



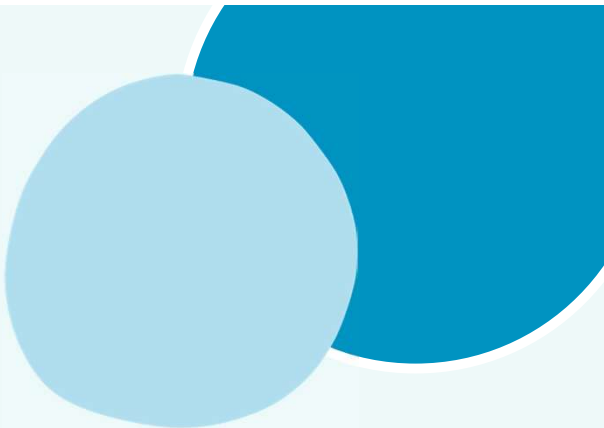
Session 2

Innovations, Tool, and Sector Updates



Session 2

Innovations, Tool, and Sector Updates



Next Presentation:

Esther Shaylor – UNICEF

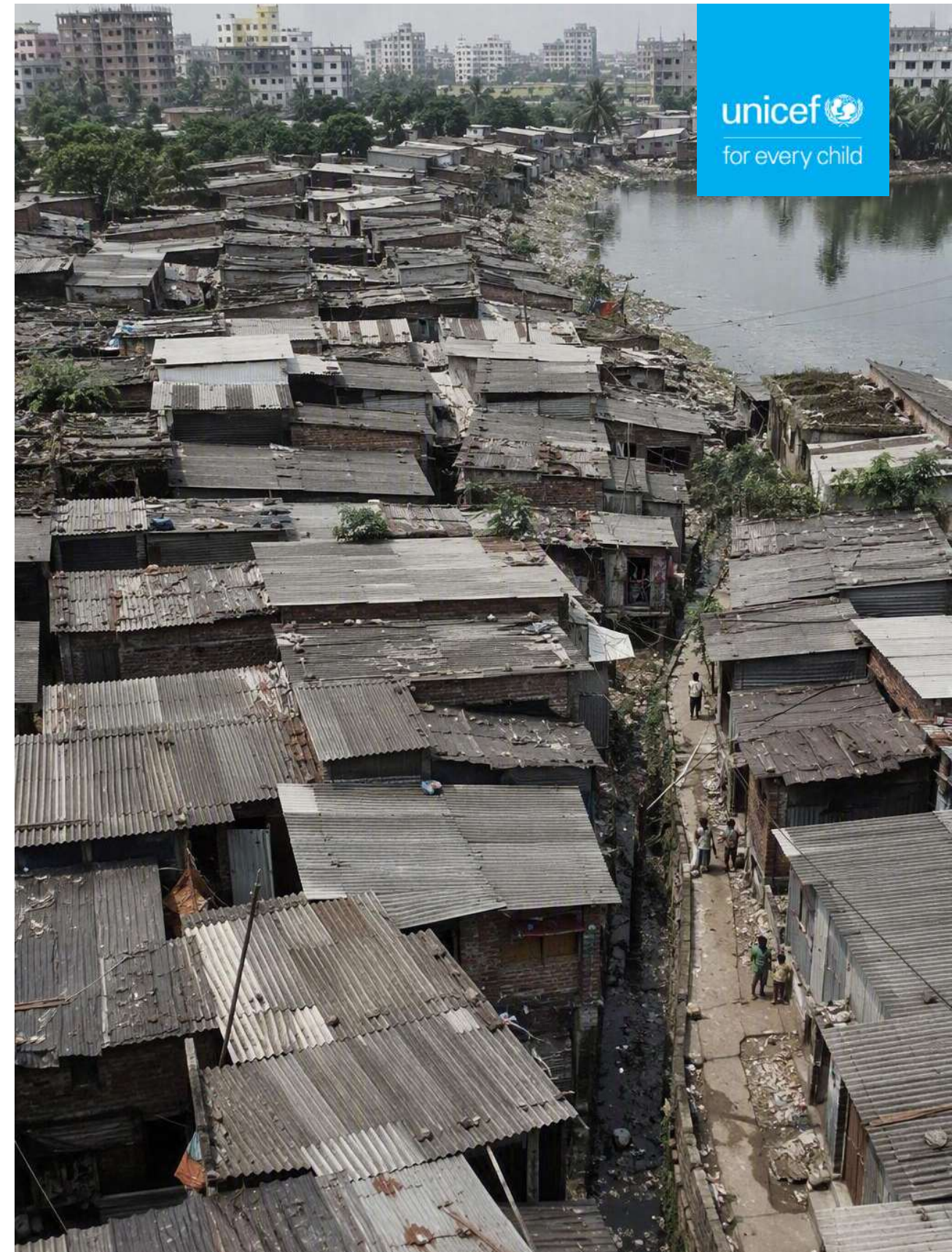
THE CHALLENGE

Big sanitation questions, tight spaces: lessons from Korail, Dhaka, Bangladesh

Rapid urbanisation is outpacing sanitation infrastructure. Conventional sewerage and faecal sludge management are technically and financially difficult in dense settlements.

Korail faces limited land, irregular drainage, fluctuating flows and thin institutional O&M capacity — with untreated wastewater driving health risks and polluting surrounding water bodies.

The question: can decentralised wastewater treatment move from pilot to a sustainable service model?



WHAT THE PILOTS SHOW

Three systems, three use cases, no single “best” technology

NeerVana

Engineered nature-based

40 m³/day

~970 households / 4,850 people

Lowest cost per m³/day; needs space.

Aquonic-1

Compact containerised

4 m³/day

~100 households + a primary school

Institutional reuse; nitrogen gap.

Aquonic-2

SBR / interceptor model

20–25 m³/day

Polluted drains and lake inflows

Daily oversight and energy input.

No single best technology — match the plant to the setting.

All three perform well on core treatment; nitrogen removal remains the key gap for the Aquonic systems.

From pilot to public service: what must be in place

Five conditions for responsible replication

- 1 Context fit** Match the technology to the settlement, land availability and service objective.
- 2 Treatment readiness** Address nitrogen removal and disinfection gaps before replication.
- 3 O&M capacity** Put procedures, logbooks, spare parts and operator routines in place.
- 4 Financing** Include multi-year running costs from the start, not just capital.
- 5 Institutional pathway** Embed the model within CWIS planning and public service systems.

So what next?

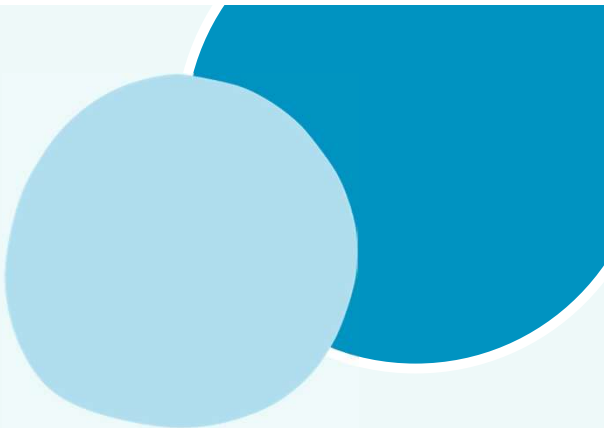
From proving the technology to enabling adoption

- | | | |
|---|-------------------------------------|--|
| 1 | Shared vision | Within five years, a recognised set of options for small towns and informal urban areas across UNICEF-supported countries. |
| 2 | Shift the question | The barrier is the enabling environment, not the technology — the question has moved from “does it work?” to “how is it adopted and sustained?” |
| 3 | Support decision makers | Clear technical guidance on service outcomes, context suitability, institutional fit, financial viability, operational sustainability and scalability. |
| 4 | Connect to the frameworks | Feed into the Global Urban WASH Framework, the Game Plan for safely managed sanitation and CWIS mainstreaming guidance. |
| 5 | Where UNICEF adds most value | Entrench this as a systems-strengthening agenda, with technology choice and Innovation providing targeted support. |



Session 2

Innovations, Tool, and Sector Updates



Next Presentation:

**Linda Strande / Jess MacArthur–
EAWAG-Sandec**

Sandec Department of
Sanitation, Water and
Solid Waste for Development

Low-Cost, Low-Space and Locally Produceable Dewatering techniques for Non-Sewered Wastewater

Linda Strande and Jess MacArthur
Eawag-Sandec

eawag
aquatic research **ooo**



Nearly half the world relies on **non-sewered sanitation**.

And for dense, space-constrained settings,
conventional wastewater technologies are often:

- Too large
- Too complex
- Too costly

Additionally, wastewater from non-sewered
sanitation is often very watery.

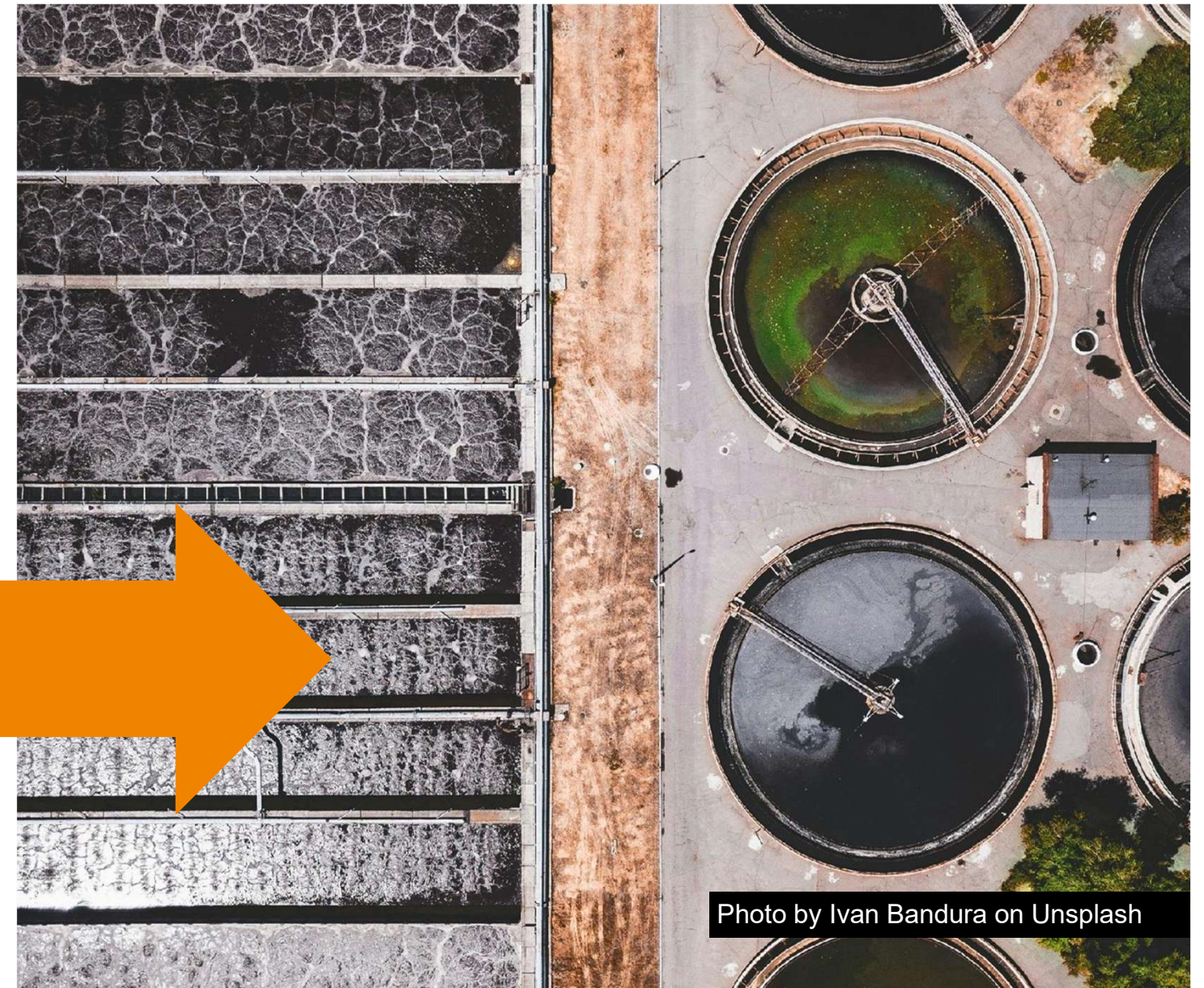
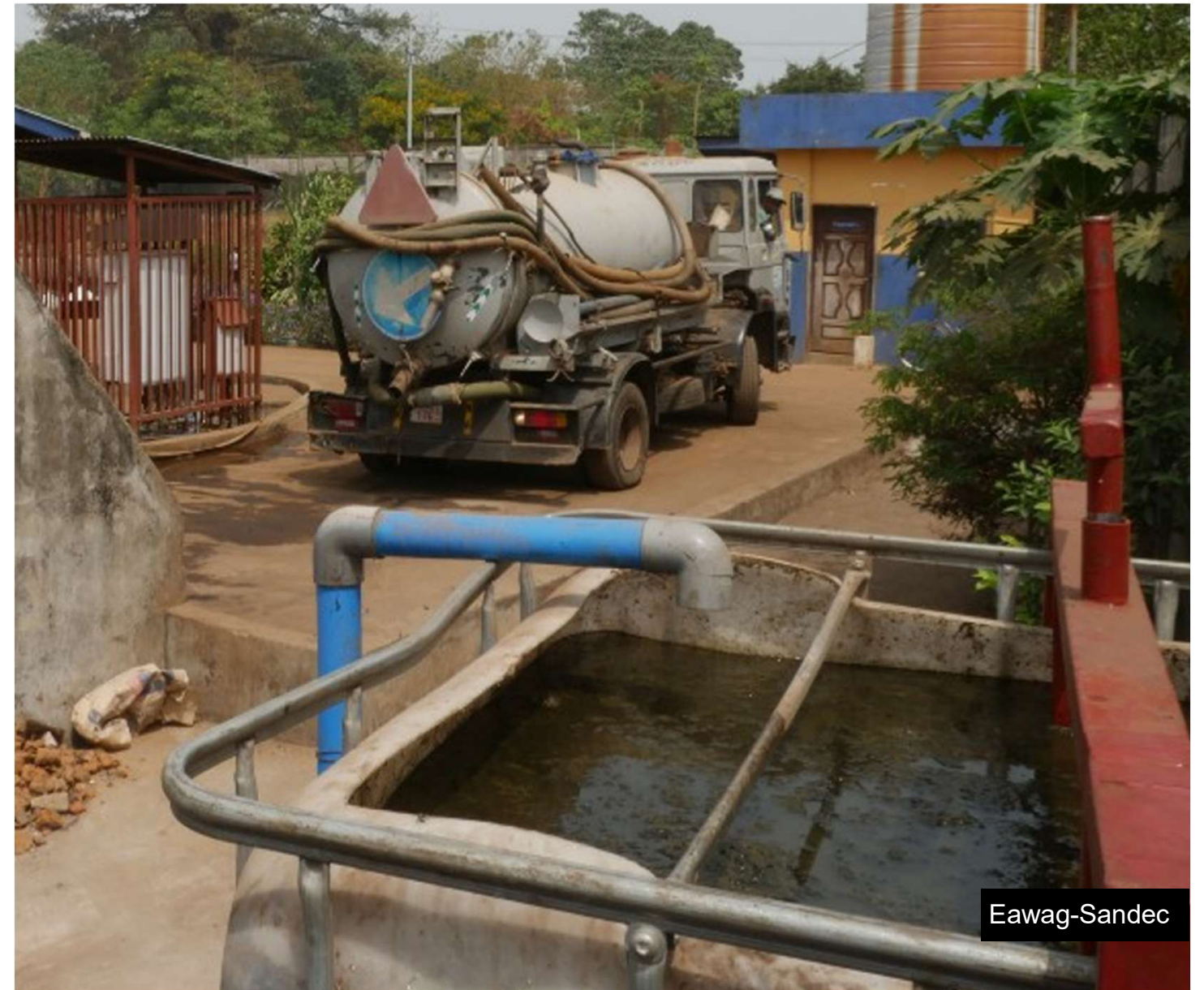
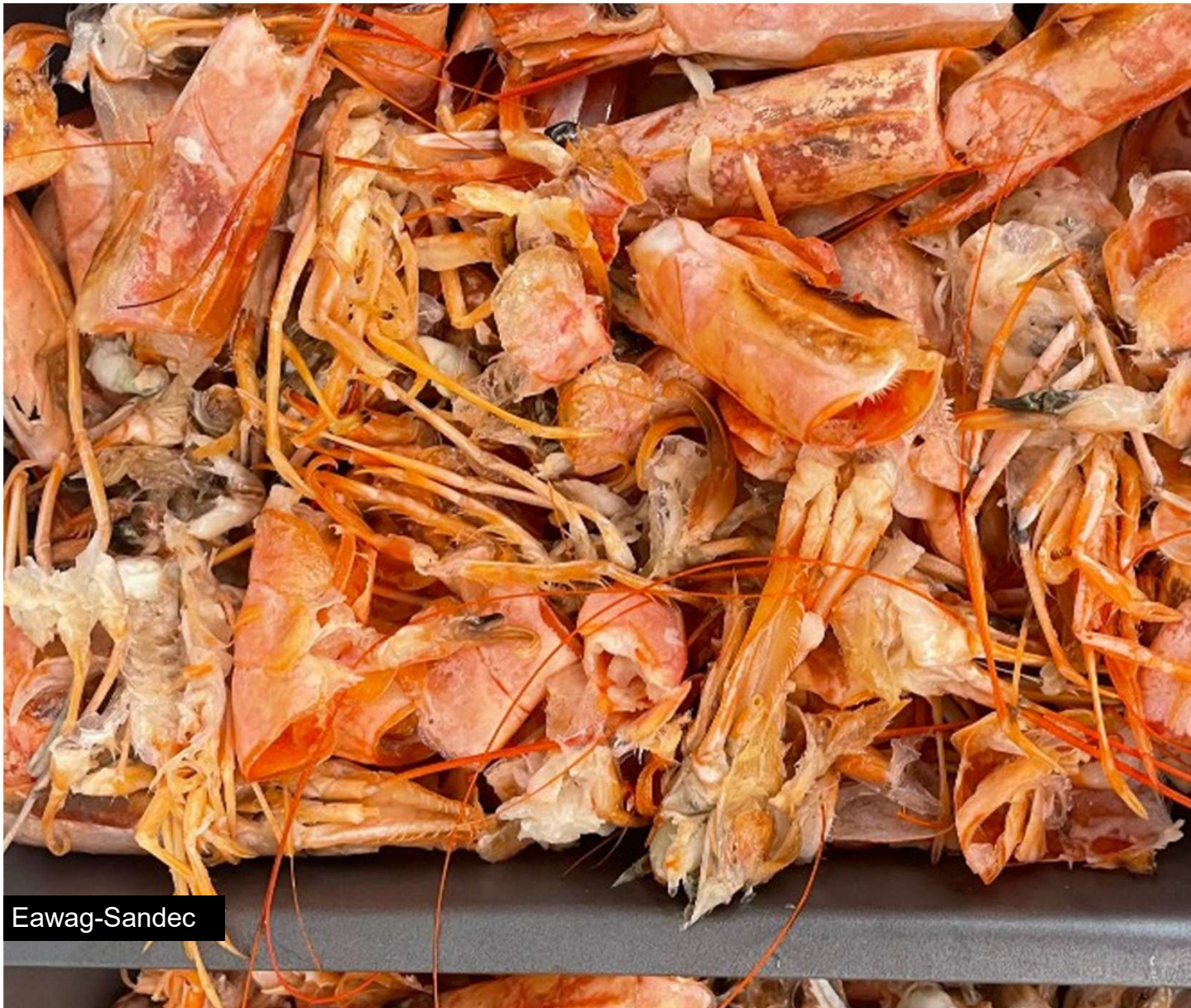


Photo by Ivan Bandura on Unsplash

In these non-sewered sanitation settings, simple **dewatering** is essential.

- Improves downstream treatment
- Makes resource recovery easier





1: Locally produced **bio-based conditioners**

Treatment facilities need to ensure dewatering solutions that are low-cost, low-footprint and locally produced - avoiding complex international supply chains.

Our team tested **corn cobs**, **shrimp shells**, **rice husks** and **avocado pits** as potential bio-based conditioners.

A pilot case study in Freetown, Sierra Leone, has shown that shrimp shells can be effectively collected and used as a bio-conditioner to dewater wastewater.

2: Manually operated filter press

Many treatment facilities don't have a lot of space, have intermittent electricity, and would like to avoid relying on international supply chains.

Our team developed and tested a locally manufactured press that is manually operated, modular and flexible to different operating conditions.

A pilot case in Freetown, Sierra Leone, has shown that using conditioners and the press together is a powerful combination.



