,
Sustainable Development and Climate Change Department

In September 2018, a 7.4-magnitude earthquake triggered a near-field tsunami, landslides, and major liquefaction in Central Sulawesi Province, Indonesia. About 5,000 people died in the disaster. ADB's Emergency Assistance for Rehabilitation and Reconstruction was created to assist the Government of Indonesia in building back better critical infrastructure damaged by the devastating event.

According to Principal Water Resources Specialist Eric Quincieu and Senior Infrastructure Specialist Paolo Manunta, the first priority of the Indonesian authorities was to save people. To do so, they needed to better understand the extent of the damage and the casualties. As the ADB project team could not fly to Central Sulawesi at that time because the airport was damaged, they asked ADB colleagues to help them contact the European Space Agency (ESA) to see if they could use satellite images of the area instead.

"Digital technology is not the future. It is the present. The partnership and relationship that we build is important. Rather than some expert coming from Europe or [the United States] with nice technology and then leaving, we want to transfer knowledge," say Quincieu.

DIGITALIZATION SOLUTIONS USED

Satellite images. ESA mobilized resources to quickly map the affected areas. The wealth of the ESA-provided satellite images helped project officers to understand which parts of Central Sulawesi were washed away.

Night and flooding maps. Night maps were used to examine the damage to the electricity network in the grid. Flooding maps were also used to further understand the extent of the damage. ESA provided assessments for the maps.

Land movement simulation. Later in the project, more information was needed on specific issues such as land movement, i.e., seismic ground movements. ESA created simulations on land movement 2–3 years before the disaster and during the disaster. The simulations indicated some parts of the province were highly unstable even before the disaster, as the area was located between major faults. Central Sulawesi was already an epicenter for tectonic movement.

Satellite information-based reconstruction and disaster recovery services. Fieldwork was greatly hampered because of mobility constraints. To monitor disaster recovery and reconstruction efforts, ESA was subsequently asked to provide information from satellite images. Accessing the images helped project officers understand how people recovered and provided quality checks to a government program that gave people cash to reconstruct their houses.

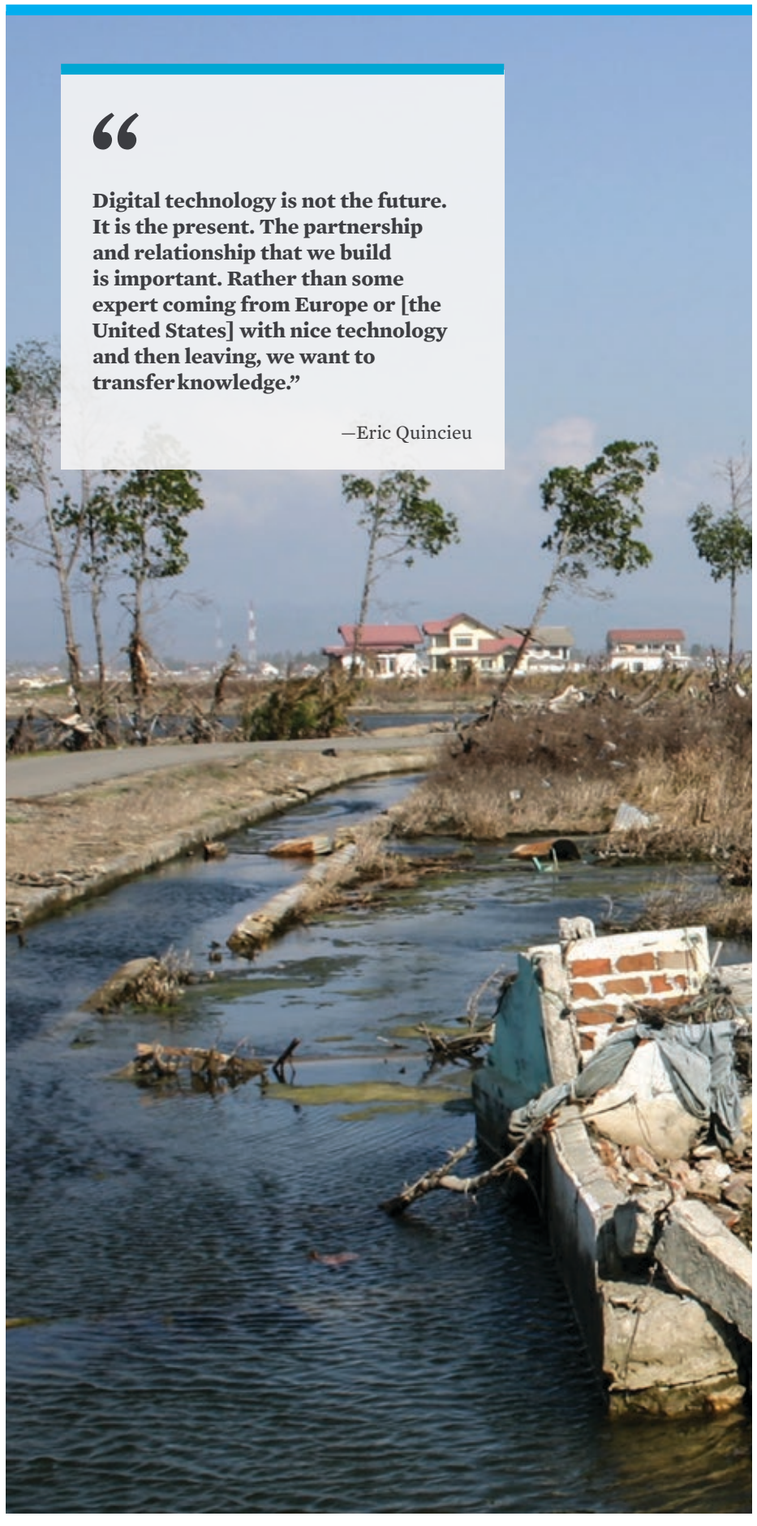
Persistence catheter. Damage assessments are important in disaster emergencies, but digital technology can also be used to support reconstruction. The persistence catheter calculates the millimetric movements between satellites and the target. It converts changes in land surface into distance, making it possible to measure movements with millimetric precision. Images are collected and processed monthly to follow land movements and the movement of surrounding buildings. The technology is so powerful it can capture movements such as cracks on land surface, even before they materialize. The technology was used to see how the land was moving, stabilizing, and supporting reconstruction.

LESSONS LEARNED

Cutting-edge technology revolutionizes projects. In the case of the Central Sulawesi project, damage assessment would have taken months. It was difficult to deal with local authorities since most of them were personally affected by the disaster and were understandably overwhelmed. But thanks to ESA's technology, the team was able to complete the assessment in a short amount of time. Access to land movement maps by millimeter gave the project team what they needed and revolutionized the way things were done.

Knowledge transfer is important for capacity building. With partnership with entities such as ESA, a not-for-profit satellite information program, ADB is working to ensure everyone can access the information and maps derived from satellite imageries. For this project, ADB worked with the Indonesian Space Agency as part of a long-term partnership between ESA, ADB, and the Indonesian Space Agency to provide training for local agencies on how to use satellite information technology and operate ESA platforms for rehabilitation and reconstruction.

The first priority of the Indonesian authorities was to save people. To do so, they needed to better understand the extent of the damage and the casualties.



Digitalization in rehabilitation. In Indonesia, innovative technology allows for remote monitoring of disaster-affected areas, when access is limited, to begin rebuilding communities quickly (photo by ADB).

PROJECT 9:

Client-Resilient and Smart Urban Water Infrastructure Project, People's Republic of China

Jinqiang Chen
Urban Development Specialist (Climate Change),
Urban and Social Sectors Division, East Asia Department

Yihong Wang
Senior Investment Officer, People's Republic of China Resident Mission, East Asia Department

Anqian Huang
Senior Financial Sector Specialist, Public Management, Financial Sector, and Regional Cooperation Division, East Asia Department

Zhijia Rao
Senior Investment Officer, Infrastructure Finance Division 2, Private Sector Operations Department

In the People's Republic of China (PRC), ADB is providing a loan to leading water group Shenzhen Water (Group) Co., Ltd. (SZWG) to enhance smart and climate-resilient urban water infrastructure in Shenzhen and surrounding third- and fourth-tier cities. As a forerunner of smart water in the PRC, the Shenzhen-based SZWG aims to export Shenzhen's smart city experience to other metropolises in the region that are less advanced in smart water applications. Another goal is to pilot a subproject for climate-adaptive options and design smart water solutions.

The Climate-Resilient and Smart Urban Water Infrastructure Project aims to build, improve, acquire, and refinance subprojects for climate-and disaster-resilient urban water infrastructure, as well as apply smart water technology to improve water supply and wastewater treatment. ADB is financing one "sponge city" and two smart water subprojects in Shenzhen. The project will be financed assuming the clients meet eligibility criteria and other requirements under the loan security.

DIGITALIZATION SOLUTIONS USED

The following SZWG-developed solutions were applied to these projects:

- **Smart metering.** SZWG has introduced smart metering based on "internet of things" and narrowband technology to connect and to share information.
- **Information and communication technology (ICT).** ICTs in water production, distribution, wastewater, real-time hydraulic modeling, and quality modeling have been applied.
- **E-payments.** To support client relationships and customer service, e-payments have been set up for billing and as a means of communication for service queries and improvements.
- **Preventive maintenance and monitoring.** For asset management, preventive maintenance and monitoring for resource planning has been introduced.
- **Process monitoring and control systems.** These systems include smart metering, communication technologies for field stations (e.g., sigFox, LoRa, Weightless, Nwave), network inspection and leak detection, sensors and equipment for ecological monitoring, and water network monitoring.
- **Data analytics and numerical modeling.** These include visualization tools (SCADA and GIS), trend analysis and forecasting tools, process-based numerical models (meteorological, hydrological, hydraulic, and water quality), water balance and audit tools, and software for leak detection.

LESSONS LEARNED

Knowledge sharing is critical. Knowledge sharing is important to push the smart water agenda. Other DMCs can look to the PRC's smart city initiatives as a reference for projects in the PRC and beyond.

Supporting technology improvement takes time. Overall, in the PRC market, hardware on advanced technology is easy to adopt, but time and practice is needed to prime institutions to reach the level of international best practices. Receptivity to applying new technology and to fully mainstream also takes time.

Choosing the right partners enables success. It is important to create proper criteria that technology partners must meet to receive funding, as well as to ask questions and ensure adequate information and documentation about the company is submitted. Selecting a partner who appreciates the project and its goals is crucial for success.

Development and financial goals need to be balanced. Getting the right balance is important to have a long-term partnership with clients.

The project aims to build, improve, acquire, and refinance subprojects for climate- and disaster-resilient urban water infrastructure, as well as apply smart water technology to improve water supply and wastewater treatment.

Replicating solutions. ADB and leading water group Shenzhen Water (Group) Co., Ltd. are helping to build and improve climate- and disaster-resilient urban water infrastructure in the People's Republic of China, using Shenzhen's smart city experience as a model for other cities (photo by ADB).

PROJECT 10:

Madhya Pradesh Irrigation Efficiency Improvement Project, India

Rajesh Yadav
Senior Project Officer (Natural Resources and Agriculture),
India Resident Mission, South Asia Department

In India, water plays a critical role in food security and welfare for the rural poor. Of the water in Madhya Pradesh, on average, it is estimated that 84% goes to agriculture, while only 42% of all agricultural land is irrigated. Moreover, the irrigation water use efficiency rate is only 38%, which shows that most utilized water is inefficiently used. With a fast-increasing population and leaps in urbanization, water shortage—both in agriculture and non-agriculture sectors—is becoming a major concern.

The Madhya Pradesh Irrigation Efficiency Improvement Project is pioneering understanding of how to develop higher irrigation efficiency by irrigating more areas in Madhya Pradesh with the same amount of water. ADB supported the preparation of the design, which focuses on developing 125,000 hectares of new irrigation networks and productive command area that are climate-resilient and efficient.

> **“We looked into how large-scale pressurized automated systems can be developed to allow considerable gains in water efficiency in irrigation systems. This was a big technical challenge because the solution needs to be flexible and provide reliable irrigation supply. It needs to be easily manageable and energy efficient.”**
>
> — Rajesh Yadav

The goals in the development of the new irrigation systems and productive command area included: development of pressurized irrigation, adoption of micro irrigation, production of high value crops, and improvement of irrigation management system. Several technology solutions were used to help achieve these.