Learn more



Primary Funding: Repic (SECO, SDC, FOEN, SFOE), Swiss Agency for Development and Cooperation
Organisations: Eawag-Sandec, The Water Hub GOAL, Freetown City Council



www.sandec.ch/mews
linda.strande@eawag.ch

eawag
aquatic research ooo



Linda Strande



Michael Vogel



Kelsey Shaw



Ednah Kemboi



Kayla Coppens



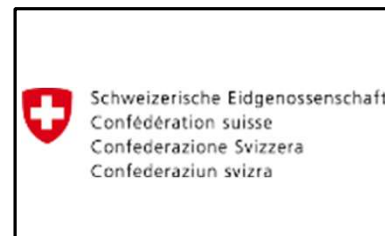
Natalia Montoya



Seju Kang



Julian Frizstche

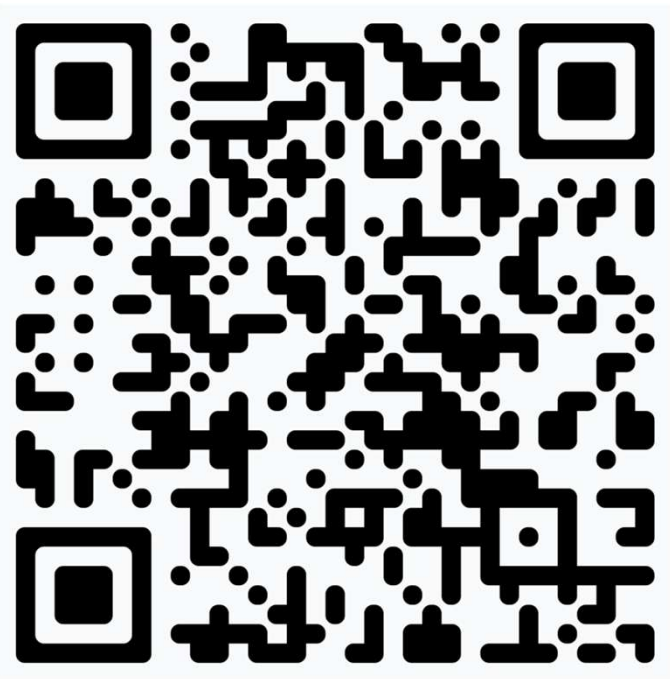
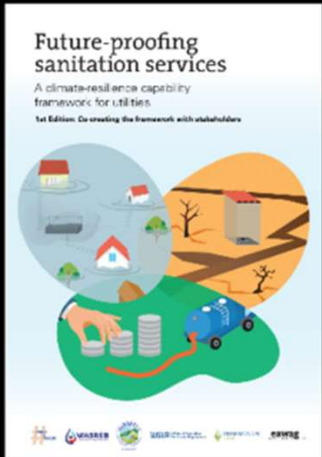
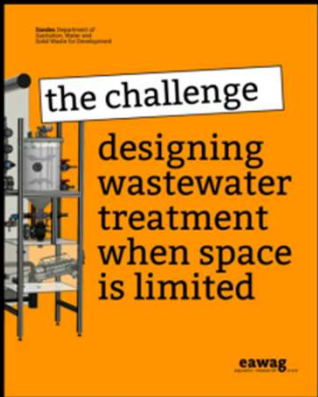


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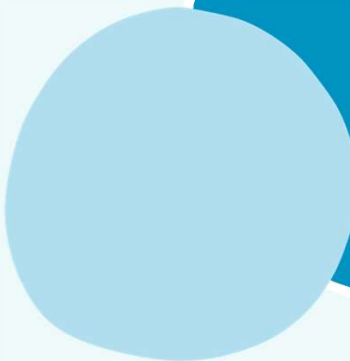
April – June 2026





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Innovations, Tool, and Sector Updates



Next Presentation:

**Paresh Chhajed-Picha – Associate
(WASH specialist), RIVA (formerly
IRCWASH) and SuSanA Forum
Moderator**

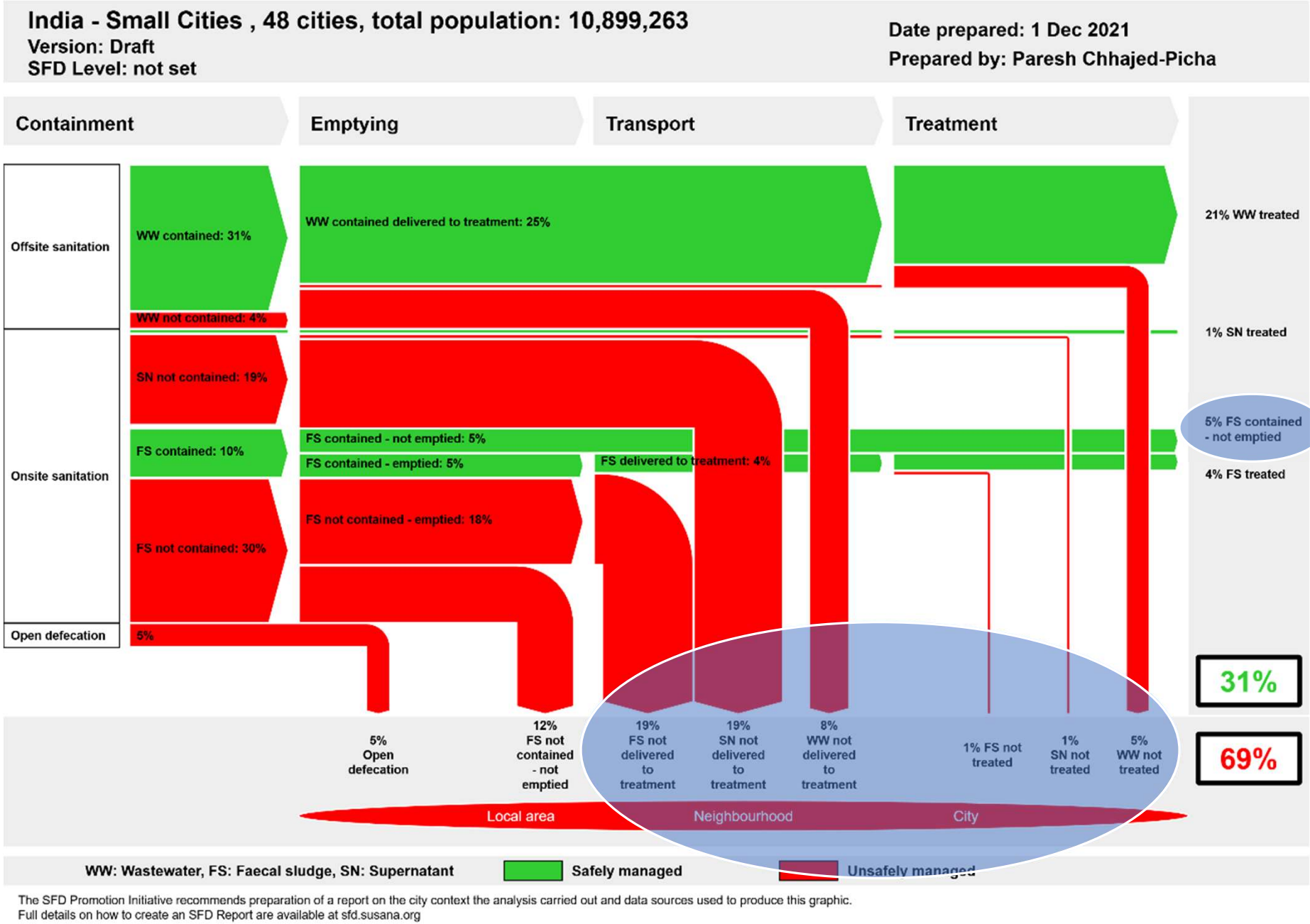
From Scaling Innovation to Sustainable Services: The Unfinished Business of FSM in India

Paresh Chhajed-Picha
RIVA (formerly IRCWASH)

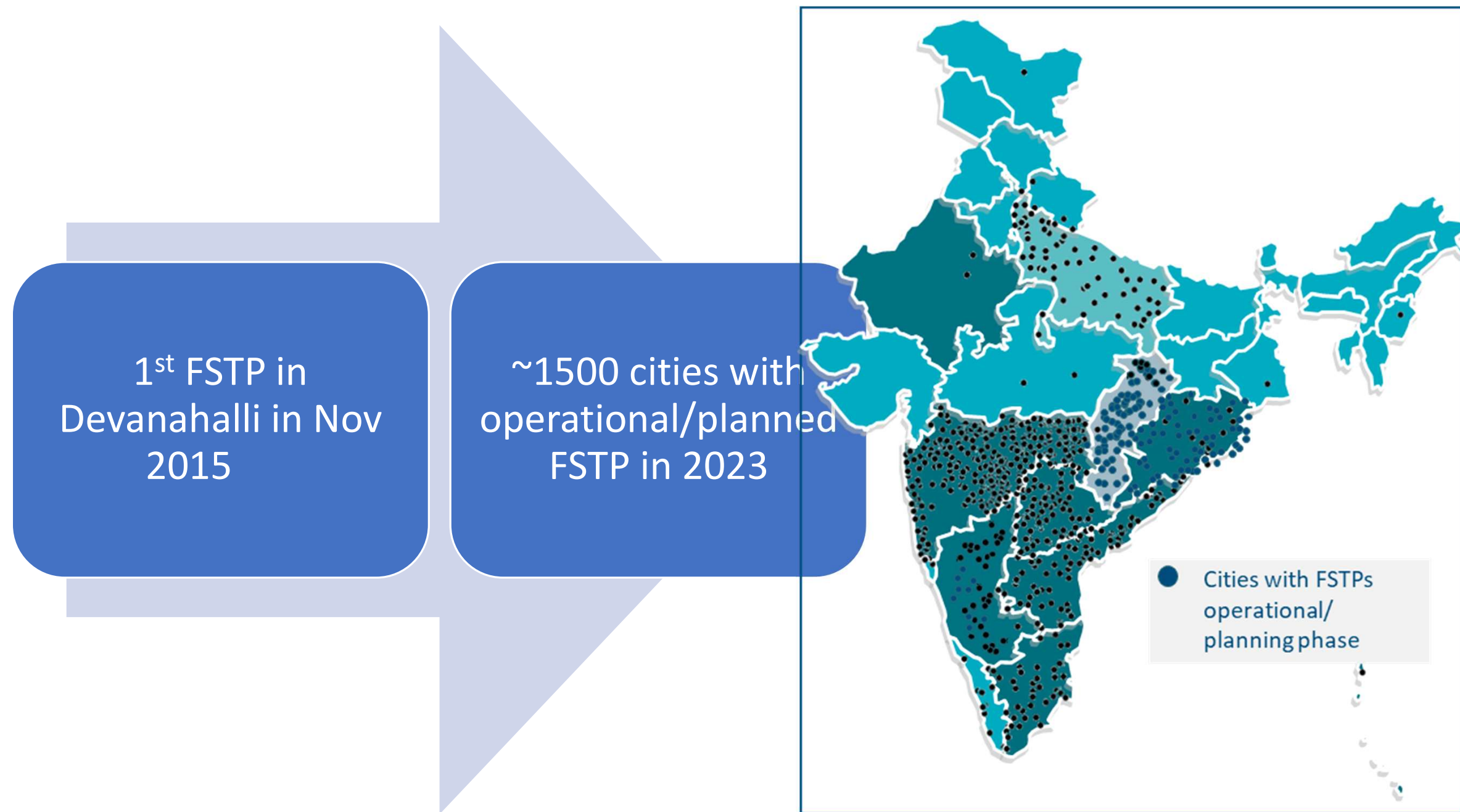
Aug 22, 2026

36th SuSanA Meeting, Stockholm

FSM Service Chain in Small Cities



The Rapid Scaling



Source of the map: Joshi (2022)

Supportive Union Government



National FSSM Policy
2017



Finance – National
infrastructure financing
schemes



Knowledge
Management – SCBP



Monitoring (Annual
Ranking of cities)

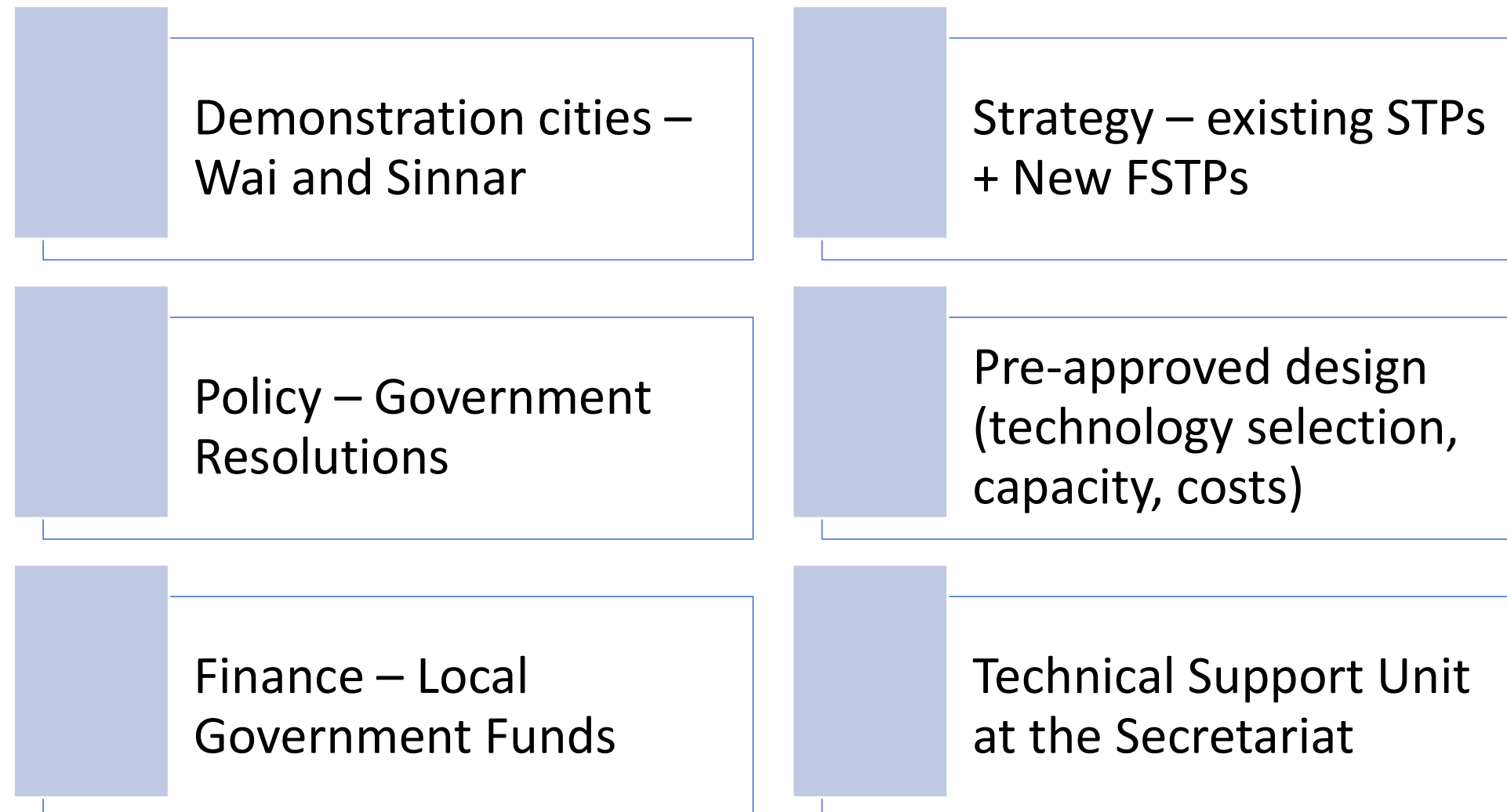


Gates Foundation -
Financial Support to
knowledge partners



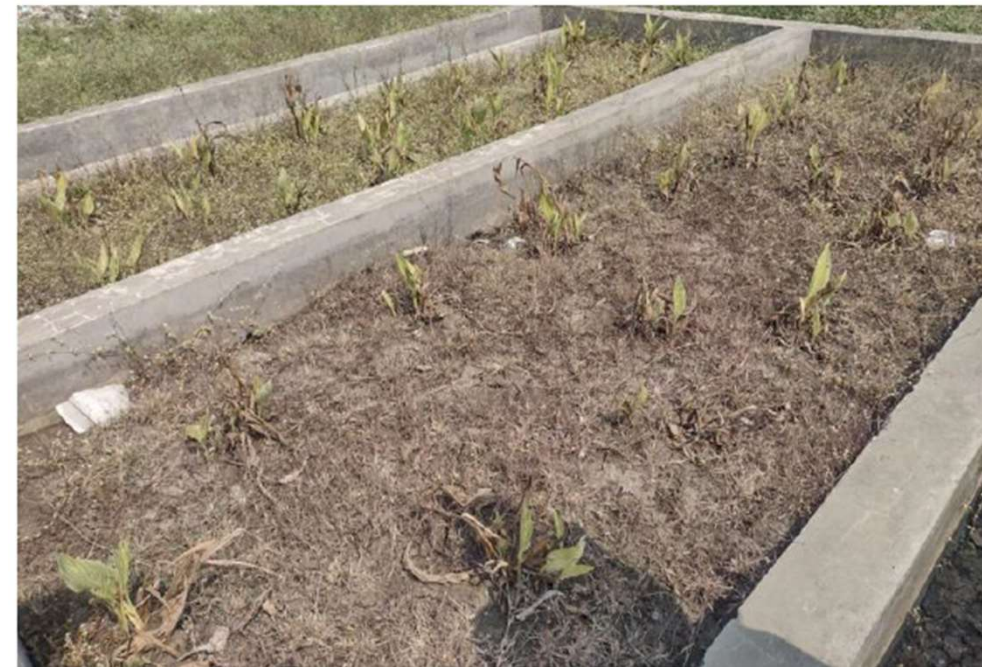
NFSSM Alliance and
partners – Technical
support

Scaling at State Level – Maharashtra



The Unfinished Business

- Backward and forward linkages
 - Scheduled desludging
 - Market for reuse
- Integration with urban management systems
 - Regulating Treatment
 - Monitoring services
- Greywater management
- (Local) Government ownership

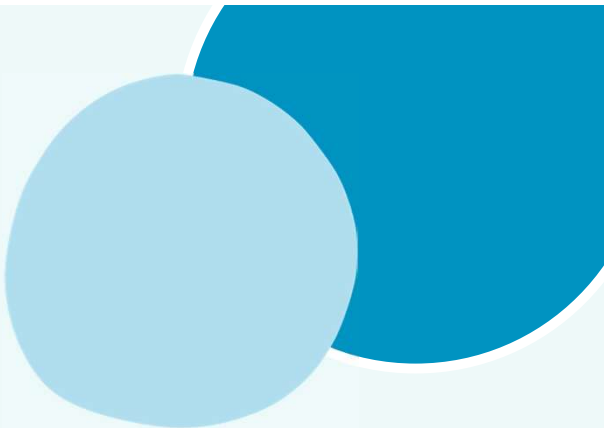


Thank you



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Next Presentation:

Susan Lamb – mWater

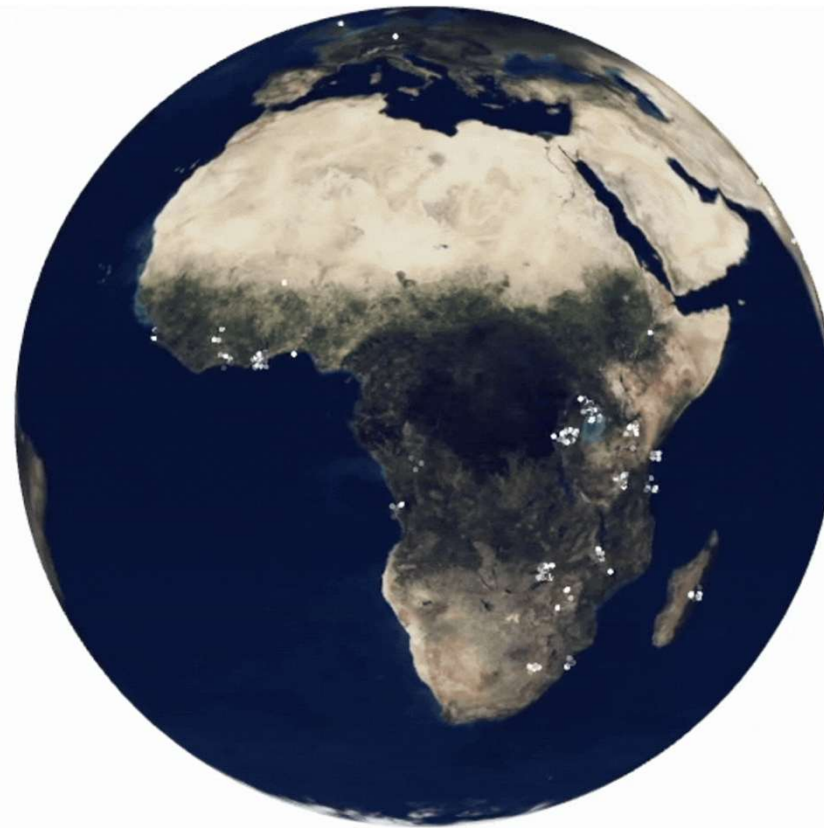
mWater for the Sanitation Sector

**AI-Powered Data Management
and a New Global Asset Standard**

Susan Lamb, mWater Program Manager
SuSanA Annual Meeting | 22 August 2026



mWater is the sector's digital public good for data collection and management.



Surveys in the Past 24 Hours (12:14 GMT)

Sites

7,430,059

Surveys

50,546,496

Users

382,617

mWater has developed other public goods such as global asset standards.

Water

1.1m water assets mapped in mWater

System		Facility	Vertical				Horizontal	
Asset types:								
Water System	Subsystem	Facility	Water point	Connection	Source	Pump	Pipe	Canal
			Tank	Power	Treatment	Meter		
			Electrical	Valve	Hydrant	Junction		
			Sampling point	Sensor	Analyzer	Datalogger		
			Structure	Other vertical				

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			Structure	Other vertical				

Sanitation

New!

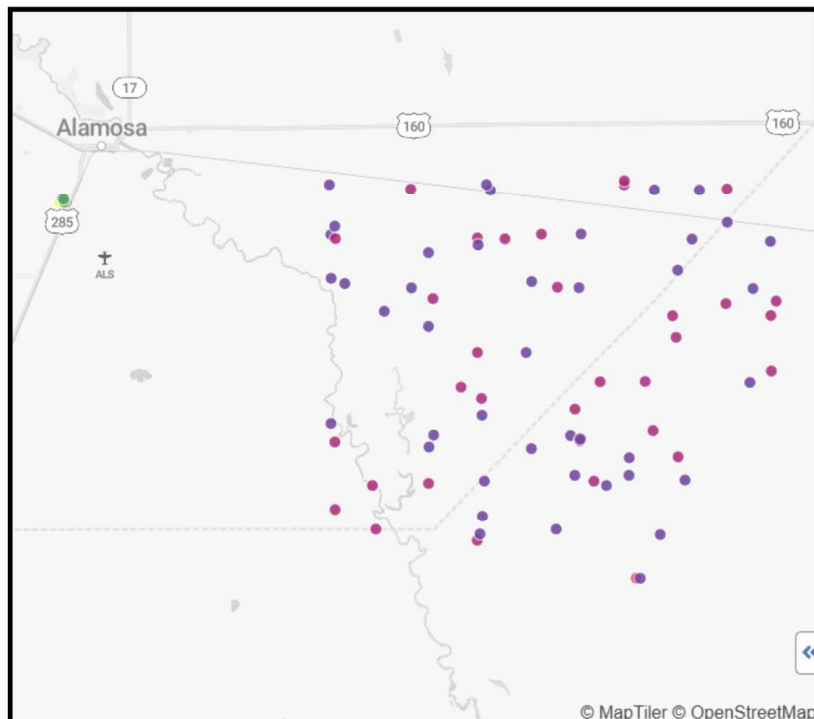
v1.0 launched today

System		Facility	Vertical					Horizontal	
Asset types:									
Sanitation System	Subsystem	Facility	Sanitation point	Connection	Containment	Vehicle	Manhole	Pipe	Channel
			Junction	Valve	Flow control	Structure	Power		
			Electrical	Meter	Sampling point	Sensor	Analyzer		
			Datalogger	Pump	Tank	Treatment	Dispersal		
			Outfall	Other vertical					



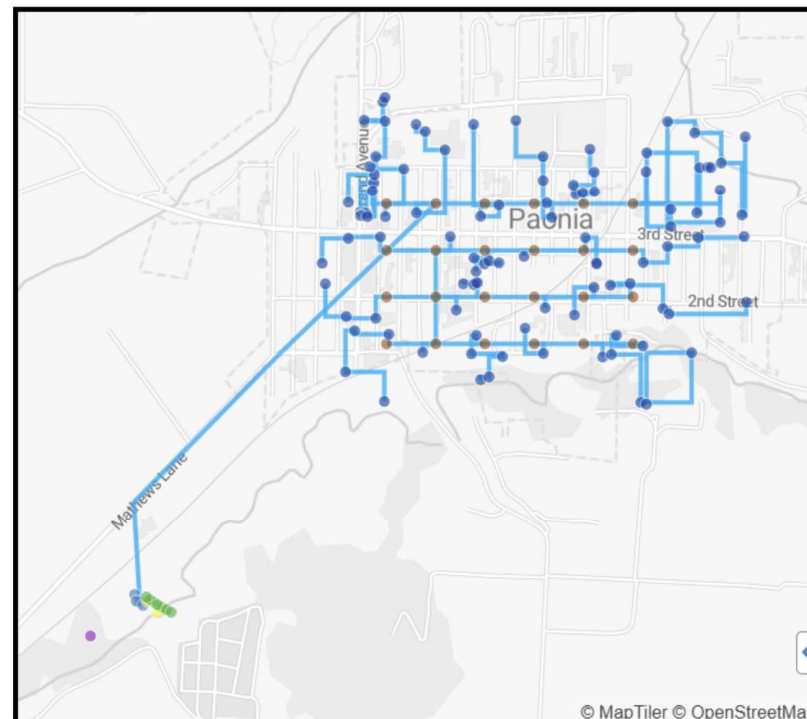
**The sanitation asset standard is
comprehensive, adaptable & fills a gap.**

The sanitation asset standard is comprehensive, adaptable & fills a gap.



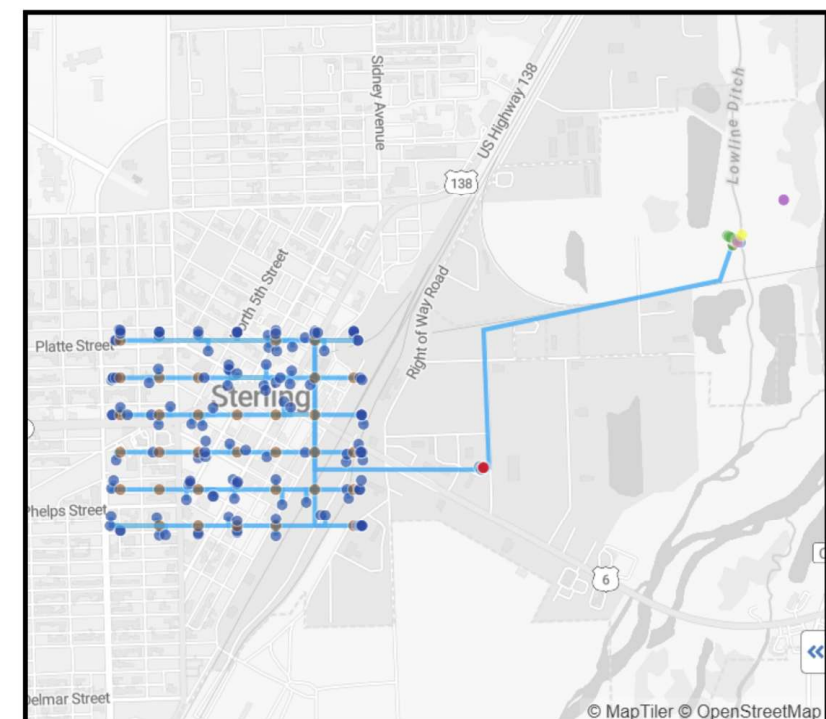
Onsite

onsite containment +
faecal sludge management



Decentralized

condominial +
DEWATS



Centralized

conventional sewer +
treatment plant

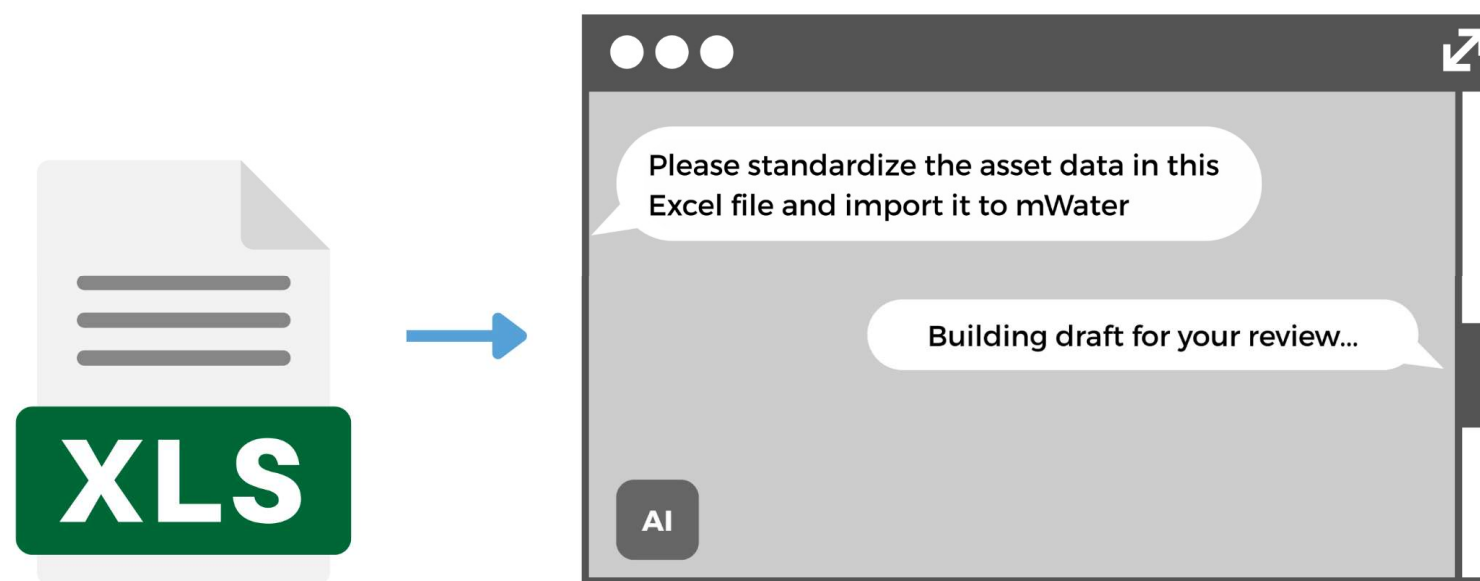
mWater's users can align their data to this standard using AI via our MCP.

mWater's users can align their data to this standard using AI via our MCP.



Your existing
asset data

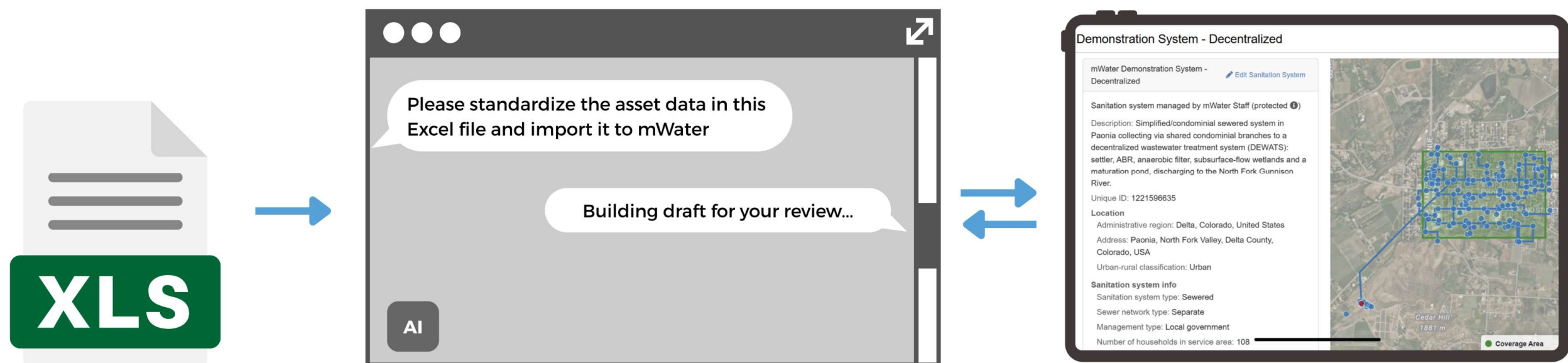
mWater's users can align their data to this standard using AI via our MCP.



Your existing
asset data

mWater **Model Context Protocol
(MCP)** server with AI model of
your choice

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Your existing
asset data

mWater **Model Context Protocol
(MCP)** server with AI model of
your choice

Outputs are directly
approved and viewed in
mWater

**Try out the new global
sanitation asset standard!**

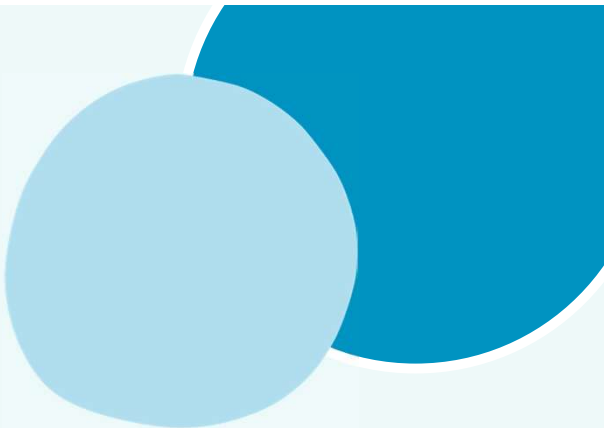


<https://go.mwater.co/sanitation>
info@mwater.co



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Next Presentation:

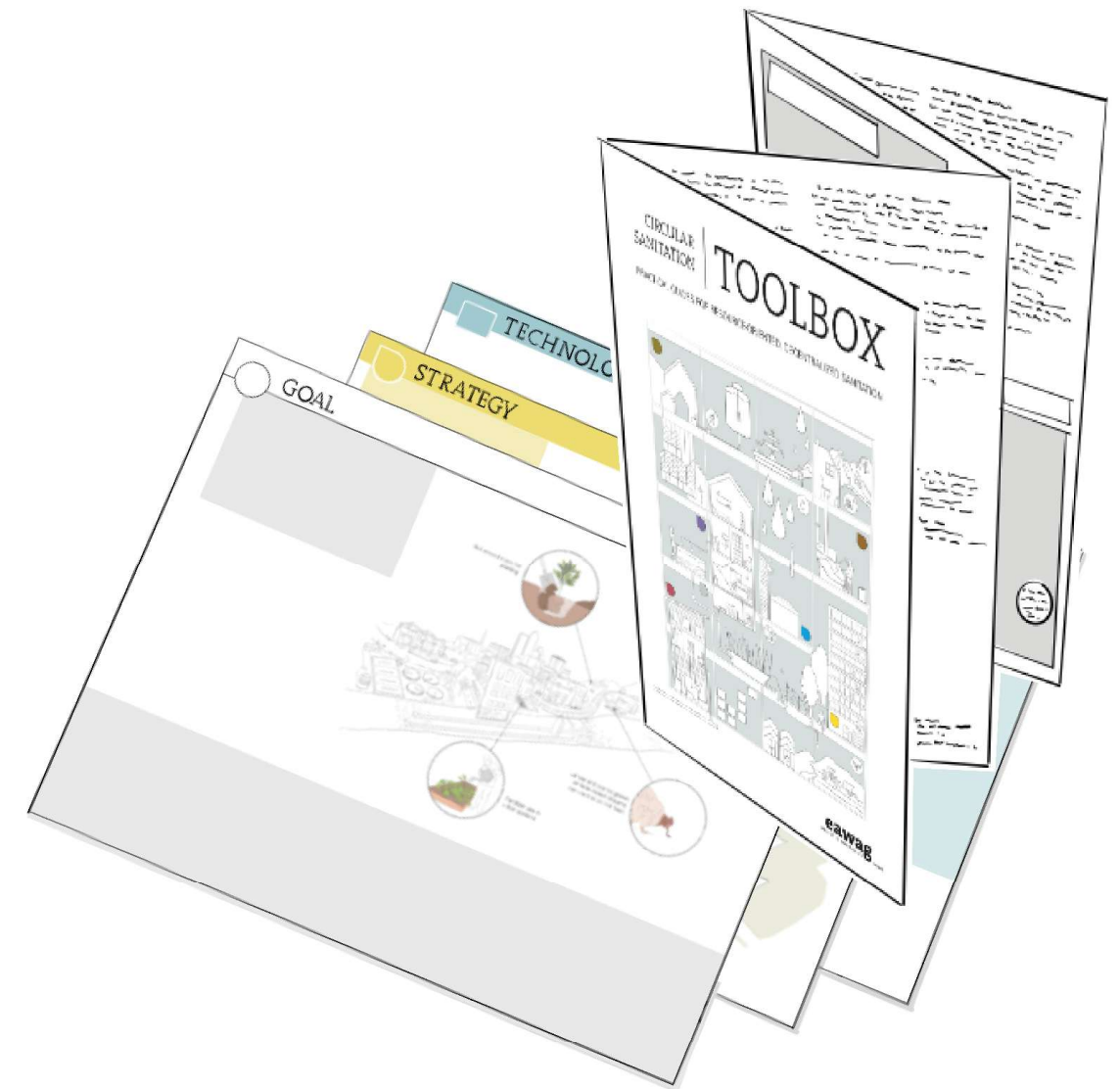
Rosanne Wielemaker – EAWAG

CIRCULAR SANITATION

TOOLBOX

PRACTICAL GUIDES FOR RESOURCE-ORIENTED, DECENTRALIZED SANITATION

Rosanne Wielemaker, Monica Conthe, Giuseppe Congiu, and Eberhard Morgenroth



SuSanA Meeting 2026
Stockholm

ROSANNE WIELEMAKER
Water Hub

Eawag, Switzerland

ooo

rosanne.wielemaker@eawag.ch
www.eawag.ch/waterhub
www.eawag.ch/en/wh/toolbox

WATER HUB @ NEST

VISION & APPROACH

Accelerate knowledge generation and transfer from science to practice on the topic of innovative water management, with a focus on resource valorisation from source-separated streams.

RESEARCH INFRASTRUCTURE

A demonstration site and laboratory for fundamental and applied research on resource oriented sanitation



EXCHANGE PLATFORM

Bridge research and practice via exchange with external stakeholders, and knowledge creation and dissemination



WATER HUB @ NEST

VISION & APPROACH

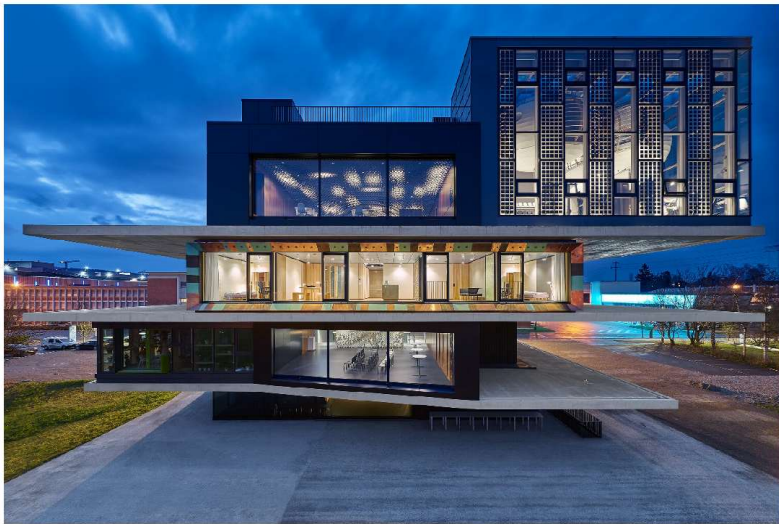
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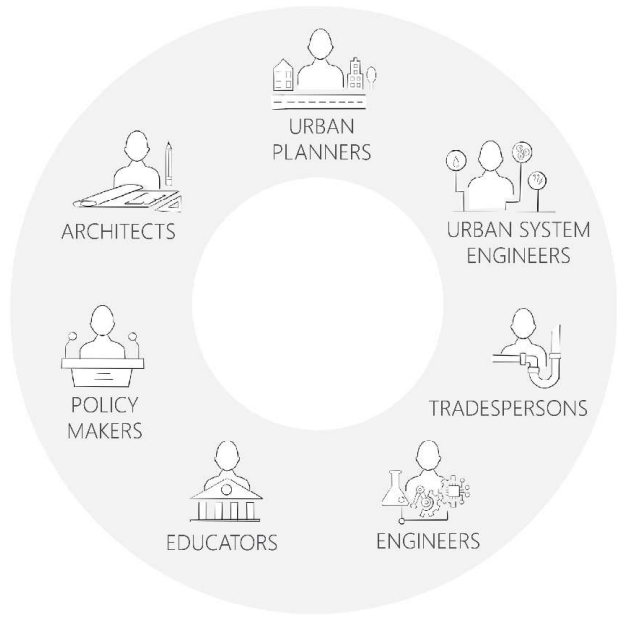


CIRCULAR
SANITATION

TOOLBOX

PRACTICAL GUIDES FOR RESOURCE-ORIENTED, DECENTRALIZED SANITATION

WHOM & WHAT



a tool that...