DIGITALIZATION SOLUTIONS USED

Supervisory Control and Data Acquisition and an outlet management system. One challenge was enabling the government to efficiently manage the large distribution network. The network used to be composed solely of canals but now includes construction of large-scale pumping stations, which will pump water from a dam to distribution chambers. To address this, SCADA will provide real-time monitoring and remote flow and pressure control. It will help optimize water use efficiency and reduce power consumption, which is considered valuable. The outlet management system—a decision support system to facilitate irrigation planning—will support equitable distribution and system safety.

Remote-sensing-based water scheduling. This technology is based on earth observation satellites that measure vegetation. Once the measurements are completed, evapotranspiration rates are computed using the Surface Energy Balance Algorithm for Land model. Crop demand information is then integrated into an app that issues advisories to farmers so they can conduct properly planned and scheduled irrigation.

LESSONS LEARNED

Client support and buy-in is beneficial in engaging other constituents. The executing agency was capable and supportive of ADB’s idea of the pressurized distribution network, since more areas will be irrigated. Private sector involvement in the large-scale system maintenance was also appreciated.

Build a strategy for community mobilization. Changing mindsets about new technology may be challenging. The executing agency is working to mitigate this. It plans to employ farmer relationship officers to convince farmers to adopt the technology. Demonstration farms are also being developed so farmers can see firsthand how the technology is applied.

> **With a fast-increasing population and leaps in urbanization, water shortage—both in agriculture and non-agriculture sectors—is becoming a major concern.**

Harvesting success. Farmers in Madhya Pradesh will benefit from digital solutions that promote more efficient water use in agricultural land (photo by ADB).

PROJECT 11:

Application of Spatial Data Analysis Explorer Platform in Second Coastal Towns Environmental Infrastructure Improvement Sector Project, Bangladesh

Virinder Sharma
Principal Urban Development Specialist, Urban Sector Group,
Sector Advisory Service Cluster,
Sustainable Development and Climate Change Department

Ma. Victoria Antonio
Consultant, Urban Sector Group, Sector Advisory Service Cluster,
Sustainable Development and Climate Change Department

Bonapart Masangcay
Consultant, Urban Sector Group,
Sector Advisory Service Cluster,
Sustainable Development and Climate Change Department

Laxmi Sharma
Senior Urban Development Specialist,
Urban Development and Water Division,
South Asia Department

The first Coastal Towns Environmental Improvement Project, currently being implemented, seeks to improve the resilience of 10 coastal towns in Bangladesh through the provision of infrastructure investments (e.g., cyclone shelters, drains, and emergency access roads). At project concept in 2015, ADB did a climate risk and vulnerability analysis (CRVA) of all coastal towns in Bangladesh to identify the most vulnerable, on the basis of which the 10 towns covered under the loan were identified.

A Second Coastal Towns Environmental Improvement Project is planned for Board approval in 2022. The 22 towns covered under the proposed loan were also among those included in the CRVA. However, the CRVA only included historic climate data. Given the high vulnerability of Bangladesh to climate change and the increasing incidence of extreme climate events, the project officers deemed the 2015 study as insufficient for determining the towns and corresponding subprojects and sites because there have been substantive changes since then. The project officers wanted to include socioeconomic data in the analysis to ensure the poorest and most vulnerable communities affected by climate change would benefit from the project.

Initially, the project focused on integrating mitigation measures toward climate change impacts in a city. Interventions were at different levels using a layered approach, looking at upstream, the overall city, and land use, and linking it with the masterplan. In two cities under the project, ADB will use digital ICT tools to generate solutions.

DIGITALIZATION SOLUTIONS USED

Spatial Data Analysis Explorer (SPADE) platform. SPADE is an open-source GIS platform that allows users to utilize earth observation data and superimpose data layers of various datasets—climate information, land use, socioeconomic data—that are translated graphically onto a map to support analysis. The platform was used to combine all these datasets to determine the implications of these factors on the selection of towns, subprojects, and sites. This platform was also used when a cyclone affected the country. Using SPADE and remote sensing, the project team looked into the performance of the shelters, examining inundation. They had city resilience officers to help verify on the ground what was seen in the map.

Climate change modeling and hydrographic modeling. By using climate change and hydrographic modeling, the project could identify the best urban drainage options for the city through information on minor urban drainage and cyclone points.

Resilience baselining. Resilience baselining was used with a standard methodology including use of digital formats that gave feedback on the situation at the city and household levels using software and tablets. Few projects do pre-project baselining. Typically, ADB only uses a design and monitoring framework, but resilience baselining considers the city as a whole. About 100 different indicators are used for baselining. Baseline resilience measurements were done using android technology in four counties from 2017 to 2019 through focus group discussions and house-to-house surveys on perceptions of resilience. Results are being presented to the cites. This resilience baseline identifies their strengths, weaknesses, and areas for investment—and makes it possible to measure the resilience dividend and justify additional investments. This will extend the life of the infrastructure.

LESSONS LEARNED

Spatial Data Analysis Explorer's comprehensive and visual analysis helps with holistic project design. SPADE helped the executing and implementing agencies recognize the value of adopting a holistic approach to project design that considers climate, socioeconomic data, natural land features, and location of vulnerable communities to ensure the needs of beneficiaries are met. For example, plotting a proposed site of one cyclone shelter on the map revealed it was a considerable distance from residential areas and had no visible access roads; in an emergency, local residents would not be able to reach it.

Resiliency boost. Using new technology, resilience baselining uncovers critical information about flood-prone areas in Bangladesh to drive investments toward protecting the poorest and most vulnerable communities (photo by ADB).

Spatial Data Analysis Explorer can be used to monitor projects remotely. Because SPADE uses satellite data, photos from construction sites can be geotagged, uploaded to the map, and viewed remotely by the implementing and executing agencies without requiring site visits.

Climate projections can build local resilience. Project staff were able to illustrate the impact of climate change to coastal towns, which will be affected by storm surges and salination. Using this analysis highlighted the various climate risks and exposed which projects need to be done and where.

Machine learning adds value. A machine learning algorithm is incorporated in the analysis, which allowed the use of historical data sets for the Bangladesh project. This is one technology that can be provided for technical assistance and other projects. It can provide project officers with visual aids for potential flooding areas, flooding extent, and flood depth so they can determine which areas of interest are heavily flooded.