- helps navigate the circular sanitation option space
- simplifies access to knowledge
- provides decision support
- provides inspiration via the cataloging of case studies
- provides links to further information
- is easy to grasp and appealing to use

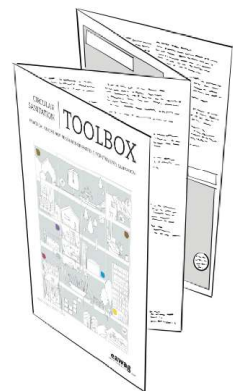


CIRCULAR SANITATION

TOOLBOX

PRACTICAL GUIDES FOR SOURCE-SEPARATED AND DECENTRALIZED SANITATION

BOOKLET

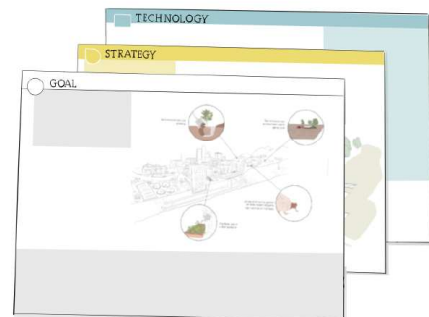


Background and scope of the toolbox

Introduction to decentralized, source-separated sanitation

Explanation of toolbox parts

GUIDES



Summarized information per goal, strategy and technology

Each guide functions as a stand-alone document

Use together to build a circular sanitation narrative



GOALS

-  SAVE WATER
-  RECOVER NUTRIENTS
-  RECOVER ENERGY
-  BUILD RESILIENT CITIES
-  DEVELOP OFF-GRID



STRATEGIES

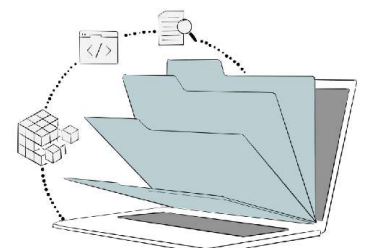
-  URINE DIVERSION
-  DRY SANITATION
-  VACUUM SANITATION
-  FLUSH SANITATION
-  WATER REUSE
-  WATER EFFICIENT FIXTURES
-  RAINWATER HARVESTING
-  HEAT RECOVERY



TECHNOLOGIES

-  T1 URINE STORAGE & PASTEURIZATION
-  T2 NITRIFICATION ON BIOCHAR
-  T3 NITRIFICATION - DISTILLATION
-  T4 STRUVITE PRECIPITATION
-  T5 AMMONIA STRIPPING
-  T21 ON-SITE COMPOSTING
-  T22 OFF-SITE COMPOSTING
-  T23 ANAEROBIC DIGESTION
-  T41 WATER TANKS | CISTERNS
-  T42 SETTLING TANKS | SCREENS
-  T43 VERMIFILTERS
-  T44 CONSTRUCTED WETLANDS
-  T45 TRICKLING FILTERS
-  T46 AERATED BIOREACTORS
-  T47 MEMBRANE BIOREACTORS
-  T48 MEMBRANE FILTERS
-  T49 GRANULAR MEDIA FILTERS
-  T50 UV & CHLORINE DISINFECTION
-  T51 OZONATION & ADVANCED OXIDATION
-  T61 HEAT EXCHANGERS | HEAT PUMPS

SUPPORTING DOCUMENTS



Case studies database

Technology and service providers per case study

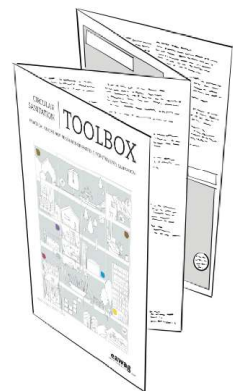
Reference documents (factsheets, guidelines, tools)

CIRCULAR SANITATION

TOOLBOX

PRACTICAL GUIDES FOR SOURCE-SEPARATED AND DECENTRALIZED SANITATION

BOOKLET

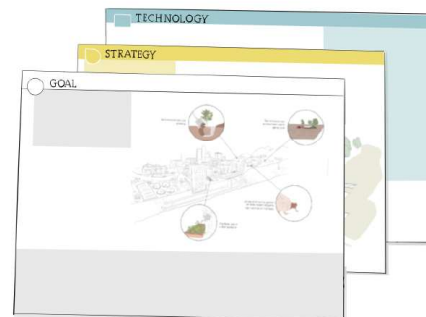


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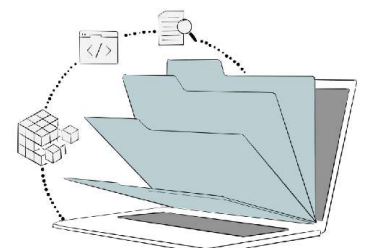
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Case studies database

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IDENTIFY GOALS

WHY DO YOU WANT TO IMPLEMENT
CIRCULAR SANITATION?

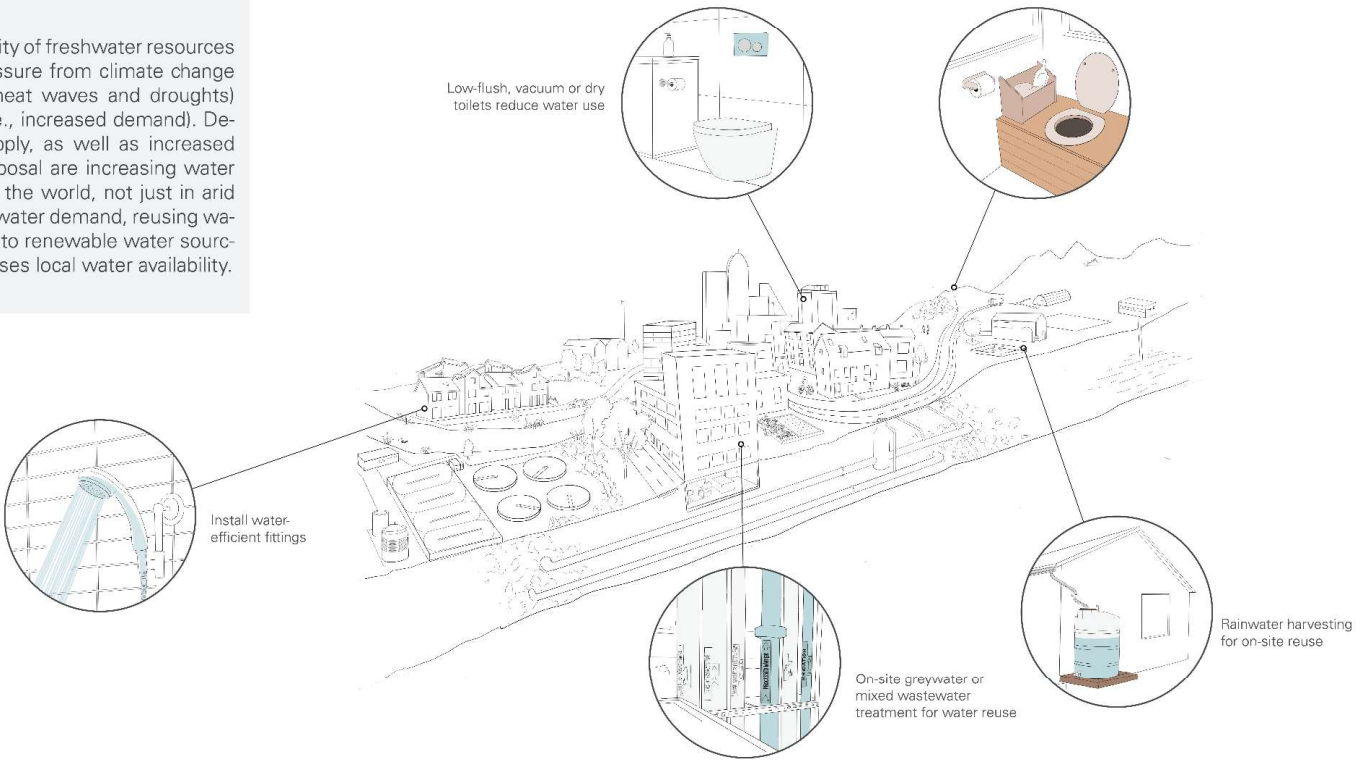
- SAVE WATER
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SAVE WATER

GOAL

The availability and reliability of freshwater resources are under increasing pressure from climate change (e.g., warmer weather, heat waves and droughts) and rapid urbanization (i.e., increased demand). Decreased and variable supply, as well as increased abstraction, use, and disposal are increasing water scarcity in many parts of the world, not just in arid environments. Reducing water demand, reusing water on site, and tapping into renewable water sources (e.g., rainwater) increases local water availability.



REDUCE WATER USE

Swap out water-intensive appliances and toilets, with waterless and water-efficient alternatives. Appliances can be anything from faucet fittings to water recirculating showers to dry or vacuum toilets. Such fixtures minimize water demand, and some also reduce the energy demand needed to heat the water.

REUSE WATER

Treat used water (e.g. greywater, blackwater, mixed water) streams to provide an alternative water supply for non-potable and potable reuse. Depending on the desired end use, water is treated to match end use demand for quality and quantity, to provide reliable and safe water supply. Reusing water minimizes demand for drinking water supply and diverts hydraulic flow to existing sewer infrastructure.

CAPTURE RAINWATER

Harvest rainwater for fit-for-purpose reuse. Depending on the desired end-use, these water sources can be treated to match end-use demand for quality and quantity, including irrigation, non-potable reuse and potable reuse. Using captured water minimizes demand for drinking water supply and diverts hydraulic flow to existing sewer infrastructure.

Circular Sanitation TOOLBOX | 2025 | © Eawag
References and further information available at www.eawag.ch/en/wh/toolbox

IDENTIFY GOALS

WHY DO YOU WANT TO IMPLEMENT
CIRCULAR SANITATION?



SAVE WATER

RECOVER NUTRIENTS

RECOVER ENERGY

BUILD RESILIENT CITIES

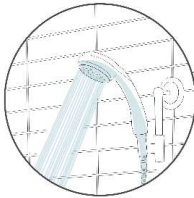
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Install water-efficient fittings

REDUCE WATER USE

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REUSE

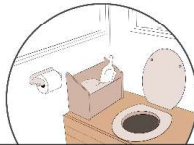
Treat use streams and pota is treated provide demand existing s



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Low-flush, vacuum or dry toilets reduce water use



eawag
aquatic research



RECOVER NUTRIENTS & ORGANIC MATTER

GOAL

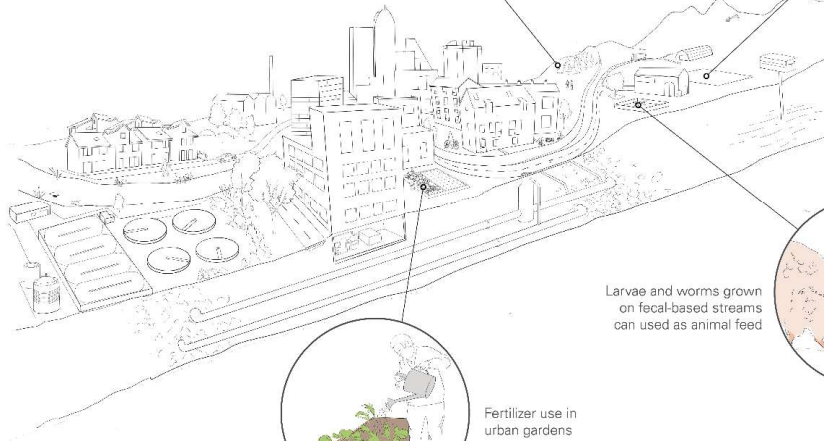
Current linear nutrient flows are characterized by: 1) cheap and resource-intensive fertilizer production that relies on fossil fuels, and finite, spatially-concentrated ore reserves, 2) food and farming systems that contribute to soil nutrient imbalances and soil organic matter depletion, and 3) and human excreta management practices that result in irretrievable losses of nutrients and organic matter to air, water, and landfills. Nutrients discharged to surface waters can cause eutrophication (algal blooms, dead zones, and fish kills). Recovering nutrients and organic matter from streams containing human excreta diverts nutrients from existing infrastructure, reduces losses, and allows for the production of renewable fertilizers and soil amendments.



Soil amendments for planting



Soil amendments and fertilizer use in agriculture



Larvae and worms grown on fecal-based streams can be used as animal feed

Fertilizer use in urban gardens

PRODUCE FERTILIZER

Separate wastewater streams containing urine and/or feces at the source to facilitate the treatment and targeted extraction of nutrients as fertilizers, minimizing pollution and losses. Recovery can target specific nutrients (often one macronutrient) or several nutrients (macro- and micronutrients). The recovered products can be reused as fertilizer in agriculture, horticulture, plant nurseries, and on sport fields.



Circular Sanitation TOOLBOX | 2025 | © Eawag
References and further information available at www.eawag.ch/en/wh/toolbox

PRODUCE SOIL AMENDMENT

Separate fecal streams at the source, or after solid-liquid separation of mixed wastewater, to aid nutrient and organic matter recovery. Treatment and recovery processes of the fecal streams, potentially combined with kitchen and/or garden waste, produce soil amendments that increase soil health and supply nutrients. Source separation also lowers pollutants, like heavy metals, compared to sludge from centralized treatment plants.



PRODUCE BIOMASS

Use streams containing urine and/or feces to grow or produce algal biomass, worms or insects (e.g., black soldier fly larvae). While algae is often grown on nutrient-rich liquids, such as urine, larvae and worms can be grown on fecal biomass and/or kitchen waste. The products can be used as, or in, animal feed, or used as soil amendments/fertilizer (e.g., algae)



EXPLORE STRATEGIES

WHICH STRATEGIES CAN YOU IMPLEMENT
TO ACHIEVE YOUR GOAL?

- URINE DIVERSION
- DRY SANITATION
- VACUUM SANITATION
- FLUSH SANITATION
- WATER REUSE
- WATER EFFICIENT FIXTURES
- RAINWATER HARVESTING
- HEAT RECOVERY

URINE DIVERSION

STRATEGY

Urine contains most nutrients and pharmaceuticals excreted, though accounts for less than 1% of the mixed wastewater flow. Diverting urine from other wastewater streams sent to sewer, reduces nutrient and micropollutant loads to centralized treatment plants  extending their operating capacity and increasing their treatment performance. Recovering nutrients  from urine to produce fertilizer can help close nitrogen, phosphorus and other nutrient cycles, and reduce reliance on synthetic fertilizers in agriculture. Urine diversion via urine-diverting flush toilets or dry toilets also enables the separate collection and treatment of blackwater via flush toilets  or feces via dry toilets . Urine diverting dry toilets, as well as waterless urinals are water efficient fixtures  that reduce water use .

INPUT STREAMS

TOILETS

PIPING | TRANSPORT

TREATMENT

TARGET OUTPUTS

Liquid fertilizer

Solid fertilizer

OFF-SITE TREATMENT
PUBLIC RESTROOMS
Switzerland | 2012

urine-diverting flush toilet

waterless urinal

ventilation (one-way to prevent ammonia loss)

urine piping

mechanical room

urine piping from neighboring buildings

BUILDING SCALE, ON-SITE TREATMENT
FORUM CHRIESBACH
Dübendorf, Switzerland | 2011

SuSanA Meeting 2026
Stockholm

ROSANNE WIELEMAKER
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EXPLORE STRATEGIES

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INPUT STREAMS

Urine

Yellow water

TARGET OUTPUTS

Liquid fertilizer

Solid fertilizer

TOILETS

Commercially available urine-diverting toilets, separate urine from feces and most flush water while waterless urinals and urine-diverting dry toilets allow for the undiluted collection of urine. Portable fixtures (e.g., funnel attachment on a jerrycan) are a low-cost urine collection option.

PIPING | TRANSPORT

Designated urine piping leads urine to a storage tank for collection at building scale. "Urinoducts" transport urine via pipes between buildings to a mechanical room, enabling neighborhood scale collection and treatment. Alternatively, collected urine can be transported in containers to a centralized treatment point (e.g., by truck). Adequate access points for collection should be considered.

TREATMENT

Treatment of the urine can take place on site or off site. On-site treatment usually takes place close to the urine collection tanks in a mechanical room in the basement. Off-site treatment can require the pumping of urine from smaller containers to larger tanks. Urine treatment integrated into the toilet/bathroom is also possible.

TO CONSIDER

COLLECTED STREAM

Approximately 0.5 m³ of urine can be collected per person per year. A urine stream collected with flushwater has a significantly larger volume. Spontaneous mineral precipitation in toilets and pipes can lead to deposit build-up and clogging. Flushing with rainwater reduces mineral precipitation compared to flushing with (calcium- and magnesium-rich) tapwater.

SPACE & PLACEMENT

Unless urine collection occurs at bathroom scale, or in portable fixtures (e.g., jerry cans), urine diversion requires designated piping. Space requirements for a mechanical room for storage and treatment depend on the volume of the collected urine and the treatment process of choice. A mechanical room is often placed in the basement.

RESOURCE INTENSITY

There are initial material, planning and installation costs for toilets, pipes, storage and treatment, which vary with the configuration and technology selected. To prevent deposit build-up and clogging of pipes, regular cleaning and maintenance is needed. In the case of urine collection in containers, transport of urine to a treatment hub should be considered. Some treatment processes (e.g., struvite precipitation) require additional chemical dosing.

NEW BUILD VS. RETROFIT

The installation of urine-diversion toilets and designated urine piping is easiest in new build planning and construction where designated piping can be incorporated into the building skeleton. However, urine diversion is possible when retrofitting buildings. The planning process is critical for a coordinated and well-executed implementation.

HYBRID VS. DECENTRALIZED

Urine diversion can be implemented in a hybrid scenario, where other streams are sent to the centralized sewer, or as part of a decentralized solution, in combination with treatment of fecal and greywater streams.

USER EXPERIENCE

Urine-diverting toilets typically require all users to sit while urinating for optimal collection and separation, though urinals are also an option. Awareness among users about appropriate cleaning products is critical for biological treatment processes and fertilizer end use of recovered products.

TREATMENT OPTIONS

Urine treatment aims to degrade organic substances (to prevent malodor and unwanted biological processes), minimize volatilization of ammonia (causing nitrogen losses, air pollution, and bad smell), remove or kill pathogens and micropollutants, and concentrate or extract nutrients. Different treatments yield urine-based fertilizers with different physico-chemical characteristics (e.g., solid/liquid; basic/acidic) and composition, suitable for different agricultural uses (e.g., hydroponics, soil injection, fertigation, broadcasting).

TREATMENT OF THE URINE STREAM

Treatment of the full urine stream yields multinutrient fertilizers. Concentration is not strictly necessary, but reduces the need for storage space and facilitates transport and fertilizer application.

NUTRIENT EXTRACTION

Processes for the targeted extraction of phosphorus and/or nitrogen from urine yield single-nutrient fertilizers which can be used directly or in fertilizer manufacturing.

SAFE END USE

PATHOGENS & PHARMACEUTICALS

Pathogens in urine mainly come from fecal cross-contamination during excretion, while pharmaceuticals, and their metabolites, come from consumed, and subsequently excreted, medication. Treatment of urine inactivates pathogens and removes pharmaceutical compounds to varying degrees depending on the treatment technology applied. It is recommended to follow safety measures during fertilizer application (lag time between last application and harvest and soil application or injection as opposed to foliar application) to further reduce risks arising from the presence of pathogens in urine based fertilizers.

Risks arising from pharmaceuticals include plant take-up of these substances, or dissipation into the environment. Targeted micropollutant removal steps, like the activated carbon filtration, ensure high removal.

PROCESS OBJECTIVES

TECHNOLOGY

PRODUCT

HYGIENIZATION

STABILIZATION

VOLUME REDUCTION

NUTRIENT EXTRACTION

T1 STORAGE | PASTEURIZATION

T2 NITRIFICATION ON BIOCHAR

T3 NITRIFICATION - DISTILLATION

T4 STRUVITE PRECIPITATION

STORED URINE

NITRIFIED URINE

CONCENTRATED URINE

STRUVITE

Circular Sanitation TOOLBOX | 2025 | © Eawag
References and further information available at www.eawag.ch/en/wh/toolbox

EXPLORE STRATEGIES

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VACUUM SANITATION

STRATEGY

Vacuum sanitation systems are based on suction for the removal of excreta with minimal water for flushing, which results in important water savings compared to flush sanitation systems. The concentration of the vacuum-collected blackwater facilitates the recovery of nutrients and valorization of organics from the stream. Compared to conventional gravity sewerage systems, vacuum sewers enable flexible piping installations regardless of topography. A growing number of neighborhoods combine vacuum sanitation with food waste management strategies for biogas production, and with water reuse and heat recovery from greywater for a holistic, off-grid solution. Implementing vacuum sanitation can help projects attain green building certificates.

INPUT STREAMS	TARGET OUTPUTS
Vacuum-collected blackwater	Biogas
	Soil amendments & fertilizers
	Treated water

TOILETS

Commercially available vacuum toilets are similar in appearance and user experience to conventional flush toilets. When flushing, a small diameter opening at the base of the toilet bowl opens, and the vacuum in the pipes "sucks" out the excreta, toilet paper, and a small amount of water used to rinse the bowl.

PIPING

Vacuum systems require pumps that generate a vacuum, or negative pressure, in the vacuum piping system. Carefully planned vacuum piping systems can cover whole neighborhoods, with central underground pumping stations keeping the pipes under constant vacuum. At a building or household scale, vacuum pumps can be located close to the toilet or within the building and can operate on demand.

TREATMENT

Treatment and recovery sites can be integrated into a building structure or in a separate treatment location. Alternatively vacuum-collected blackwater can be sent to sewer for centralized treatment.

Vacuum toilet

central vacuum pumping station

treatment site

underground vacuum piping network

NEIGHBOURHOOD SCALE
JENFELDER AU
Hamburg, Germany | 2016

vacuum pumping stations

mechanical room

BUILDING SCALE
PAE BUILDING
Portland, US | 2020

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- HEAT RECOVERY

VACUUM SANITATION

STRATEGY

Vacuum sanitation systems remove excreta with minimal water, which results in important water savings. Compared to conventional flush sanitation systems, vacuum sewers eliminate the need for large-diameter pipes. In urban areas, vacuum sewers can be installed in existing underground infrastructure, regardless of topography. In rural areas, vacuum sewers can be combined with water reuse for a holistic, green building solution.

INPUT STREAMS

- Vacuum-collected blackwater

TOILETS

Commercially available vacuum toilets use a small-diameter opening at the base of the toilet. The vacuum in the pipes "sucks" out the waste, reducing the amount of water used to rinse the toilet.

PIPING

Vacuum systems require pumps to maintain pressure. In the vacuum piping system, pumps can be placed at the building or at a central pumping station. At a building or household scale, vacuum systems can be integrated with water reuse for a holistic, green building solution.

TREATMENT

Treatment and recovery sites can be located in a separate treatment facility or in a building. Vacuum-collected blackwater can be sent to a treatment facility for reuse or to a sewer.

WATER REUSE

STRATEGY

Collecting and treating greywater or mixed wastewater for reuse in irrigation, non-potable building uses, or even potable reuse, results in significant drinking water savings. Reuse can also alleviate pressure on existing sewage infrastructures by reducing the volume of wastewater produced. Implementing water reuse can contribute credits, via water savings and blue-green infrastructure, to attain green building certificates. For holistic water management solutions, water reuse is best integrated with water efficient fixtures, rainwater harvesting, and heat recovery. Cities like Melbourne, San Francisco, Barcelona, and New York are pioneering legislative frameworks enabling widespread on-site water reuse at different scales.

INPUT STREAMS	TARGET OUTPUTS
Greywater	Treated water for non-potable reuse (toilet flushing, irrigation, infiltration, laundry)
Mixed wastewater	Treated water for potable reuse

PIPING

Building scale water reuse must consider needs for additional piping for collecting greywater (if implemented) and/or for distributing treated water to the point of use. For non-potable, in-building reuse, adequate measures should be taken to prevent cross connections and backflow between treated water pipes and drinking water pipes and to minimize microbial regrowth in storage tanks and pipes.

TREATMENT

Mechanical rooms for water treatment and recovery are typically placed in the basement for building scale reuse or at a neighboring treatment facility in larger district-scale projects. Some treatment technologies can be placed outdoors, either underground or integrated in the (urban) landscape (e.g., constructed wetlands).

The diagram illustrates water reuse at three scales. The Appliance Scale shows a bathroom with a shower and sink, with water being treated in-appliance. The Building Scale shows a multi-story building with greywater being collected and treated in a mechanical room, then reused for toilet flushing and irrigation. The District Scale shows a neighborhood with treated greywater being used at a neighboring factory. Labels include: greywater, water reuse for irrigation of rooftop garden, water reuse in cooling towers, water reuse for toilet flushing, designated piping for non-potable reuse within the building, excess wastewater, solids from primary tanks, and excess sludge to sewer, mechanical room, in-appliance water treatment, treated greywater used at neighboring factory, and APPLIANCE SCALE GULDSEMEDEN AXEL Copenhagen, Denmark | 2018.

BUILDING SCALE
THE SOLAIRE
New York City, NY, USA | 2004

DISTRICT SCALE
DE NIEUWE DOKKEN
Ghent, Belgium | 2020

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- RAINWATER HARVESTING
- HEAT RECOVERY

VACUUM SANITATION

STRATEGY

Vacuum sanitation systems remove excreta with minimal water, which results in important water savings. Compared to conventional flush sanitation systems, vacuum sewers eliminate the need for large-diameter pipes regardless of topography. In urban neighborhoods, vacuum sewers can be combined with water reuse for a holistic, off-grid water management strategy. Implementing vacuum sanitation can contribute to green building certificates.

INPUT STREAMS

- Vacuum-collected blackwater

TOILETS

Commercially available vacuum toilets use a small-diameter opening at the base of the toilet. The vacuum in the pipes "sucks" out the waste, reducing the amount of water used to rinse the toilet.

PIPING

Vacuum systems require pumps to maintain pressure. In the vacuum piping system, pumps can cover whole building or district-scale projects. At a building or household scale, vacuum pumps are located near the toilet or within the building.

TREATMENT

Treatment and recovery sites can be located in a separate treatment facility or in a separate treatment facility. Odorous blackwater can be sent to sewer treatment plants.

WATER REUSE

STRATEGY

Collecting and treating greywater or mixed wastewater for reuse in irrigation, non-potable building uses, or potable reuse, results in significant drinking water savings. Reuse can also alleviate pressure on municipal sewage infrastructures by reducing the volume of wastewater produced. Implementing water reuse can contribute credits, via water savings, to green building certificates. For holistic water management solutions, water reuse is best integrated with water efficient fixtures, rainwater harvesting, and heat recovery. In London, Melbourne, San Francisco, Barcelona, and New York, pioneering legislative frameworks enable on-site water reuse at different scales.

INPUT STREAMS

- Greywater
- Mixed wastewater

TARGET OUTPUTS

- Treated water for irrigation, infiltration, laundry, etc.
- Treated water for reuse

PIPING

Building scale water reuse must consider needs for collecting greywater (if implemented) and distributing treated water to the point of use. For non-potable reuse, adequate measures should be taken to prevent cross-connections and backflow between treated water pipes and drinking water pipes, and to minimize microbial regrowth in storage tanks and pipes.

TREATMENT

Mechanical rooms for water treatment and recovery can be placed in the basement for building scale reuse. In larger district-scale projects, treatment facilities can be placed outdoors, either underground or in the (urban) landscape (e.g., constructed wetlands).

RAINWATER HARVESTING

STRATEGY

Rainwater harvesting is the collection of rainwater from rooftops, balconies and/or other (above grade) surfaces during rainfall events. Collection is dependent on precipitation intensity, and by means of storage, collected rainwater can be used at a later point in time. Using rainwater for non-potable, even potable uses, results in drinking water savings. In off-grid locations, rainwater can be an important primary water source. Rainwater harvesting can be key to supporting urban blue-green infrastructure and is often included in sustainable building certification criteria. Rainwater harvesting can be part of a larger water saving and reuse strategy in combination with water efficient fixtures, and the reuse of greywater or mixed wastewater.

INPUT STREAMS

- Rainwater (from roofs, balconies)
- Rainwater from green roofs
- Stormwater (from lawns, pavement, roadways, etc.)

TARGET OUTPUTS

- Treated water for non-potable reuse (toilet flushing, irrigation, infiltration, laundry)
- Treated water for potable reuse

COLLECTION & STORAGE

Gutters and downspouts direct rainwater from catchment surfaces to storage tanks or ponds. Ponds additionally support local biodiversity and cooling. Pre-storage measures include debris screens, filters, and first-flush diversion. Storage helps bridge the gap between wet and dry weather, and between collection, treatment, and reuse.

TREATMENT

Rainwater can be directly reused for non-potable purposes like toilet flushing and irrigation, though treatment expands safe reuse, especially indoors. Treatment is typically done in a basement for building-scale projects or at a decentralized facility for neighborhood or district-scale systems.

PIPING & REUSE

A separate piping network distributes treated rainwater to reuse applications. For in-building non-potable reuse, precautions must prevent cross-connections and backflow between treated and drinking water pipes, and minimize microbial regrowth in tanks and pipes.

The diagram illustrates two scales of rainwater harvesting. The 'BUILDING SCALE' shows the KENDEDA BUILDING in Atlanta, GA, USA, featuring a large catchment surface on the roof with integrated gutters and downspouts. Rainwater is collected and stored in a tank/cistern, then distributed to a mechanical room and used for infiltration. The 'HOUSEHOLD SCALE' shows the TINY HOUSE in Bryon Shire, Australia, with a smaller catchment surface and a collection & storage tank. Both scales include a debris screen to filter out debris before water enters the storage tank.

BUILDING SCALE
KENDEDA BUILDING
Atlanta, GA, USA | 2017

HOUSEHOLD SCALE
TINY HOUSE
Bryon Shire, Australia | 2019

SELECT TECHNOLOGIES

WHICH TECHNOLOGY FITS YOUR
STRATEGY AND GOAL?

- T1 URINE STORAGE & PASTEURIZATION
- T2 NITRIFICATION ON BIOCHAR
- T3 NITRIFICATION - DISTILLATION
- T4 STRUVITE PRECIPITATION
- T5 AMMONIA STRIPPING
- T21 ON-SITE COMPOSTING
- T22 OFF-SITE COMPOSTING
- T23 ANAEROBIC DIGESTION
- T41 WATER TANKS | CISTERNS
- T42 SETTLING TANKS | SCREENS
- T43 VERMIFILTERS
- T44 CONSTRUCTED WETLANDS
- T45 TRICKLING FILTERS
- T46 AERATED BIOREACTORS
- T47 MEMBRANE BIOREACTORS
- T48 MEMBRANE FILTERS
- T49 GRANULAR MEDIA FILTERS
- T50 UV & CHLORINE DISINFECTION
- T51 OZONATION & ADV. OXIDATION
- T61 HEAT EXCHANGERS | HEAT PUMPS

T.3

TECHNOLOGY

urine storage tanks in adjacent room

offgas pipe (to ventilation system)

pressurized air

buffer tank

sensors

pumps

fertilizer storage tank

control system (not visible)

(1) Nitrification Reactor

(2) Granulated Activated Carbon Filter

(3) Vacuum Distiller

tank for distilled water (not shown)

distilled water

COLLECTION TANK

NITRIFICATION - DISTILLATION

Nitrification-distillation of urine, also referred to as the VUNA process, is a treatment and complete nutrient recovery technology that converts urine into a liquid nutrient fertilizer through (1) biological treatment in an aerated reactor for the stabilization of carbon and nitrogen compounds, (2) activated carbon filtration for the removal of micropollutants and (3) vacuum distillation for the concentration (down to 5-10% of the original volume) and hygienization of the stream. It is a relatively high tech solution, best suited to treat urine flows of at least 500L/day (roughly 350 p.e.). The core of the treatment is the aerated bioreactor in which microorganisms aerobically degrade organics and convert ammonium to nitrate (a process known as nitrification), with residence times between 5-10 days.

The technology can be implemented in (and potentially retrofitted into) large "nutrient hotspot" buildings to alleviate the burden of N & P removal on municipal wastewater treatment. The produced fertilizer solution contains macro- and micronutrients that can be used in agriculture.

INPUT STREAMS

Urine

Yellow water

TARGET OUTPUT(S)

Liquid Fertilizer

FORUM CHRIESBACH

Dübendorf, Switzerland | 2006

Treatment of urine from three neighboring buildings

Forum Chriesbach includes urine-diverting flush toilets, urine piping, and a storage and treatment room at the underground level, where the VUNA process was developed and optimized. In 2021, two additional campus buildings with urine-diverting flush toilets were connected via piping to the treatment room. In 2022 the treatment system was renewed and scaled to treat the increased volumes of urine. The system treats ~400L/d in a mechanical room of ~50 m².

SuSanA Meeting 2026
Stockholm | ROSANNE WIELEMAKER
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T.3

TECHNOLOGY

NITRIFICATION-DISTILLATION

Nitrification-distillation of urine, also referred to as the VUNA process, is a treatment and complete nutrient recovery technology that converts urine into a liquid nutrient fertilizer through (1) biological treatment in an aerated reactor for the stabilization of carbon and nitro-

Diagram illustrating the Nitrification-Distillation process. The system includes urine storage tanks in an adjacent room, an offgas pipe to a ventilation system, pressurized air input, a buffer tank, pumps, and a fertilizer storage tank. The process involves (1) Nitrification Reactor and (2) Granulated Activated Carbon Filter. A control system (not visible) manages the process.

SPECIFICATIONS

INFRASTRUCTURE

Nitrification - distillation can treat large volumes of urine in a relatively small space, usually in a dedicated technical room at ground or underground level so that the storage tanks can be fed by gravity piping. The system can also be placed in a technical building. If multiple buildings are connected to a single treatment station, gravity piping can be used if sufficient slope can be granted (2 - 3% slope). Alternatively, intermediate tanks and lifting pumps are needed to convey the urine to the treatment station (see T1).

Potential incentives for the implementation of urine diversion coupled with treatment by nitrification-distillation include (1) savings at wastewater treatment plants, particularly those operating at capacity, (2) returns on investment through sales of the fertilizer produced, and (3) water recovery from the distillation process.

OPERATION & MAINTENANCE

Operation and maintenance is carried out by the service provider or trained personnel. The process is automated, with a control system and a series of sensors, and can be monitored remotely.

Energy: Energy is required mainly for the distillation process, and a small amount is needed for aeration and for pumps (to pump solutions between processes).

Consumables: The granular activated carbon filter for micropollutant removal is designed to be exchanged 1-2 times/year.

Byproducts: Distilled water is the main byproduct of the treatment and can either be disposed of to sewer (it contains traces of ammonia) or treated further for water reuse.

TARGET OUTPUTS

Nitrification-distillation produces a complete liquid fertilizer, with nitrogen (ammonium nitrate) phosphorus and potassium, and a broad range of micronutrients (e.g., iron, boron, zinc). The distillation step enables reuse in agriculture by hygienizing the solution and reducing its volume, facilitating its transport and application on field. Risk of ammonia volatilization during application is low thanks to the low pH (~4) and high solubility of ammonium nitrate. Fertigation, after dilution with water, is possible. The fertilizer has been authorized for sale in Switzerland, Lichtenstein, Austria and France.

Circular Sanitation TOOLBOX | 2025 | © Eawag
References and further information available at www.eawag.ch/en/wh/toolbox

SELECTED CASE STUDIES

SAINT VINCENT DE PAUL

Paris, France | 2021

Urine diversion and treatment at neighborhood scale

The renovated "eco-district" of Saint Vincent de Paul will include urine diversion on a neighbourhood scale to reduce the pressure on the municipal wastewater treatment plants discharging to the Seine. The urine piping system, consisting of three gravity pipes (spanning 500m) and one pressurized pipe with a pumping station, was built in 2021, before renovations and new construction. A treatment room in the basement will treat the collected urine from the urine diverting flush toilets and urinals. The fertilizer produced will be used by the parks and gardens services of the City of Paris.

KREISWERKE BARNIM (ZIRKULIERBAR)

Eberswalde, Germany | 2023

Nitrification-distillation of collected urine in centralized location

Urine collected from public composting toilets and waterless urinals is transported to a recycling center. The urine is stored in IBC tanks next to a shipping container which houses the technology. The produced liquid fertilizer will be used in field tests in nearby agriculture.

EUROPEAN SPACE AGENCY

Paris, France | 2023

Nitrification-distillation fit into newly refurbished office building

During the complete renovation of ESA's headquarters in 2023, urine diverting toilets and a dedicated urine piping system were installed. A nitrification-distillation system, set up in a technical room in the basement of the building, treats the yellow water from the building's 72 toilets and converts it into the liquid fertilizer known as "Aurin". The system is designed to process 200L/d.

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T.23

ANAEROBIC DIGESTION

TECHNOLOGY

biogas

gas collector

effluent pipe (via drum filter to nutrient recovery steps)

UASB reactor for vacuum-collected blackwater

blackwater sludge tank

sludge blanket

sludge bed

blackwater inlet

excess sludge to sludge tank

anaerobic CSTR for kitchen waste

Anaerobic digestion is the degradation of organic matter by microorganisms in the absence of oxygen. The technology is well-suited for wastewater and wastes with high levels of organic matter, yielding biogas, a mix of 50-75 % methane (CH₄) and 25-50 % carbon dioxide (CO₂), a reduced and stabilised sludge volume and an effluent. Anaerobic digestion spans a four-stage process in which different bacteria work to break down the carbohydrates, proteins and fats into sugars, acids, and finally, biogas. Temperature, sludge retention time (SRT) and pH are determining parameters for process performance. Typical anaerobic reactor configurations for concentrated separated household streams include Upflow Anaerobic Sludge Bed (UASB) reactors, Anaerobic Baffled Reactors (ABRs) and Continuous Stirred-Tank Reactors (CSTRs). These anaerobic reactors vary in design, operation, retention time, and biogas production.

Biogas can be used as a renewable energy source (heat and electricity). Methane is a greenhouse gas 28 times more potent than carbon dioxide. Recovering it can avoid its emission to the atmosphere.

INPUT STREAMS	TARGET OUTPUT(S)
Blackwater	Biogas
Dewatered mixed wastewater	Solid Fraction, Sludge
	Liquid Fraction, Effluent

OCEANHAMNEN, RECOLAB
Helsingborg, Sweden | 2021

Two anaerobic digesters to treat blackwater and kitchen waste

This waterfront development that has a “three-pipes out” collection of greywater, vacuum-collected blackwater and kitchen waste scaled for 2100 p.o., treated at the Recolab building. The blackwater is anaerobically treated in a UASB. The sludge is sent to the wastewater treatment plant next door for further treatment. The effluent undergoes struvite precipitation and ammonia stripping for nutrient recovery; it is then treated with the greywater for water reuse.

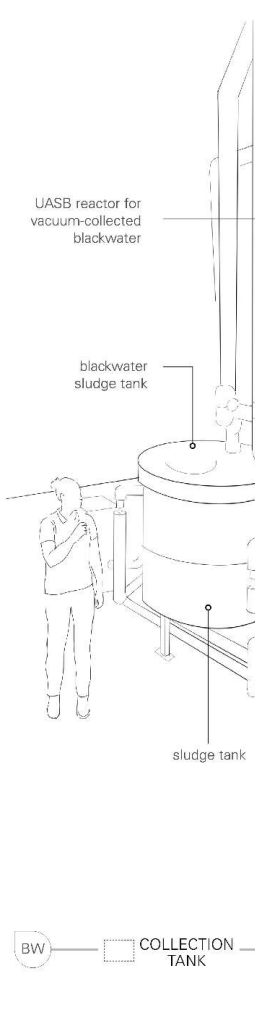
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- T1 URINE STORAGE & PASTEURIZATION
- T2 NITRIFICATION ON BIOCHAR
- T3 NITRIFICATION - DISTILLATION
- T4 STRUVITE PRECIPITATION
- T5 AMMONIA STRIPPING
- T21 ON-SITE COMPOSTING
- T22 OFF-SITE COMPOSTING
- T23 ANAEROBIC DIGESTION
- T41 WATER TANKS | CISTERNS
- T42 SETTLING TANKS | SCREENS
- T43 VERMIFILTERS
- T44 CONSTRUCTED WETLANDS**
- T45 TRICKLING FILTERS
- T46 AERATED BIOREACTORS
- T47 MEMBRANE BIOREACTORS
- T48 MEMBRANE FILTERS
- T49 GRANULAR MEDIA FILTERS
- T50 UV & CHLORINE DISINFECTION
- T51 OZONATION & ADV. OXIDATION
- T61 HEAT EXCHANGERS | HEAT PUMPS

T.23 TECHNOLOGY

ANAEROBIC DIGESTION



UASB reactor for vacuum-collected blackwater

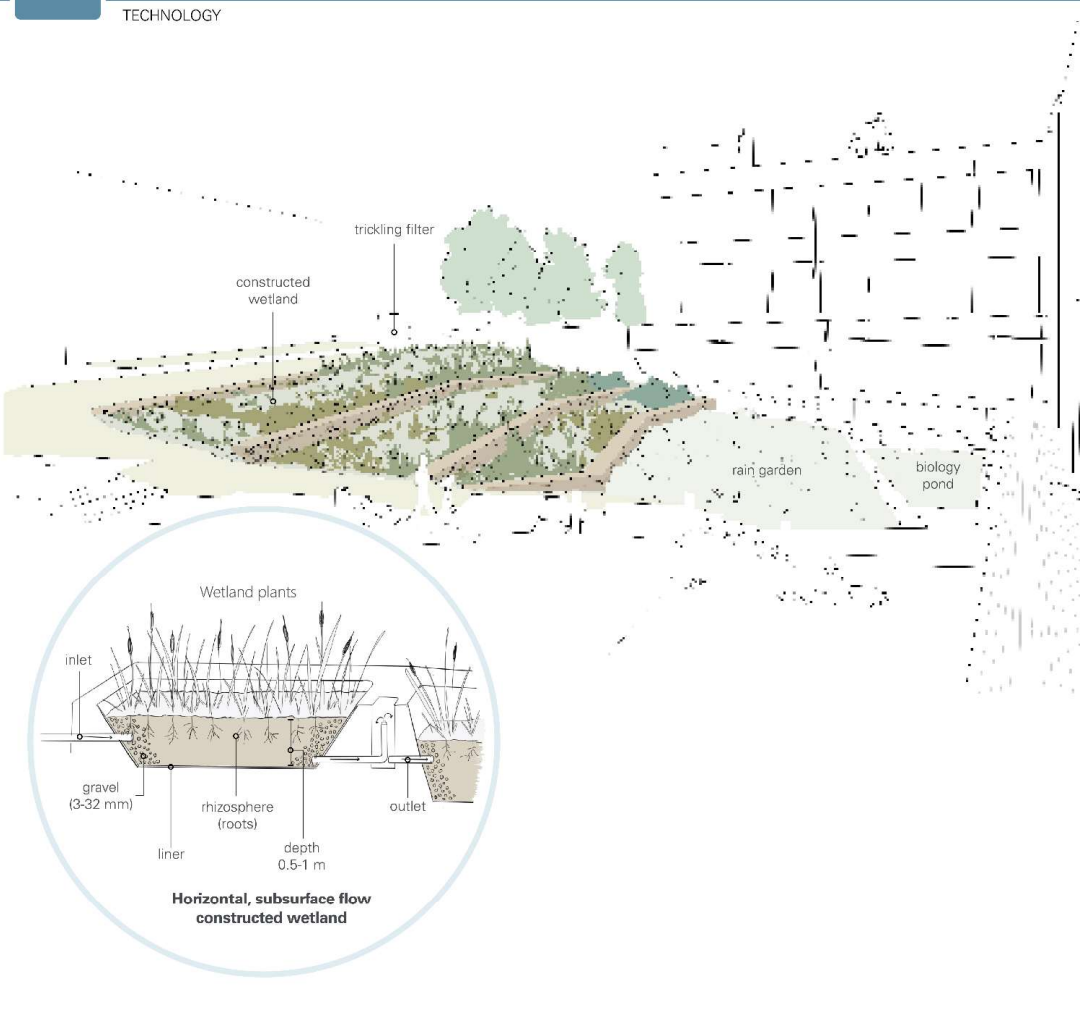
blackwater sludge tank

sludge tank

COLLECTION TANK

T.44 TECHNOLOGY

CONSTRUCTED WETLANDS



trickling filter

constructed wetland

rain garden

biology pond

Wetland plants

inlet

gravel (3-32 mm)

rhizosphere (roots)

liner

depth 0.5-1 m

outlet

Horizontal, subsurface flow constructed wetland

Constructed wetlands (also referred to as artificial marshes, reed filters, or heliophyte filters) are engineered marshes that mimic natural wetland mechanisms to improve water quality. Constructed wetlands consist of sealed basins filled with permeable filter substrate (soil, rock, gravel, sand, etc.) and planted with reeds and plants adapted to water-saturated conditions, called macrophytes. The water either flows over the surface of the wetland or through the porous substrate, horizontally or vertically. The material, colonized by microorganisms, allows for sorption and biological degradation of nutrients and contaminants; the plants serve to maintain the permeability of the filter, keep it aerated, assimilate nutrients, and provide a habitat for microorganisms. The treatment train for a constructed wetland often includes pre- and post-treatment steps.