Even with remote sensing, ground truthing remains important. Technology has limitations. The platform reports revealed which places were affected by flooding but not which particular areas within a site were affected. It is necessary to develop a platform that visualizes climate change.

Combatting idea that Geographic Information System is expensive and complicated is crucial. Although GIS is well established, it is stereotyped as expensive and complicated. SPADE is simple, identifies problem areas, and helps in visualizing the whole picture.

Open-source and free datasets needs to be exploited. If projects want to start using digital technology, they can do so with open-source resources rather than having to invest in propriety software.

Visualization helps communicate impact. In working with DMCs and stakeholders, anything that can visually show project, impacts, and beneficiaries will help ADB better communicate projects and potential impact. In stakeholder consultations, especially on environmental safeguards and relocation, this can be an important tool to foster ownership.

PROJECT 12:

Screening Tool for Energy Evaluation of Projects Application in the People's Republic of China and Georgia

Alexandra Conroy
Urban Development Specialist,
Urban Development and Water Division,
South Asia Department

Stephane Bessadi
Senior Procurement Specialist, Procurement Division 2,
Procurement, Portfolio and Financial Management Department

ADB has an extensive portfolio of water supply and wastewater investment projects in its DMCs in Asia and the Pacific. Given its decades of experience in designing and implementing these projects, ADB embarked on developing a computer-based tool for energy evaluation of urban water supply and wastewater management projects called the Screening Tool for Energy Evaluation of Projects (STEEP). STEEP is a free Excel-based reference guide that can be used to make system assessments and identify potential areas for energy use savings in existing or planned water supply and wastewater facility projects.

For Urban Development Specialist, Alexandra Conroy, and Senior Procurement Specialist, Stephane Bessadi, applying STEEP in project sites in the PRC and Georgia not only optimized energy spending, but also reduced the climate impact for water utilities. "The STEEP initiative started when we were focusing on support to water utilities, resilience, and operational and maintenance capacities within the SDCC department," says Bessadi. "It's well established that one of the key issues for water utilities is to manage on the long-term their expenses and to better address unplanned events and expenses or investments."

> **"STEEP gives users the ability to assess future energy spending and provides recommendations on how to optimize and reduce it. More importantly, as energy often comes from fossil sources in developing countries, STEEP directly affects climate impact by reducing water utilities' energy usage. It is also in line with [the] broader ADB Strategy 2030."**
>
> — Alexandra Conroy

In Georgia, STEEP was applied to a project focused on potable water supply in defined cities. The tool estimated that electricity consumption could be reduced 30%–50% by applying simple measures. Implementing these measures would reduce short-and medium-term electricity spending. The operational costs would also be reduced as a result of reduced expenses. The exercise showed that even in a low-income context, these savings can help drastically improve the situation.

For the PRC, STEEP was applied to wastewater plants in large cities in different provinces. By using the STEEP tool and approach, plants consumed less energy while keeping the same level of treatment. The tool helped establish new operational actions to achieve 30%–50% reduction in energy consumption.

"What's interesting is that these are two different cases," says Bessadi. "In Georgia, the local capacity was developing. In the PRC, the capacity of the operator was much higher. This means that this tool was able to expand in different contexts."

WHY USE SCREENING TOOL FOR ENERGY EVALUATION OF PROJECTS?

Screening Tool for Energy Evaluation of Projects is easy to use. Assessing energy consumption is not as complicated as it sounds. As STEEP is an Excel-based tool, it is user-friendly and easy to use.

Screening Tool for Energy Evaluation of Projects is customizable. STEEP is a digital tool that uses indicators to compile data. While it is Excel-based for accessibility, more advanced versions with automatic data inputs or more sophisticated digital developments can be considered. It could also be adapted for different sectors.

Screening Tool for Energy Evaluation of Projects has potential for public–private partnerships and the private sector. It can be relevant for different ADB modalities, such as results-based lending. Energy consumption could be used more widely as a target indicator for water and wastewater projects, to encourage utilities to reduce energy consumption.

Screening Tool for Energy Evaluation of Projects is in line with the Paris Agreement and the climate change agenda. The tool is increasingly relevant to the Paris Agreement and climate change agenda, as well as to COVID-19 resilience. There is currently much focus on improving water and wastewater treatment, and some of these treatment processes are energy-intensive. This makes energy consumption even more relevant regarding costs of operation for utilities.

Energy-saving solution. ADB's innovative Screening Tool for Energy Evaluation of Projects allows for energy consumption monitoring to promote efficiency and reduce climate impact, and is adaptable across contexts—as evidenced by its success in the People's Republic of China and Georgia (photo by ADB).

LESSONS LEARNED

Securing buy-in can be a challenge. Securing buy-in depends on how receptive a stakeholder is about introducing new solutions into their operations. ADB project teams are busy, so using a new tool can feel like an additional task. The project teams promoted the tool by hosting internal knowledge-sharing sessions and showing the benefits of its use. Government agencies and utilities are also busy. It is important to emphasize the advantages of this tool, such as possible financial savings due to energy savings, but this has been a challenge to demonstrate and communicate.

Development banks need to demonstrate action. There is much enthusiasm about lessening carbon footprints but in big development banks such as ADB, there is sometimes not yet enough practical change. This can be done by incrementally changing the way things are processed. Putting energy screening at the forefront of project development is important. Many carbon dioxide mitigation actions can be implemented simply and easily. For example, STEEP can be used at the strategic procurement planning stage when the different packages are defined to ensure future procurement has considered financial sustainability and climate change impact.

Teamwork is essential. This type of initiative is achievable through teamwork. At each point in the process, the different team member inputs were very helpful.

Infrastructure facelift. The water supply facility in Gulistan, Uzbekistan was rehabilitated and upgraded through ADB's Urban Water Supply Project (photo by ADB).

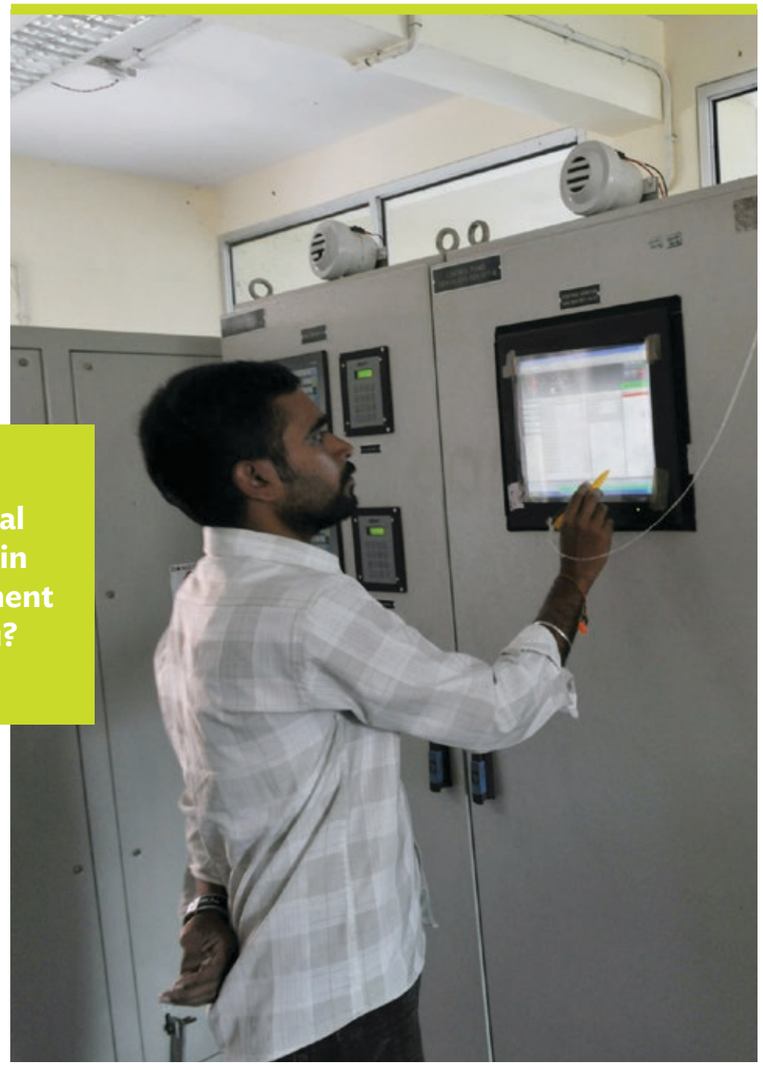
Spearheading Digitalization in the Water Sector of ADB: A Look Ahead

The use of digital tools to improve developing Asia's water security and resilience will require ongoing effort and constant adaptation. No one solution is a magic bullet.

In July and October 2021, the Water Sector Group (WSG) conducted surveys of ADB's water sector community (360 recipients) and water sector clients, including executing agencies and implementing agencies. The survey asked both groups two questions:

What does digital transformation in water management look like for you?

What will be the catalyst to bring this about for ADB projects, programs, or clients?



Data-driven change. Data collection at a sewage treatment plant in Jaipur. ADB is helping India improve the living conditions of urban residents in Rajasthan by refining and upgrading water supply, sanitation, waste management, and transportation (photo by ADB).

KEY TAKEAWAYS:

Knowledge sharing will lead to success. Rather than recreate existing solutions, ADB and its partners in government and the private sector need to prioritize disseminating data and narratives from successful digitalization efforts. Pilot projects and information about successful transitions to digital water management will ease the way for others. Once people see others have successfully transitioned to digital, with data on cost-saving and success in efforts such as flood control, they will seek solutions themselves. The more information is available, the more choices additional adopters will have.

Maintain focus on both micro and macro approaches. One major benefit of modern digital technology is its scalability. Projects do not need to be overarching, multi-year solutions costing billions of dollars. Instead, digital technologies can be gradually implemented to deliver the biggest impact while tailored to individual cases. Pilot projects can be used as examples. Each successful implementation builds on the next, and with each success the demand from client users and consumers will grow. However, the big picture cannot be ignored. While an individual solution can be small in scale, it needs to be considered part of an overall water system. Executing agencies, implementing agencies, governments, and partners such as ADB need to maintain focus on the entire system while implementing each project or study.

Build local capacity with each project. Water management systems need both the buy-in and long-term commitment of local managers. Whatever the scale of initial projects, they must not become one-time solutions where initial excitement erodes over time. The mental ownership of new technology must reside with the users and consumers, and each project must prioritize capacity building. As possible, the management and upkeep of technological innovations need to be local. Every local official and manager, if given ownership, is a potential promoter of digitalized water management.

Developing Asia and the Pacific is already mostly water insecure. A quantitative assessment of ADB DMCs' water security, reported in ADB's flagship publication, Asian Water Development Outlook 2020, found that 22 out of the 49 DMCs were found "insecure"—representing 2 billion people or half of the region's population. Asia and the Pacific is also the most disaster-affected region in the world, home to more than 40% of the globe's calamities and 84% of the people they affect.

Developing Asia and the Pacific is already mostly water insecure.

The effects of climate change are expected to worsen water security and water-related disaster risks. Digitalization can help the region be better informed on water, climate, and related factors, so it can better plan and manage water.

Instead of a wave of high-tech solutions, digitalization may come as a series of small, steady improvements in the water sector. The success of each of these efforts will provide impetus for further adoption. As emerging best practices and smart solutions for many subsectors of water (see Examples of Smart Solutions in Water Management) provide evidence of improved results at affordable cost and capacity, faster uptake of and lesser resistance to these solutions are becoming more visible.

The COVID-19 pandemic has been a good reminder for the water sector, which has been at forefront of dealing with the pandemic, to digitalize to become more resilient to such shocks and stresses in the future.

To attract support and incentivize uptake of digitalization solutions in its DMCs, ADB needs to help its water sector clients find low-hanging fruits: improvements that will help demonstrate, show quick results, and generate greater openness to and appetite for digital tools, while paving the way for scalable and deeper impacts. There is no better way to remove barriers and misconceptions than to show technology at work.

The e-marketplaces, technical assistance on mainstreaming digitalization and high-level technology grants, and e-magazine are a few examples, alongside multiple other paths being taken by ADB's operational departments, sector and thematic groups such as WSG, and the digital technology unit that are supporting the operations and bringing innovations, of intended catalysts in this process.

Evidence of technology's effectiveness can help garner vital support from local partners, and industry and user demand must drive the acceleration of digitalization. To make a lasting change, multilateral financial institutions such as ADB and national and regional governments, as well as local constituents must work together to harness the best technology to aid in the effort for a water-secure and resilient Asia and the Pacific.