Wetlands are low-tech, nature-based solutions that in addition to treating water, offer ecosystem services, and have recreational and aesthetic value. Wetlands can be integrated into the urban environment to support biodiversity, store water, and provide local cooling.

INPUT STREAMS	TARGET OUTPUT(S)
Pre-treated Greywater	Treated Water
Pre-treated Mixed Wastewater	
Rainwater	

SIDWELL FRIENDS MIDDLE SCHOOL
Washington DC, USA | 2007

Wetland treatment for mixed wastewater at urban school

This LEED Platinum-certified school treats mixed wastewater from toilets and sinks through a series of physical and biological technologies. The gravity-fed wetland (3600 m²) treats 11 m³ per day, circulating through the entire treatment train for 3-5 days before reuse (toilet flushing and irrigation). Pre- and post-treatment steps take place in the basement. The school has reduced their water consumption by 90%. The wetland, rain garden and biology pond are used in the school curriculum.

MW — T42 SETTLING TANK — T44 CONSTRUCTED WETLAND — T45 TRICKLING FILTER — T49 SAND FILTER — T50 UV DISINFECTION —

SELECT TECHNOLOGIES

WHICH TECHNOLOGY FITS YOUR
STRATEGY AND GOAL?

- T1 URINE STORAGE & PASTEURIZATION
- T2 NITRIFICATION ON BIOCHAR
- T3 NITRIFICATION - DISTILLATION
- T4 STRUVITE PRECIPITATION
- T5 AMMONIA STRIPPING
- T21 ON-SITE COMPOSTING
- T22 OFF-SITE COMPOSTING
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- T61 HEAT EXCHANGERS | HEAT PUMPS

T.23 TECHNOLOGY

UASB reactor for vacuum-collected blackwater

blackwater sludge tank

sludge tank

COLLECTION TANK

BW

T.44 TECHNOLOGY

Wetland

inlet

gravel (3-32 mm)

rhizosph (roots)

liner

Horizontal, construi

MW

T42 SETTLING TANK

T.47 TECHNOLOGY

biological reactor

screen

excess sludge pump

aeration pipe

ultrafiltration membranes

treated water tank

control panel

skid and chemicals for membrane backwashing

GW

T42 SCREEN

T47 MBR

T50 UV DISINFECTION

A membrane bioreactor (MBR) combines biological treatment with membrane filtration. In the aerated bio-reactor, microorganisms degrade organics and remove nutrients (see T46 for more information on aerated bioreactors). The subsequent microfiltration or ultrafiltration membranes (pore sizes ~0.01–0.1 microns) physically separate suspended solids and microorganisms (see T48 for more information on membrane filtration), and eliminate the need for a clarification step. Membranes (flat sheet or hollow fiber) can be directly submerged in the biological tank, or placed in a dedicated membrane tank. MBRs are compact systems, compared to other bioreactor configurations, that ensure a high quality effluent that is often already suitable for some types of non-potable reuse. The treated water can be further disinfected or treated for micropollutant removal or desalination.

MBRs provide effective biological treatment and filtration in one system, producing high quality treated water in a relatively small footprint. They are therefore often the preferred solution for water reuse projects in urban settings where space is limited.

INPUT STREAMS	TARGET OUTPUT(S)
GW Pre-treated Greywater	Treated Water
MW Pre-treated Mixed Wastewater	
SW Stormwater	

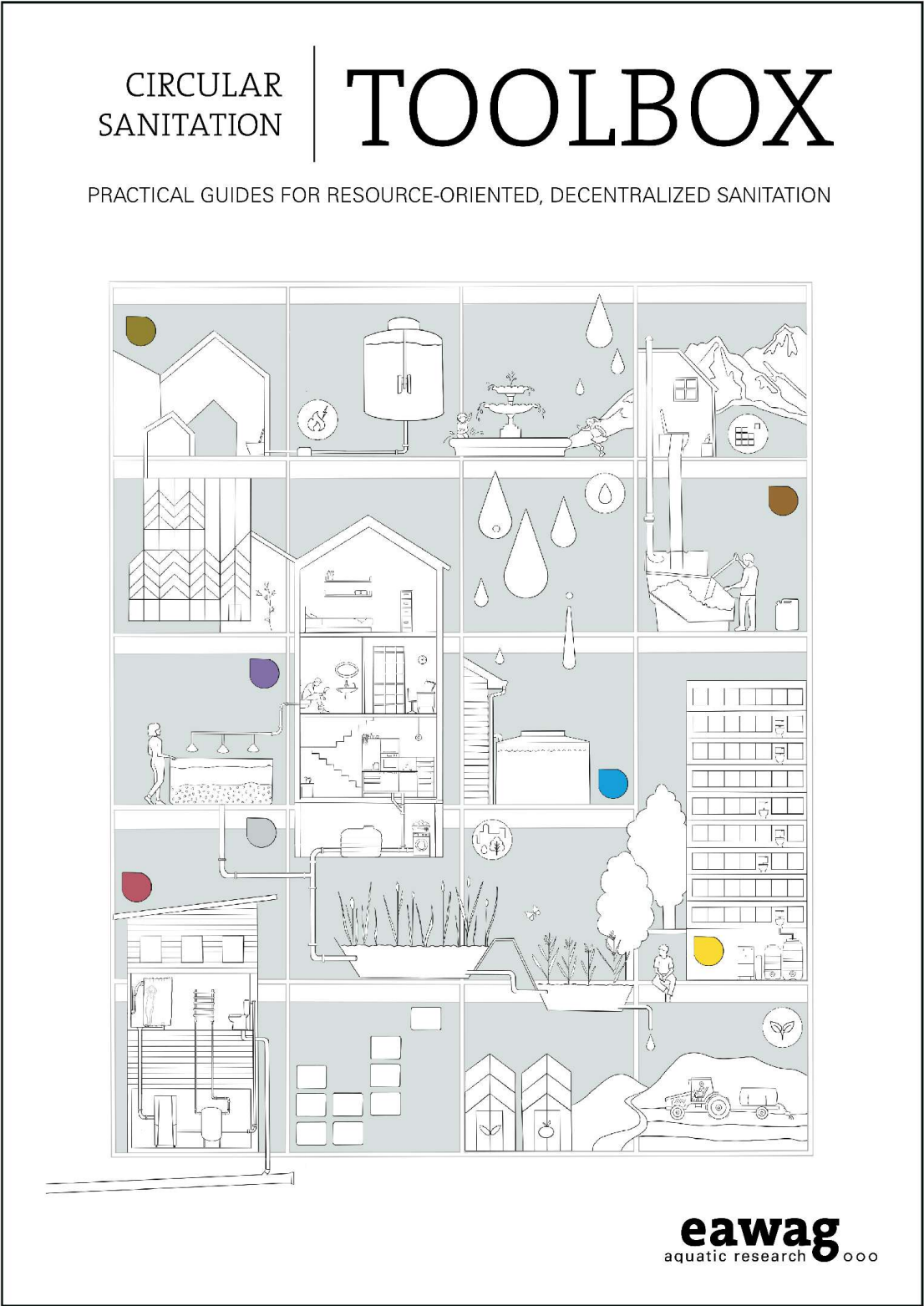
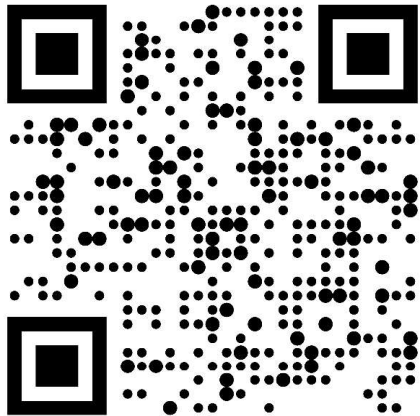
GUESTHOUSE
Schleswig-Holstein, Germany | 2021

Greywater treatment and reuse
Source-separated greywater from a guesthouse serving 62 users is treated with a membrane bioreactor followed by UV disinfection. The treatment system is located in the basement of the building. The treated water is used to cover the water demand (~1.5 m³/d) for toilet flushing (35 toilets) and running two large washing machines.

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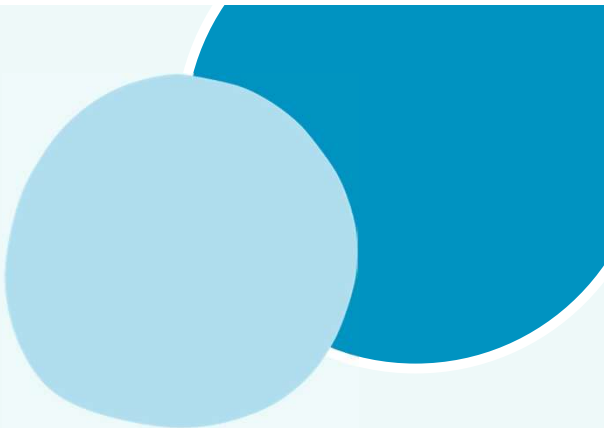
www.eawag.ch/en/wh/toolbox





Session 2

Innovations, Tool, and Sector Updates



Next Presentation:

**Daniela Alzate Amú – Stockholm
Environmental Institute**

Reuse by the numbers:

A decision-support tool for evaluating the agricultural reuse potential of treated wastewater

Luz Daniela Alzate Amú

Stockholm Environment Institute

36th SuSanA Meeting



When we talk about agricultural reuse

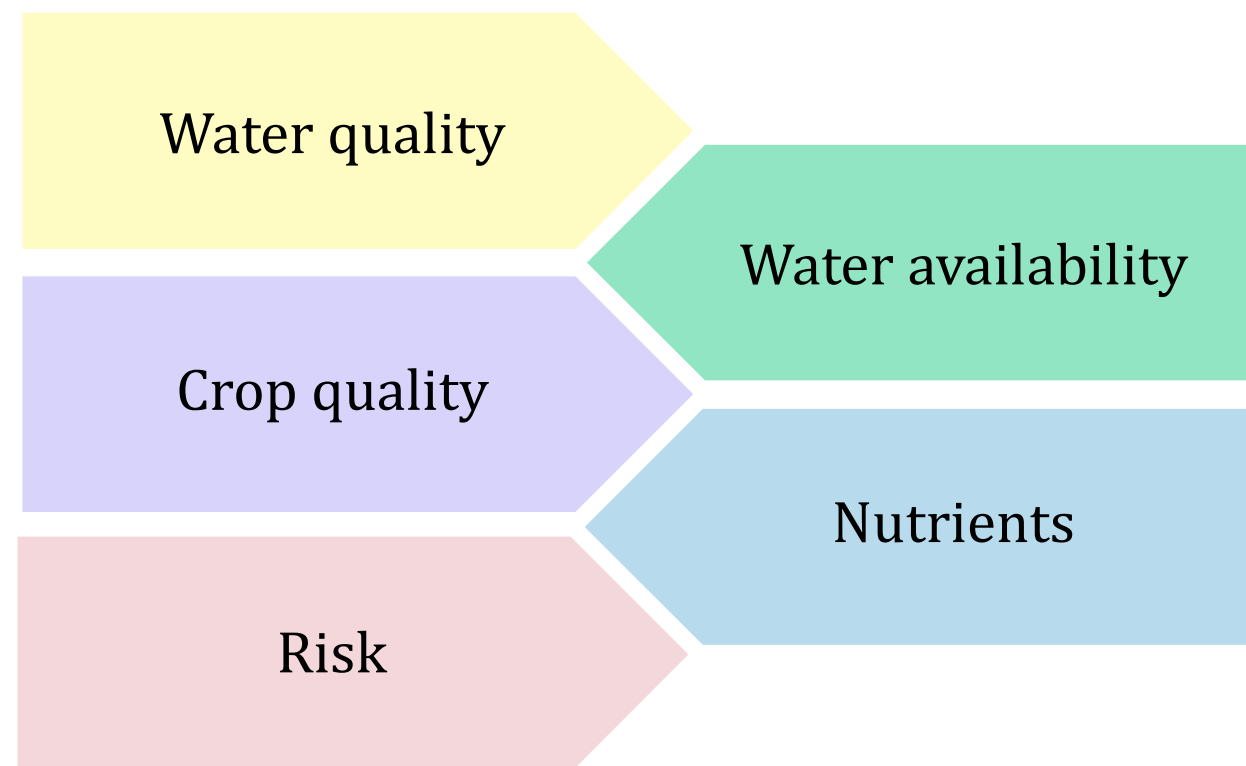


Photo: Fernanda Sanchez. Chinchaya, Bolivia

When we talk about agricultural reuse

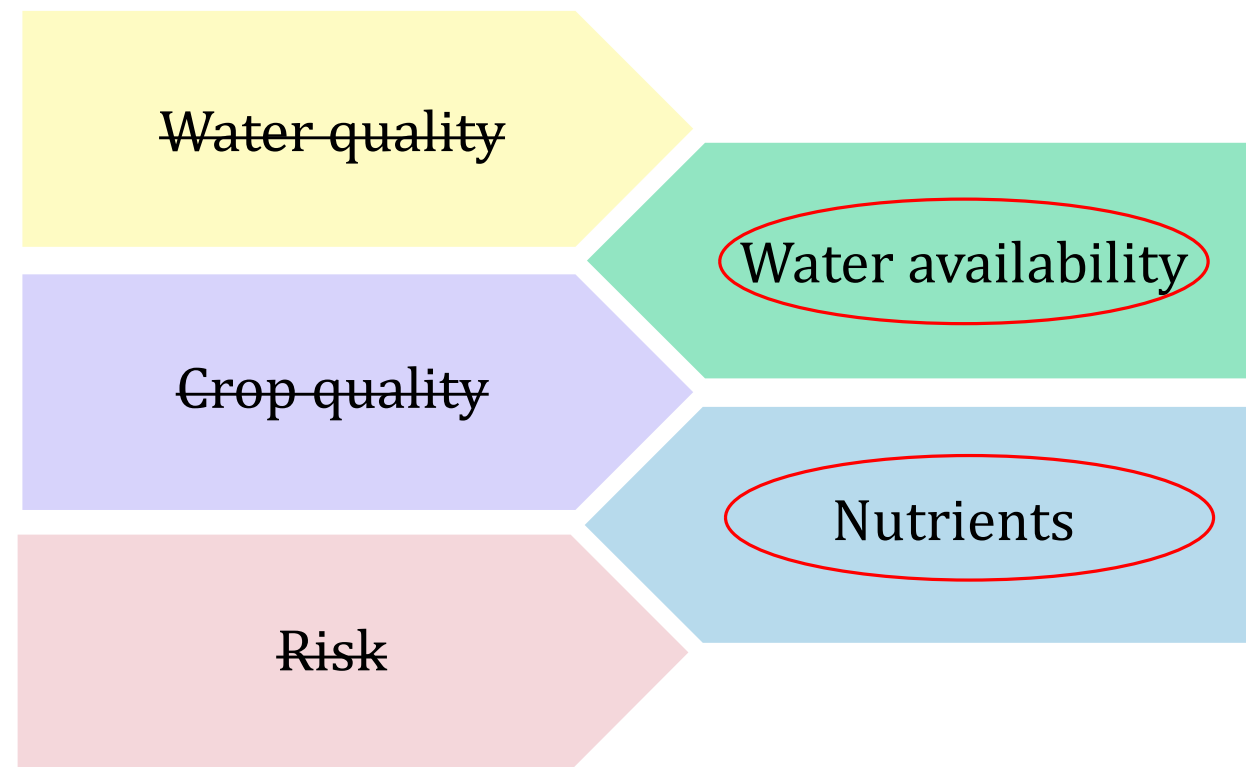
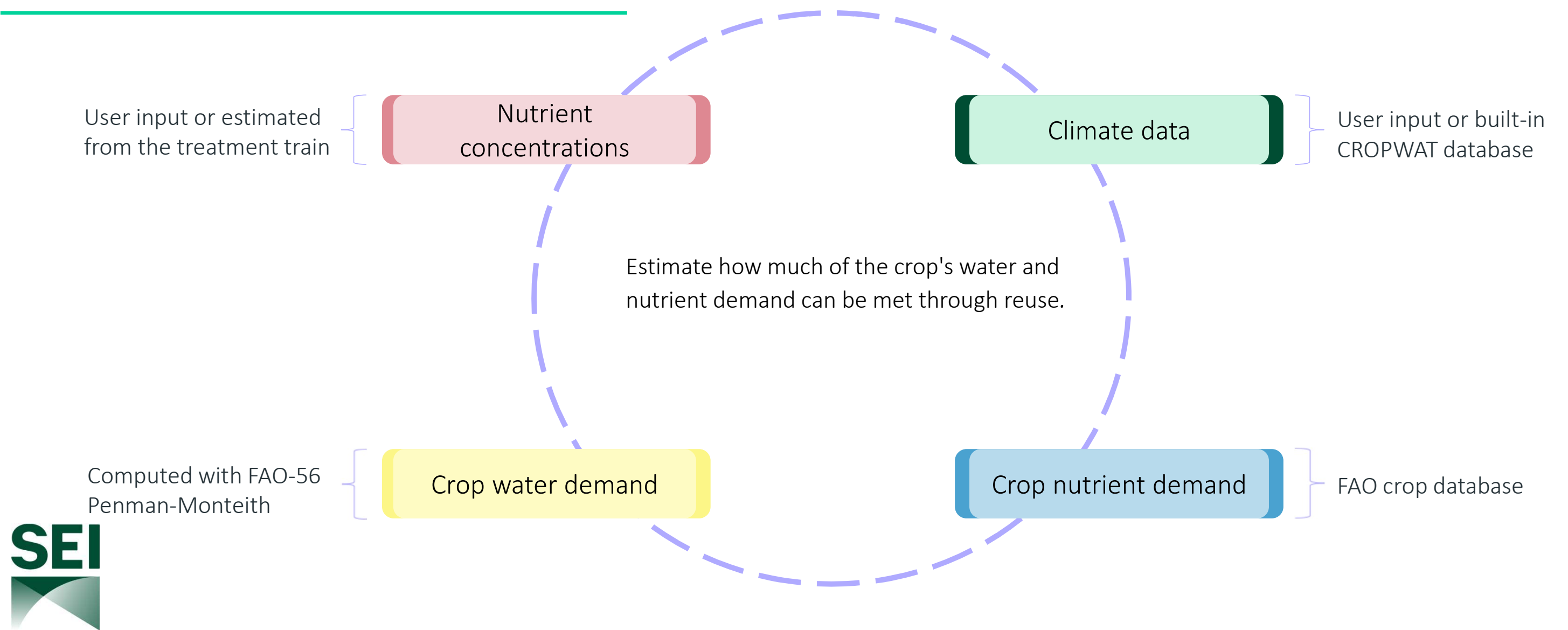