"There are many opportunities for digitization to transform the water sector, including major technology areas like cloud computing, artificial intelligence, "Internet of Things," and digital imagery. Earth observation imagery is a particularly promising area in the development sector due to the rapidly increasing capabilities and the global data coverage. ADB is partnering with the European Space Agency, for example, and their global imagery is available at no cost as a public good. This is in stark contrast to most sources of big data that are proprietary and come with complex privacy and security issues."

—Thomas E. Abell
Advisor, Sustainable Development and Climate Change Department and Chief of Digital Technology for Development

"Digital technologies are not a "nice to have" but a "need to have" component in water sector projects. Digitalization, such as smart water management and integrated management information systems, will help evidence-based informed decision-making, support efficient and sustainable operations, and offer better customer services. We are already observing transformational changes in service delivery through the use of innovative digital technologies."

—Norio Saito
Director, Urban Development and Water Division, South Asia Department

"Digital transformation is a must in water sector projects for Pacific countries. The island countries are too small and isolated, and digitalization technology can provide remote technical support to standardize and sustain water service operations with low cost and high reliability. Smart water management and the use of digital images will help build resilience to climate change and pandemics when it is not easy to do frequent field visits."

—Jingmin Huang
Director, Urban Development and Water Division, Pacific Department

Irrigation inroads. In Viet Nam, ADB's project used canals to shorten the distance from water sources; 11 kilometers of canals from Truc Kinh Lake irrigate about 1,000 hectares of rice paddies. The project has also reduced water waste and minimized land desertification by shoring up the canals' banks (photo by ADB).

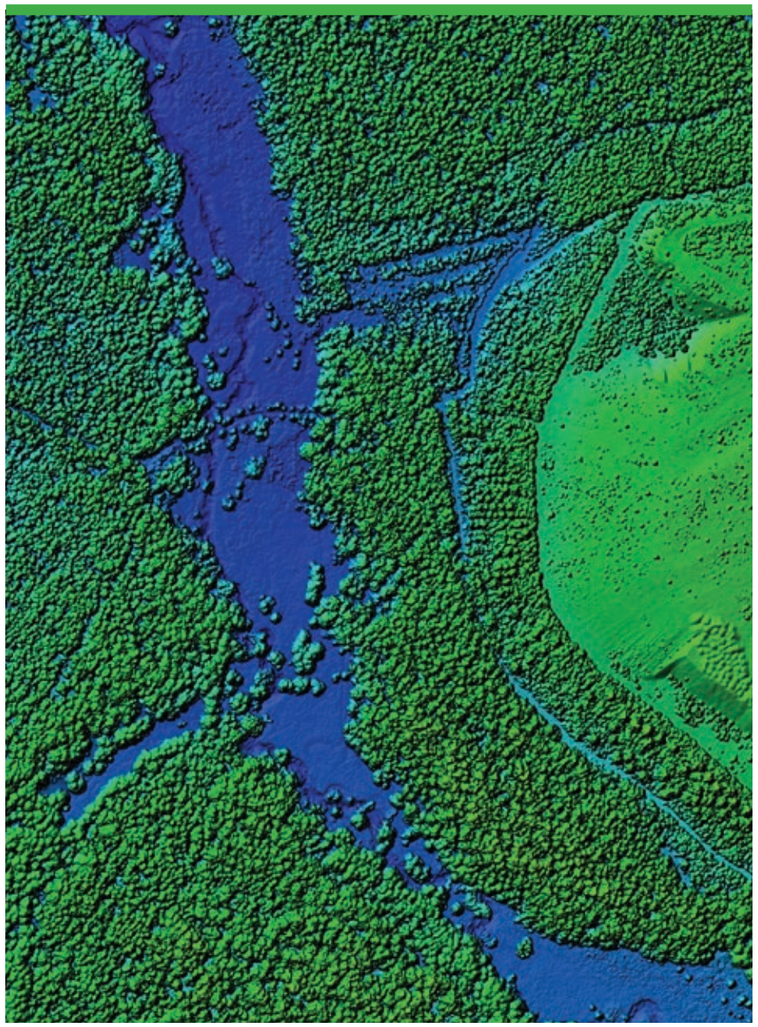
Building for health. Rehabilitated and upgraded water supply facilities have improved health conditions in Gulistan City, Uzbekistan (photo by ADB).

Examples of Smart Solutions in Water Management

FLOOD RISK MANAGEMENT

Flood risk management has been influenced greatly by advances in technology, mainly since about 50 years ago with computational fluid dynamic and hydrological process modeling software. One-dimensional hydraulic models based on implicit computational schemes evolved toward complex two-dimensional, nonstructured explicit schemes run on multiple processors. More recently, three-dimensional, non-hydrostatic software solving the full Navier–Stokes equations have become cost-effective and practical in some cases. It is possible that three-dimensional flood modeling will soon become ubiquitous for flood risk management.

Advances in hydraulic modeling software have demanded more refined representations of the terrain. Digital elevation models (DEMs) are now standard for flood risk management projects and can be developed using many methods. Traditionally gathered from land-based topographical surveys or stereoscopic pairs of aerial photographs, the industry quickly took advantage of LIDAR early in this century. In the early 2000s, detailed DEMs can be obtained from satellite remote sensing. Although not as accurate as LIDAR, they are much cheaper, and the accuracy is sufficient in many cases. Drone-sourced LIDAR is also gaining popularity for some applications and supplements other sources of data. The fine spatial representation of DEMs (down to 1 meter) and relative vertical accuracy (down to less than 1 meter) has seen a growth in two-dimensional hydraulic modelling software—some of which is freeware from a rapidly expanding development community often around universities—and applications. With fine spatial representation of the terrain and prevalence of two-dimensional hydraulic modeling software and industry capability, detailed flood depth maps over various return periods are typical and standard project outputs.



Digital flood modelling. Geographic information system three-dimensional illustration made after processing aerial pictures from a drone. Drone-sourced light detection and ranging is is gaining popularity to supplement other data sources for flood risk management (photo © Marcel Miziołek/Shutterstock).

URBAN WATER MANAGEMENT

Despite progress, many Asian cities still face coverage, reliability, and water quality challenges in their urban water supply. Water leakages and nonrevenue water continue to be a major problem in developing Asian cities, resulting in inefficient water service delivery, energy waste, drinking water contamination, revenue loss, and increased operational costs.

Adopting smart technologies in water management can address these issues and facilitate better urban water service delivery. "Internet of things" devices, such as sensors, valves or pumps, enable remote monitoring and remote control that can identify leaks and manage water flow and pressure, and therefore contribute to nonrevenue water reduction. GIS mapping assists utilities to manage water infrastructure on a digitalized and location-based network, allowing for easier and more precise water operations and asset management. Smart metering and online billing systems achieve real-time and automatic consumption monitoring as well as greater efficiency in tariff collection.

More importantly, data generated and collected through smart technologies empower utilities with evidence-based water management and planning. Water remains a scarce resource in cities in Asia and the Pacific. Demand for water has increased given growth in urban populations and in people's incomes. Extreme weather events have become more intense and frequent due to climate changes, putting pressure on water services.

Cities not only need to ensure continuous water supply but must also manage demand and stay resilient in response to the changing climate. Data can support utilities with a better understanding of water consumption patterns, energy requirements, and climate impacts. Moreover, water-related data can be correlated with other data sets (e.g., transport, energy distribution, communication) to better understand needed urban services, thereby contributing to planning, implementing, and operating such services.

With digitized water infrastructure, data analytics, and even artificial intelligence, utilities can develop complex models to better anticipate demand and plan for uncertainties, contributing to more sustainable and resilient urban water and related service delivery. Examples of such models are "digital twins" powered by "internet of things" technologies, which are virtual representations of physical infrastructure. The pairing of a virtual model and its physical counterpart allows monitoring and parallel analysis of its functioning to identify problems before they occur, prevent downtime, develop new operation scenarios, plan how to mitigate future events using simulations, and automate decision processes for faster response.

The #DigitalAgainstCOVID-19 Virtual Challenge on Improving Remote Monitoring of Water Utilities, held on 20 January 2021, called for participants to team up and explore digital solutions for tackling water utility challenges during the COVID-19 pandemic. In this challenge, ADB aimed to find smart water management solutions for water utilities that can remotely monitor water operations, maintain service delivery, and manage assets and staff performance, as well as identify vulnerabilities within service areas. The challenge selected two winners—Hiraya Water and Nobel Systems.

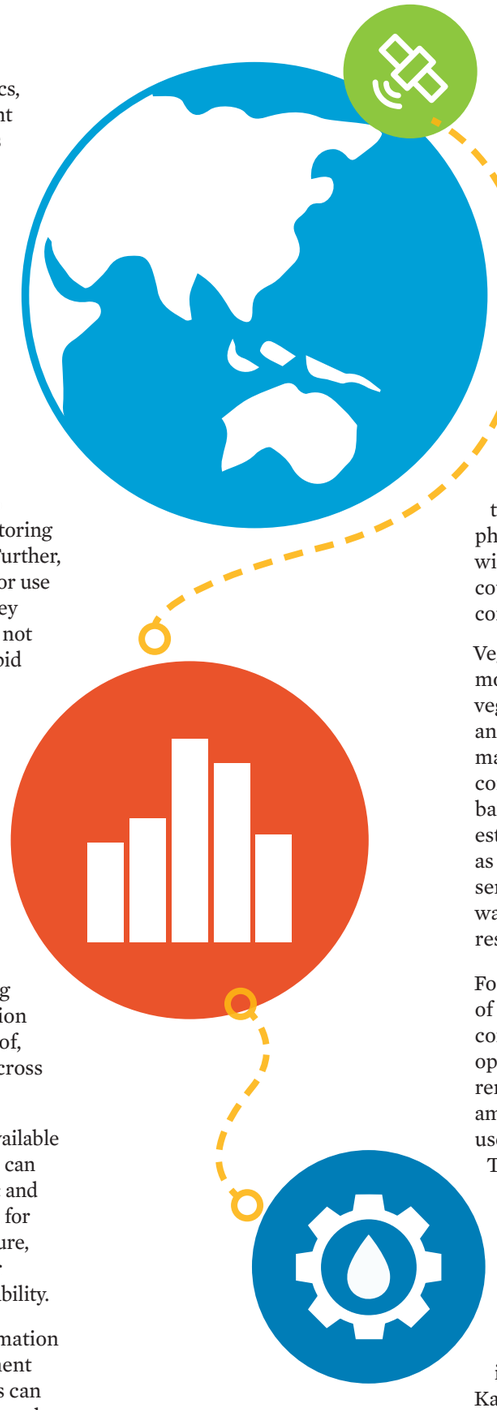
Rural water access. In Cambodia, ADB has supported rehabilitating and constructing new wells, community ponds, and small community water supply systems that benefit 370,000 rural residents in six provinces (photo by ADB).

Hiraya Water

NOBEL SYSTEMS

EARTH OBSERVATION

The use of Earth observation for descriptive and diagnostic analytics, with its ability to unlock significant data for spatial planning, provides several advantages over traditional field-based surveys such as household surveys and/or census data normally used for urban and other planning. Multiple ADB projects are currently using it. Free data, such as the European Space Agency Sentinel suite, are globally available, making them suitable to gather information in difficult-to-access areas. The timeliness and high frequency of their availability also make the data useful for the monitoring aspects of societal development. Further, analysis-ready data are available for use soon (days or even hours) after they are acquired. Such data are useful not only for monitoring but also in rapid assessment for disaster response.



Earth observation is a non-intrusive technology and sometimes the only feasible method of collecting information, especially in very remote or difficult-to-access regions (e.g., areas experiencing fragility, conflict, and violence). Many developing countries lack even the most basic mapping information, and Earth observation can deliver up-to-date mapping of, for instance, natural resources across whole countries and regions.

Since satellite imaging has been available since the 1970s, changes over time can be analyzed by comparing historic and recent earth observation data sets, for instance on urbanization, agriculture, deforestation, shoreline erosion or accretion, or water resource availability.

Satellite Earth observation information can also support social development work. Social protection measures can be designed through rapid, large-scale spatial distributions and monitoring of population densities, housing conditions, transport networks, and mass human displacements, along with mapping of environmental factors that could threaten social stability (e.g., droughts, floods, fire, and air pollution). It can also provide information that serve as proxies to monitor activity sectors and therefore help formulate economic recovery measures.