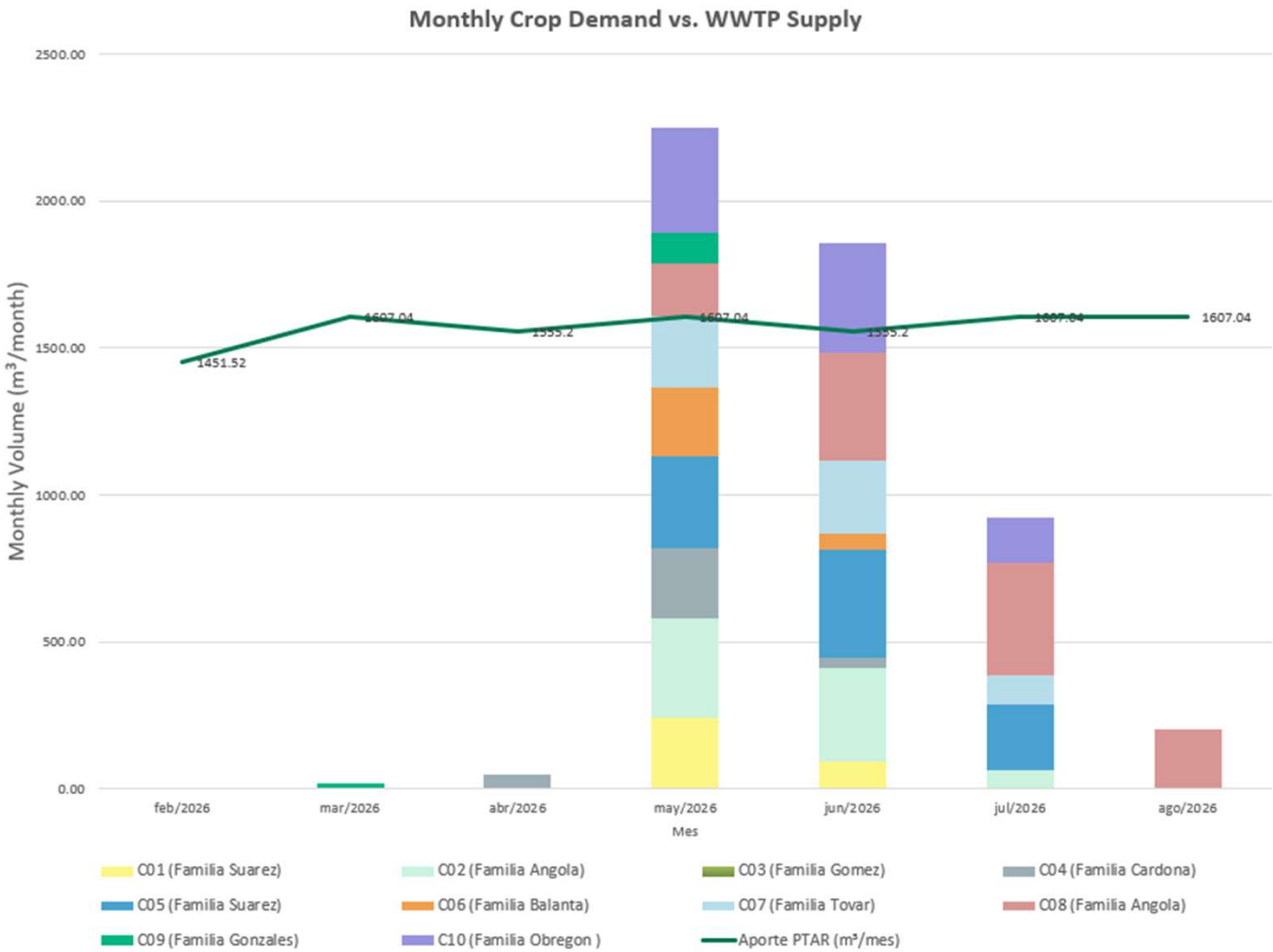
Photo: Fernanda Sanchez. Chinchaya, Bolivia

NARIA - Nutrients and Wastewater for Agricultural Irrigation



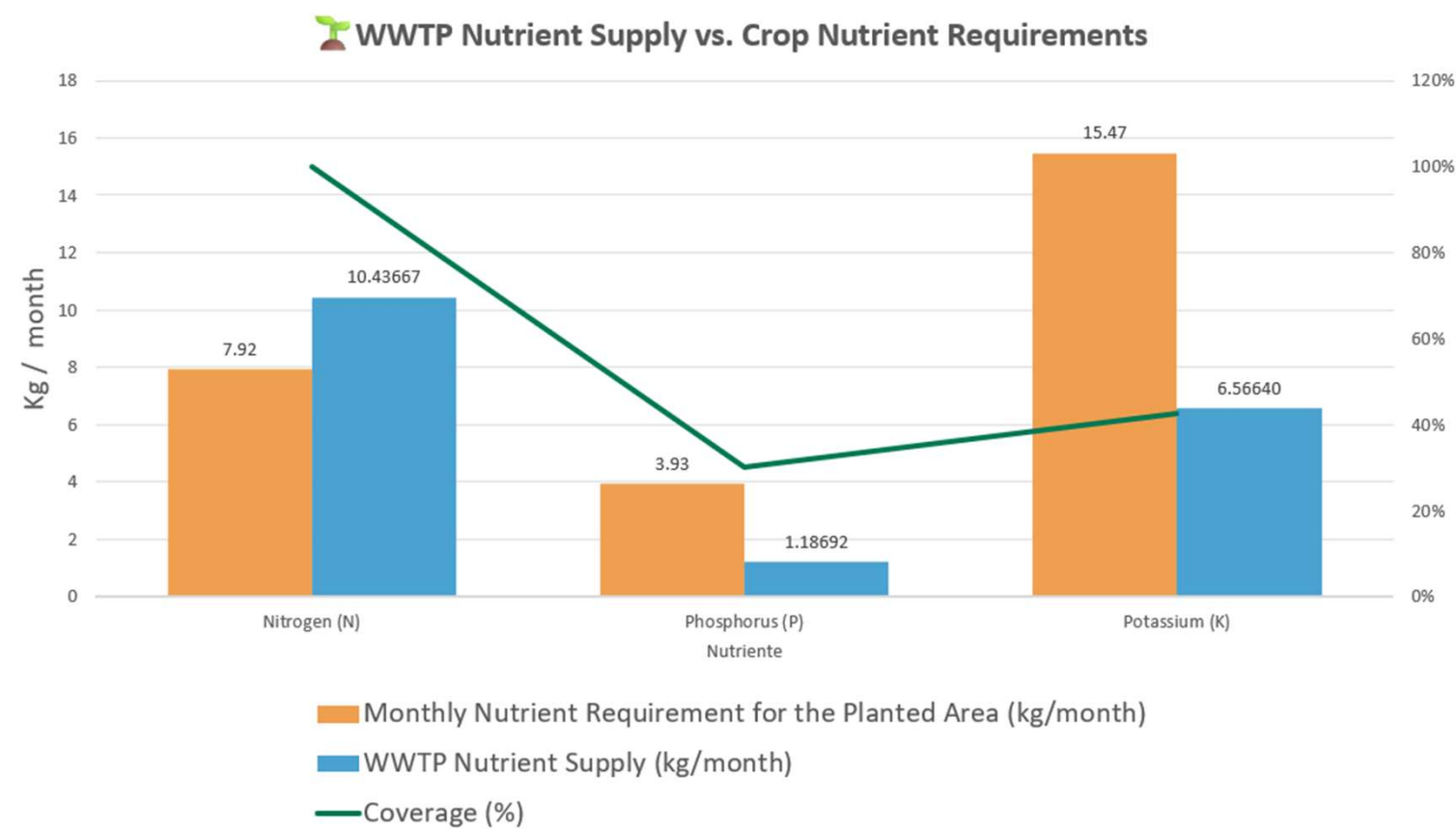
How much water?

- Not just whether water is enough, but in which specific months it falls short, and how much would be needed from an alternative source.
- In which months water is left over, to assess how much could be stored for the dry season.
- Which crop needs the most water, and when.
- And for one crop under a given allocated flow: how much area could actually be planted.



How many nutrients?

- It estimates what share of the crop's nutrient requirement is met by the wastewater — nutrient by nutrient, for N, P and K.
- It shows in which months the nutrient demand is covered and in which it is not — so complementary fertilization can be timed.



How many opportunities?



Estimating fertilizer savings



Estimating water not withdrawn



NARIA makes visible, in advance, the benefits we so often talk about when we talk about reuse



This could increase interest not only in wastewater reuse, but also in the implementation of the treatment plants that make it possible.



Photo: Fernanda Sanchez. Chinchaya, Bolivia

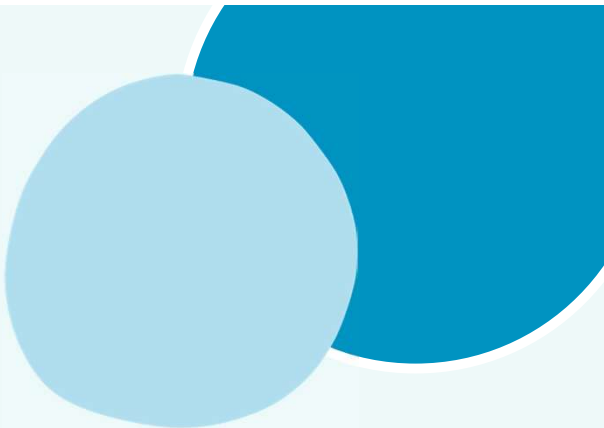


A benefit that can be measured is a project that can be defended



Session 2

Innovations, Tool, and Sector Updates



Next Presentation:

**Angelique Muhawenimana –
Kosmotive**

36TH SuSanA MEETING

Achieving SDG 6.2 on Sanitation Beyond 2030

Bridging the Gap Between Policy and Implementation

From community-level barriers to menstrual hygiene management, local innovation, and inclusive, people-centered sanitation systems



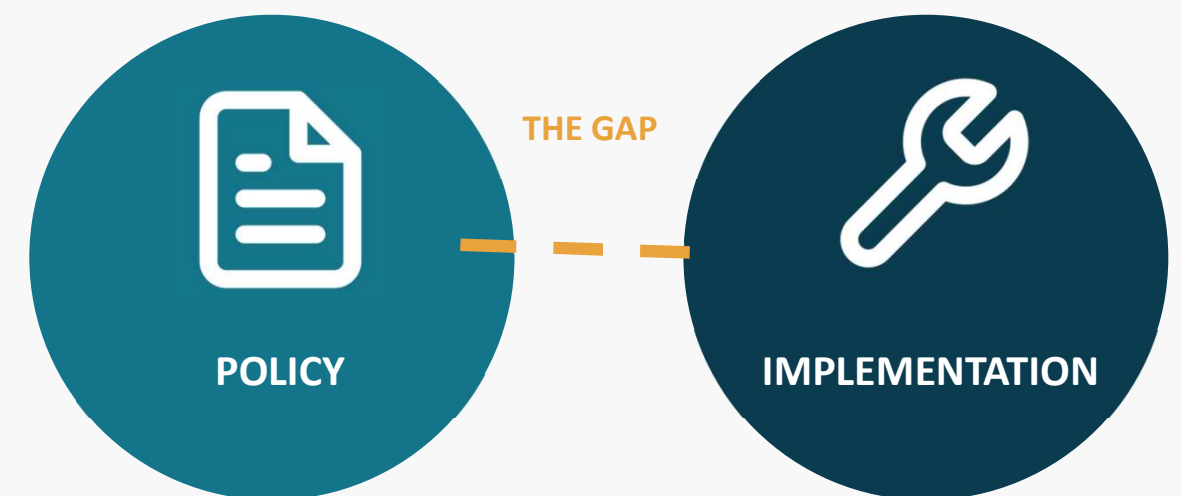
Sustainable Sanitation Alliance | 2026

Angelique MUHAWENIMANA , Kosmotive Ltd

THE CORE CHALLENGE

Policies Exist. Implementation Doesn't Follow.

Progress toward SDG 6.2 remains insufficient despite sanitation policies existing in many countries. The primary barrier is no longer the absence of policy frameworks. It is the persistent gap between policy commitments and effective implementation at community level.



Reframing sanitation



Beyond infrastructure and toilets. It also includes hygiene practice, dignity, gender equity, health education, and social inclusion.

A BROADER DEFINITION

Sanitation Is More Than Toilets

A truly effective response integrates five interconnected dimensions especially critical in low-resource settings where vulnerable populations face persistent barriers to safe, dignified sanitation.



**Hygiene
Practices**



Dignity



**Gender
Equity**



**Health
Education**



**Social
Inclusion**

The Scale of the Crisis

700M

people in Sub-Saharan Africa still
lack safely managed sanitation
services

*Interconnected barriers stall progress
even where policy exists*



Inadequate funding



Weak institutional coordination



Rapid population growth &
urbanization



Climate-related challenges



Limited community engagement



Social & cultural stigma

A NEGLECTED COMPONENT

Menstrual Hygiene: Not Just a Women's Issue

Menstrual hygiene management (MHM) is a sanitation, public health, education, and human-dignity issue, yet it remains one of the most overlooked components of sanitation systems and policy implementation.

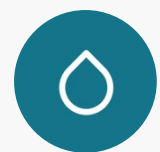
Where MHM support is absent, the consequences compound:



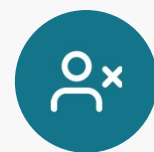
School absenteeism



Reduced confidence
among girls



Poor hygiene outcomes



Social exclusion



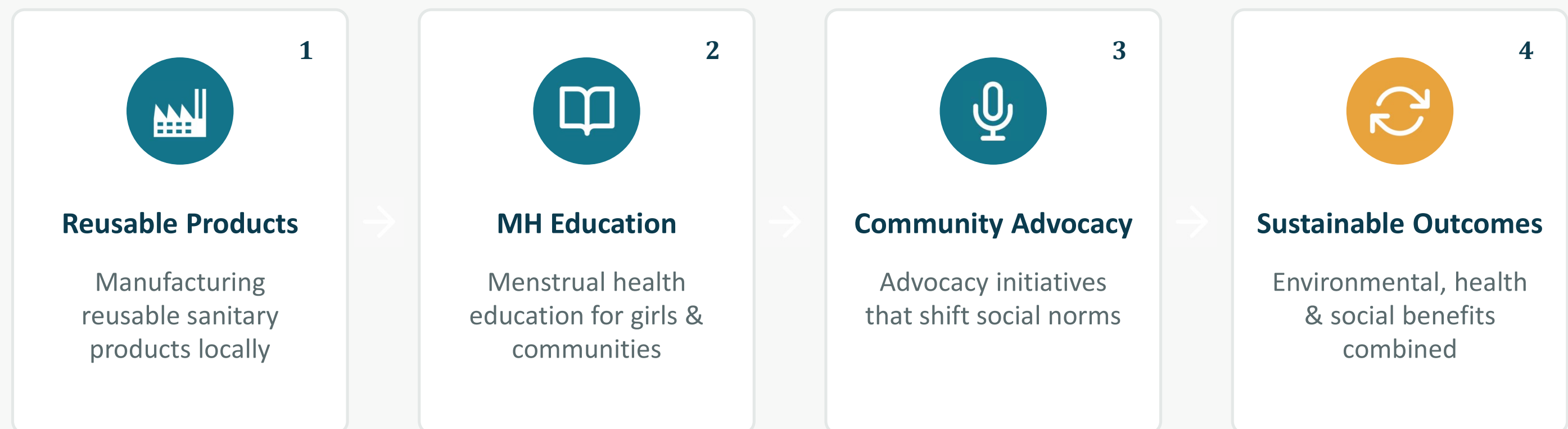
This perspective expands traditional sanitation discourse by integrating gender-responsive and inclusive approaches — approaches too often overlooked in policy implementation.

MHM AS A SANITATION & DIGNITY PRIORITY

LOCAL INNOVATION SPOTLIGHT

Kosmotive Ltd: Products, Education, Advocacy

A locally driven enterprise advancing sustainable sanitation solutions through the manufacture of reusable sanitary products, menstrual health education, and community advocacy initiatives.



Access to products + awareness creation + behaviour-change communication = sustainable, scalable impact for women and girls.



Voices from the Field

Field-based community experience provides practical evidence of existing knowledge gaps and underscores the importance of continuous engagement with vulnerable groups.

Communities are willing to participate in sanitation and menstrual health initiatives when solutions are accessible, culturally sensitive, and supported by education this linking theoretical discussion with real community realities.

Accessible

Culturally Sensitive

Education-Supported

Community-Willing

STRATEGIC ALIGNMENT

Why This Matters to SuSanA

The integration of MHM into sanitation programming aligns closely with SuSanA's objectives of promoting sustainable and equitable sanitation systems worldwide.



Inclusive Sanitation



**Menstrual Hygiene &
Gender Equity**



**Community-Centered
Implementation**



Local Innovation



Youth Engagement



**Behaviour Change
Communication**



**Govt – NGO – Enterprise
Partnerships**

RECOMMENDATIONS

Potential Contributions to SuSanA

01



Strengthen MHM Advocacy

Reinforce advocacy efforts around menstrual hygiene integration across sanitation programming.

02



Share Product Knowledge

Support knowledge exchange on reusable menstrual products and locally manufactured solutions and we are ISO 9001 certified.

03



Community-Led Approaches

Encourage community-led sanitation approaches grounded in accessibility and cultural context.

04



Cross-Sector Collaboration

Promote collaboration between local innovators and international sanitation actors.



Beyond 2030: A People-Centered Path Forward

Achieving sustainable sanitation will require inclusive, locally adapted, and people-centered solutions, not infrastructure-focused interventions alone.

Thank you

36th SuSanA Meeting | Questions & Discussion Welcome

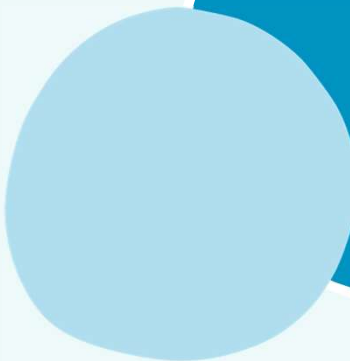


Scan here for Kosmotive



Session 2

Innovations, Tool, and Sector Updates



Next Presentation:

James Wallace – University of Leeds

Monitoring Climate-Resilient WASH JMP/GLAAS

Developing globally applicable indicators to monitor climate resilience across WASH systems.

36th SuSanA Meeting 22nd August 2026

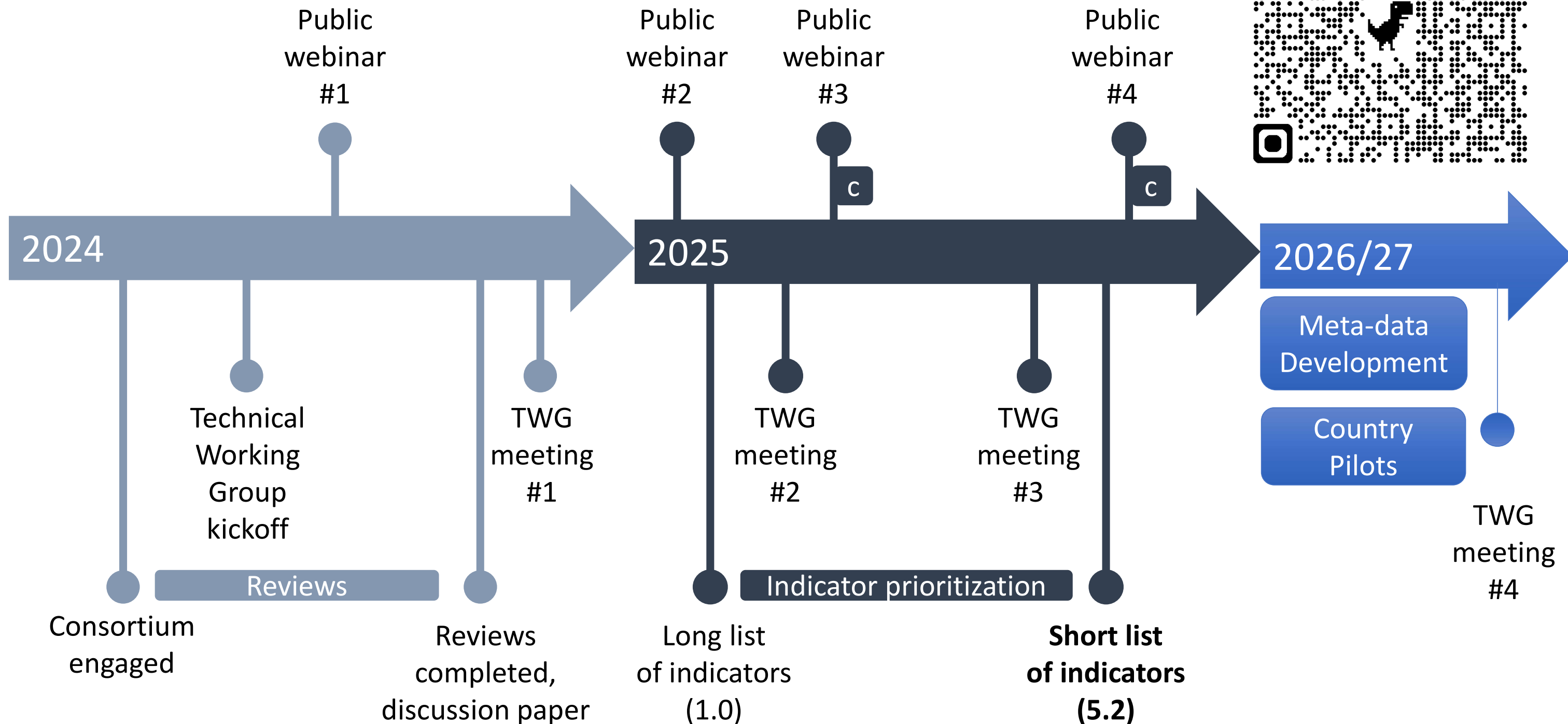


Why monitor Climate-Resilient WASH?