INTEGRATED WATER RESOURCE MANAGEMENT

A major challenge in water resources management is the availability of reliable data for planning and management. The advances in satellite remote sensing, GIS, and numerical processing offer partial solutions. Geo-referenced digital asset management systems coupled with financial routines can be used to support infrastructure management, operations, and maintenance. More detailed digital surveys that combine drone imagery and photography, and satellite imageries with image-processing technologies could be used to efficiently identify construction-relevant information.

Vegetation growth can be monitored through a normalized vegetation development index, and a reliable calculation can be made of evapotranspiration or the consumption of water using the energy balance protocol. Precipitation can be estimated within acceptable accuracy as well. Together, this remotely sensed information can be used for water accounting in basins and water resources development planning.

Food production is the major consumer of water. Small reductions in water consumption for food production, by optimizing water productivity through remote sensing, can result in a large amount of water available for other uses or for expanded food production. These remote sensing techniques are still only sparsely used for planning water resources management and to guide investments in water infrastructure. ADB has been on the forefront of applying remote sensing for guiding investments and monitoring their effects in Cambodia, India, Indonesia, Kazakhstan, Mongolia, Pakistan, the Philippines, Sri Lanka, and Viet Nam.

Digital asset management systems could significantly improve the life cycle productivity of water infrastructure, such as water distribution networks, as well as help optimize supply and demand. The potential exists, particularly in water resources management, to use these systems to improve monitoring of asset conditions and functionality and to budget for routine maintenance and repairs. But they are not yet sufficiently used, which leads to deteriorating infrastructure, lost benefits, and unnecessary expenses for rehabilitation and modernization.

Adoption of digital asset management systems should become routine in water investments and preferably include options for water flow and water storage measurements and management. For clients with less-developed economies, it would be essential to ensure such systems can be maintained and kept functional over the long term. For irrigation system management, operation and maintenance combinations between asset management and productivity measurements would be ideal. Flow measurements can be added through traditional measurement techniques but also further digitized using mobile phone applications, a technique currently being piloted.

The remote sensing, digital asset management, and discharge measurement systems should be combined with basin and system management and operation models to optimally distribute water resources and save water for other uses. Advances in artificial intelligence algorithms might well be used to develop better solutions and explore scenarios that until now have remained out of reach. Artificial intelligence could also be used to determine optimal measures within the water–food–energy nexus, including monitoring indicators and investment outcomes and impacts.

Drone technology and imagery in combination with GIS can be used for project preparation, construction supervision, and quantity surveying. An example for preparatory data is through accurate topography mapping and identifying hot spots for embankment breaches. Construction supervision can be accomplished as exact position, alignment, and quantities can be determined in real time. The real-time dimension also solves a continual problem of post-construction quality and quantity control—the underground parts of structures.

Clean living. The Third Provincial Towns Water Supply and Sanitation Project provided sustainable water supply to improve sanitation conditions in Binh Duong Province, Viet Nam (photo by ADB).

SANITATION MANAGEMENT

Many middle-income and most lower-income cities in developing Asia have not yet made safe, affordable sanitation services available to all their residents. This poses serious risks to public health and perpetuates inequalities, environmental and water pollution, and degradation.

Every city is unique—in its urban development, housing type, and tenure; topology, climate, and water resources; policy, institutional capacity, and regulations; private sector engagement; and revenue and budgets. These factors impact the possibilities for sustainable sanitation services. Their uniqueness and complexity limit the use of universal approaches, tools, and decision-making shortcuts. They require situation-tailored tools and professional expertise and experience in applying them.

Innovative, practical, bespoke digital tools are under development that can help support sanitation systems planning. One example is the integrated management information system tool. Key parameters, such as population density, urban sprawl, socioeconomic status, climate change, and vulnerability mapping, are overlayed and processed in a GIS-based data system. The outcome is an evidence-based proposal of which sanitation systems may be suitable in which area (e.g., centralized or decentralized on-site sanitation systems).

Earth observation tools such as Spatial Data Analysis Explorer are another example. These can be used to analyze climate projections to determine the climate risk and vulnerability of a certain urban area or city that can inform the city or site selection of planned assets, such as wastewater treatment plants. The field data can be collected and uploaded directly onto a GIS platform to determine the location and quality of existing sanitation facilities for select towns in the project area.

These innovative and practical approaches will give city officials and other stakeholders ideas for similar decision-making and operational support to improve sanitation services for their residents.

ASSET MANAGEMENT

ADB's Strategy 2030 acknowledges the importance of asset management in ensuring the quality and sustainability of infrastructure services. Recognizing that poor-quality infrastructure requires urgent attention, the strategy emphasizes that rehabilitation, better management, and adequate maintenance of assets are essential. Digital asset management is part of ADB's plan to use ICT to improve the quality of public service delivery by supporting policy, regulatory, and tariff reforms that promote the financial sustainability and effective operation and maintenance of infrastructure and services. A core component is the implementation of an Asset Management Information System (AMIS).

An underlying challenge of DMCs is to manage a significant portfolio of water system assets and infrastructure, which are critical to their local economies. Asset management plays a key role in efficient water services provision and is critical in managing water systems and service delivery. Under an attached technical assistance to Georgia's Sustainable Water Supply and Sanitation Sector Development Program, ADB reviewed and benchmarked proprietary water supply AMISs for a select city service center of the United Water Supply Company of Georgia. The second stage will involve AMIS implementation for the city service center.

Productivity boost. With ADB assistance, a water treatment plant established in 2003 by the Binh Duong Water Supply Sewerage Environment Company Limited in Viet Nam increased its productivity to 60,000 cubic meters a day and night in 2005 and 90,000 cubic meters a day and night in 2010 (photo by ADB).

This e-magazine was prepared to provide a compendium of case studies across ADB's developing member countries highlighting the use of digital technology in water operations. It also showcases solutions, lessons, and knowledge shared from ADB's 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.

Asian Development Bank
6 ADB Avenue, Mandaluyong City
1550 Metro Manila, Philippines
Tel +63 2 8632 4444

Notes:
In this publication, "$" refers to United States dollars.
Cover photo © Butusova Elena/Shutterstock

PSN ARM220062-2 DOI: http://dx.doi.org/10.22617/ARM220062-2 pubsmarketing@adb.org