- Climate change is increasingly affecting WASH services
- Countries need evidence to guide adaptation
- Existing monitoring does not adequately capture resilience
- JMP and GLAAS are developing indicators to support national and global monitoring



Timeline and milestones



Progress so far: monitoring climate resilience and WASH

- Conducted 5 Literature Reviews to identify WASH (&WASH adjacent) system attributes and adaptation actions that influence resilience
- Reviewed WASH Climate Resilience Frameworks
- Identified >1,500 potential indicators which were whittled down to 403 indicators to consider for monitoring for CR WASH.
- Following public consultation & input from TWG shortlist was developed
 - 46 Indicators for Global Monitoring of CR WASH
 - 59 Indicators for Local Monitoring of CR WASH

>1,500 Indicators Identified

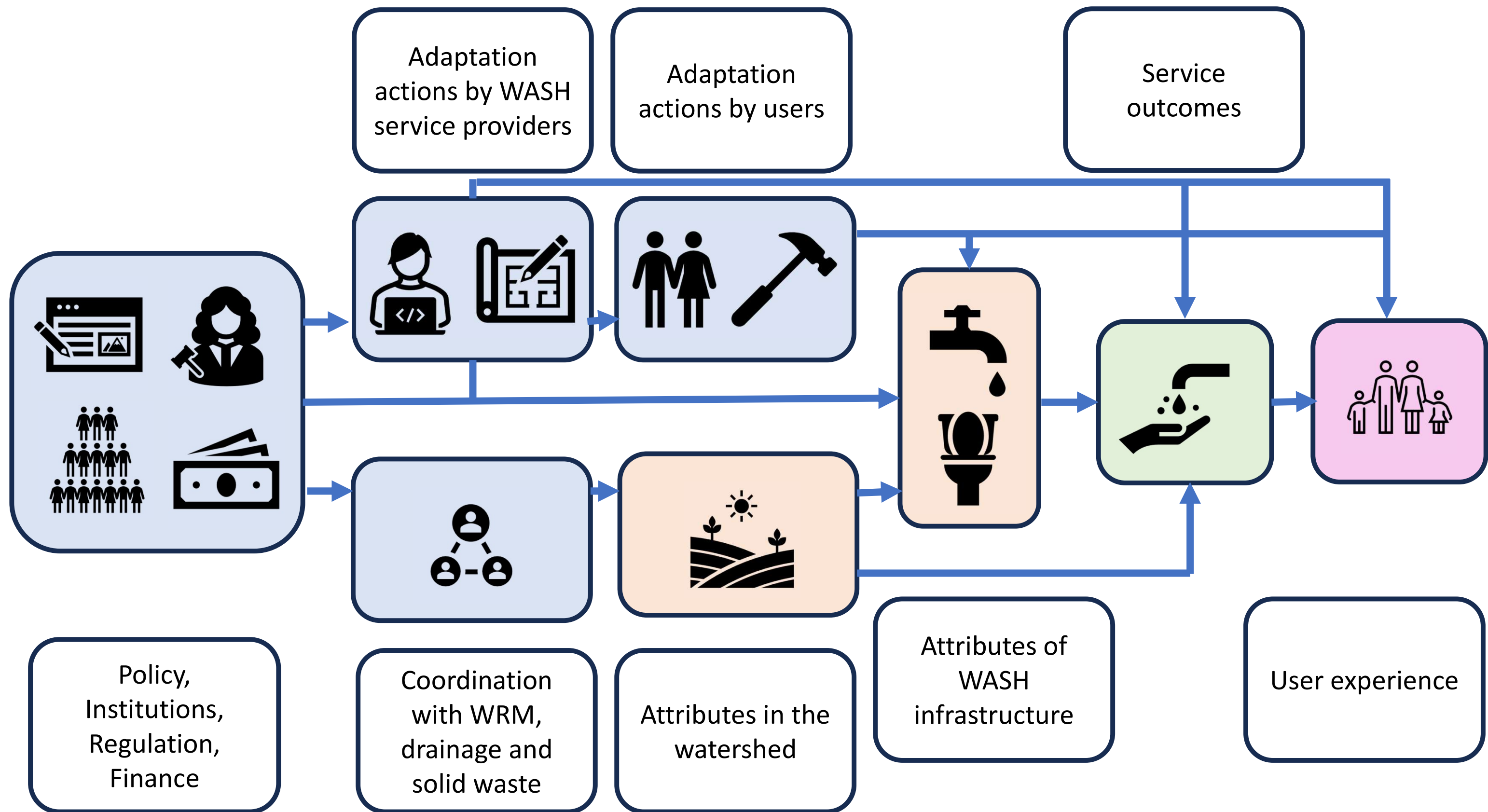


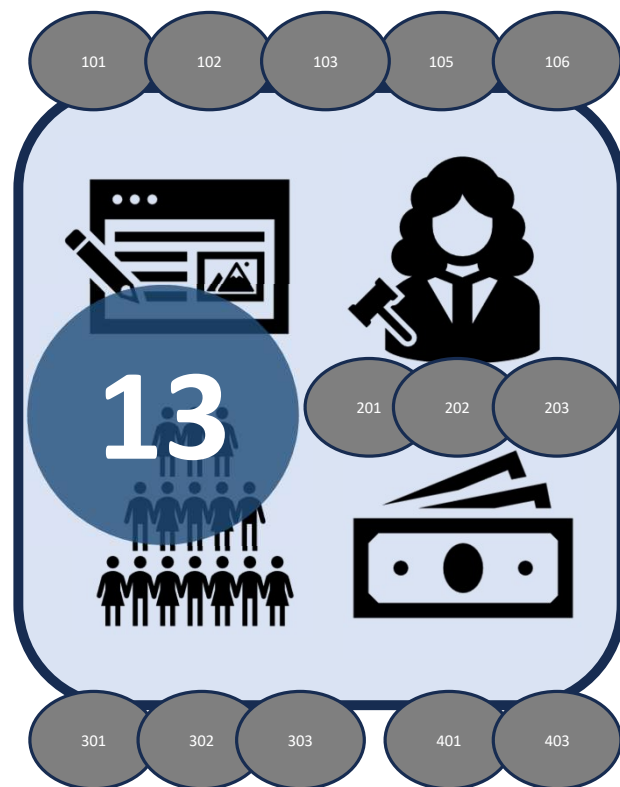
Long list - 403 Indicators



Short list –

46 Indicators for Global Monitoring
59 Indicators for Local Monitoring





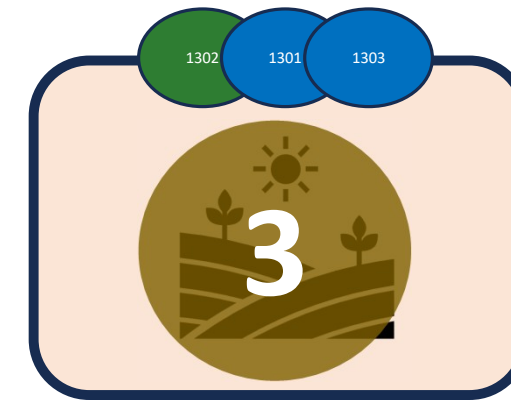
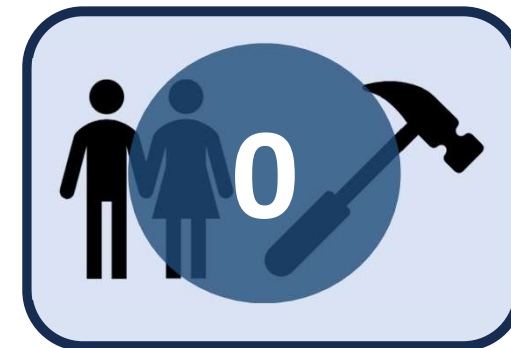
Policy,
Institutions,
Regulation,
Finance

Adaptation
actions by WASH
service providers



Coordination
with WRM,
drainage and
solid waste

Adaptation
actions by users



Attributes in the
watershed

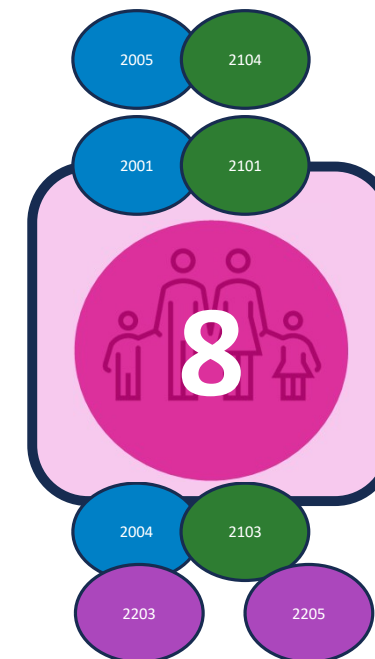
Attributes of
WASH
infrastructure



Service
outcomes



User experience



Global Indicators (Set A) vs Local Indicators (Set B)

Shortlist - 46 Indicators for Global Monitoring & 59 Indicators for Local Monitoring

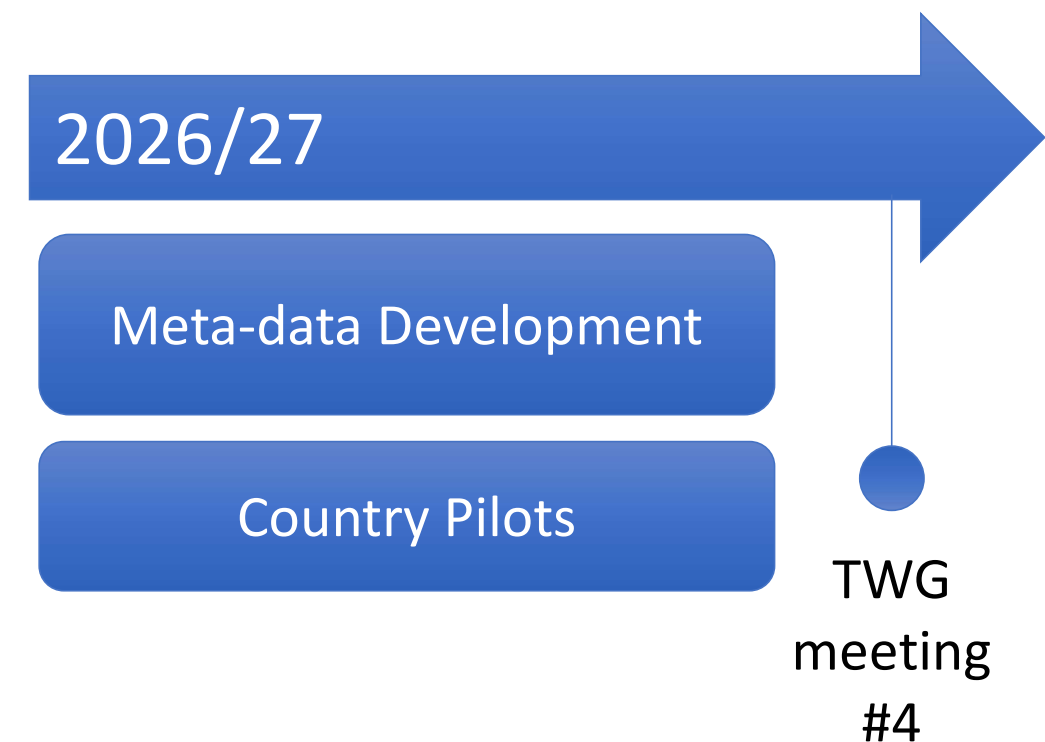
Set A: Global indicators for JMP/GLAAS Programmes	Set B: National / Local indicators
Comparable across countries	Tailored to local contexts
Suitable for JMP/GLAAS reporting	Supports programme and operational decisions
Limited number of core indicators	Greater level of detail
Feasible to collect routinely at scale	May require specialised or resource-intensive data collection
Focus on global trends and progress	Focus on local risks, performance and adaptation actions
Prioritised for development in this project	Valuable indicators for future development and use at national/sub-national level

Example global indicator	Example local indicator
0601/0701 - Proportion of population / schools / health care facilities served by water or sanitation service providers that implement risk management plans which consider current and future climate	0705 - Proportion of sanitation service providers that have protocols and procedures in place for safe, appropriate and timely emptying of pits and tanks on receipt of early warning relating to a climate event

Current & Future Work

Moving from indicator identification to indicator operationalisation

1. Developing indicator metadata
 - Definitions
 - Data sources
 - Collection methods
 - Disaggregation requirement
 - Reporting guidance
2. Pilot Testing
 - Assess data availability
 - Test collection methods
 - Engage national stakeholders
 - Identify implementation challenges
 - Refine indicators and metadata

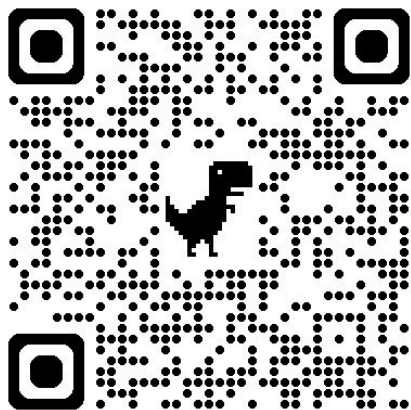


Monitoring Climate-resilient WASH Summary



Project Website to download

- Indicator Short List
- Discussion Paper
- Indicator Meta Data



Sign up here to receive updates!

World Water Week Session	Where?	When?	
Making the most of data on WASH systems	C3, Level 2	Sunday	9:00-10:30
Catalysing action: Strengthening monitoring of SDG 6 Means of Implementation	C2, Level 2	Sunday	11:00-12:30
Improving data use on water for people	C3, Level 2	Sunday	14:00-15:30
Operationalising Climate resilient WASH under the GGA	C2, Level 2	Monday	09:00-10:30

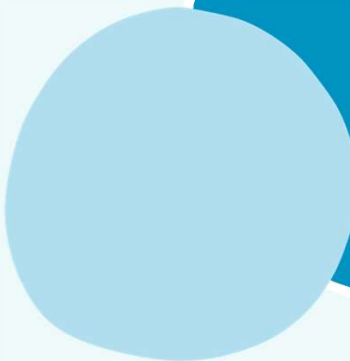
washmonitoring@who.int





Session 2

Innovations, Tool, and Sector Updates



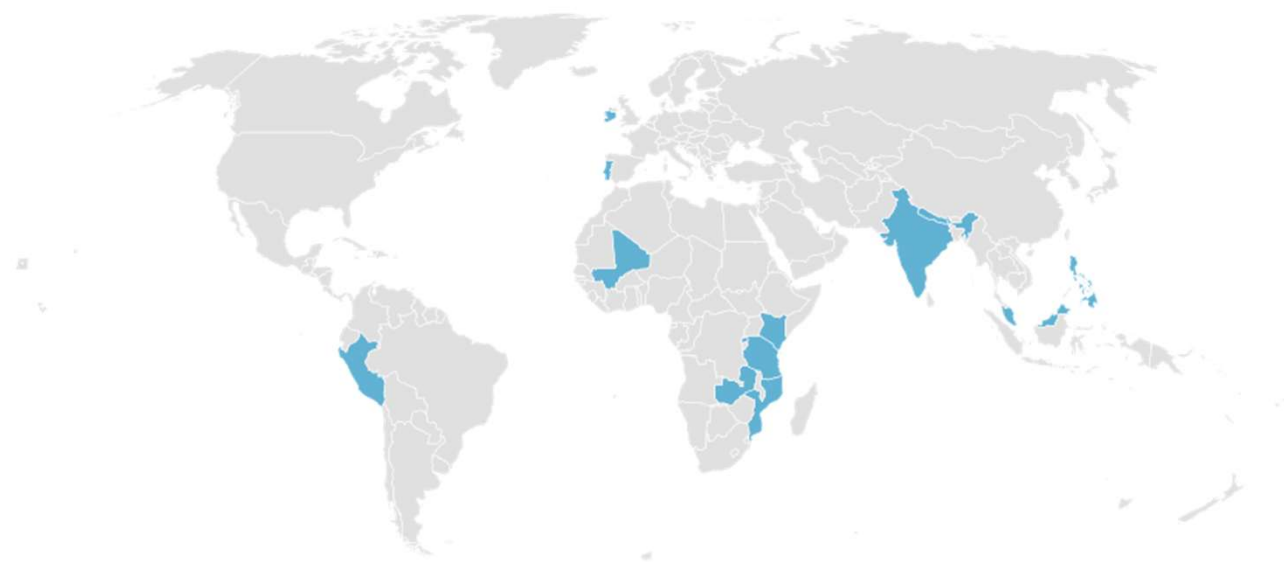
Next Presentation:

Rick Johnston – WHO

A Roadmap for Advancing Sanitation Regulation



Roadmap for advancing sanitation regulation: approach and methods

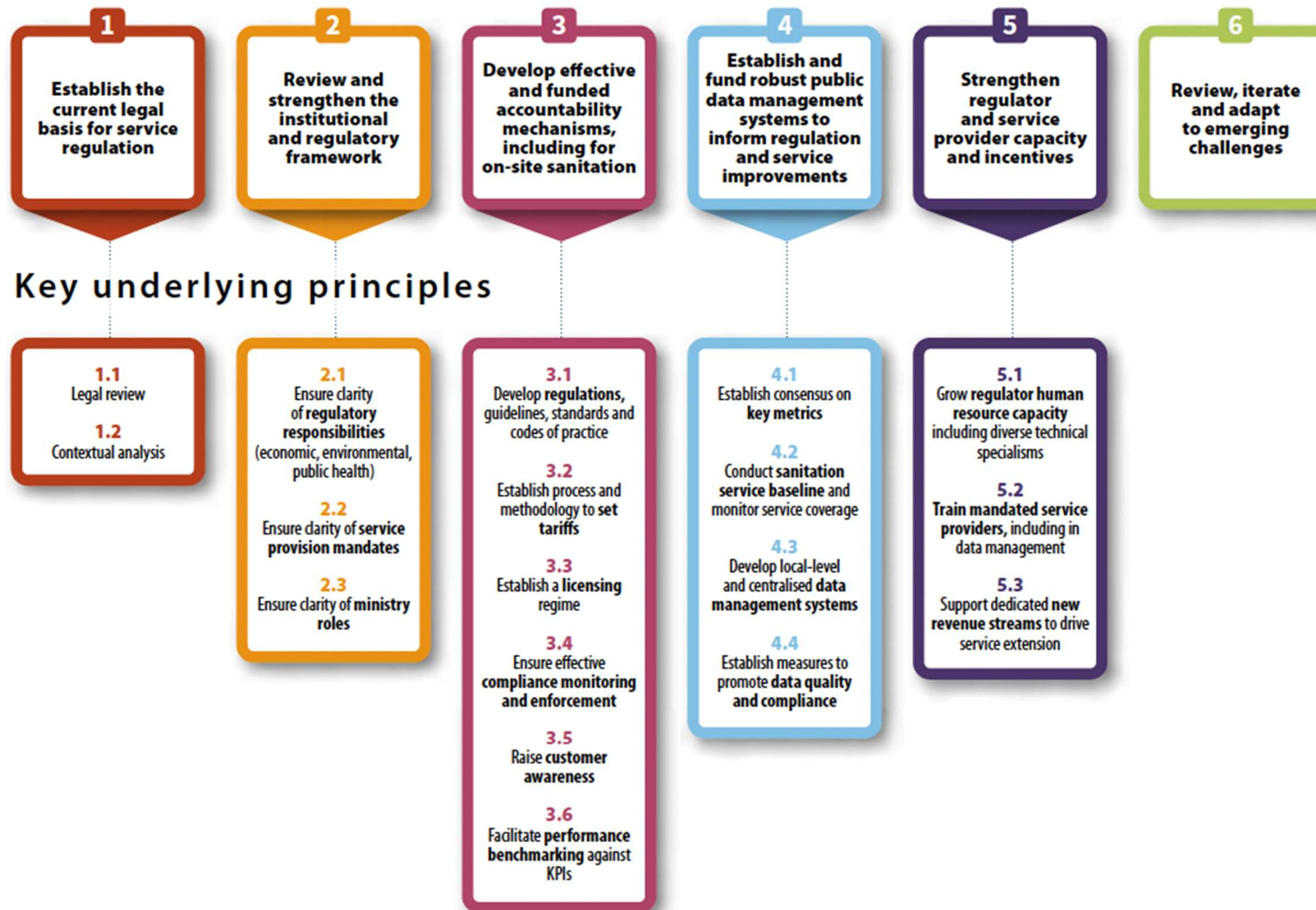


■ Chile; India; Ireland; Jordan; Kenya; Malaysia; Mali; Mozambique; Nepal; occupied Palestinian territories; Peru; Philippines; Portugal; Senegal; Serbia; Tanzania; Zambia

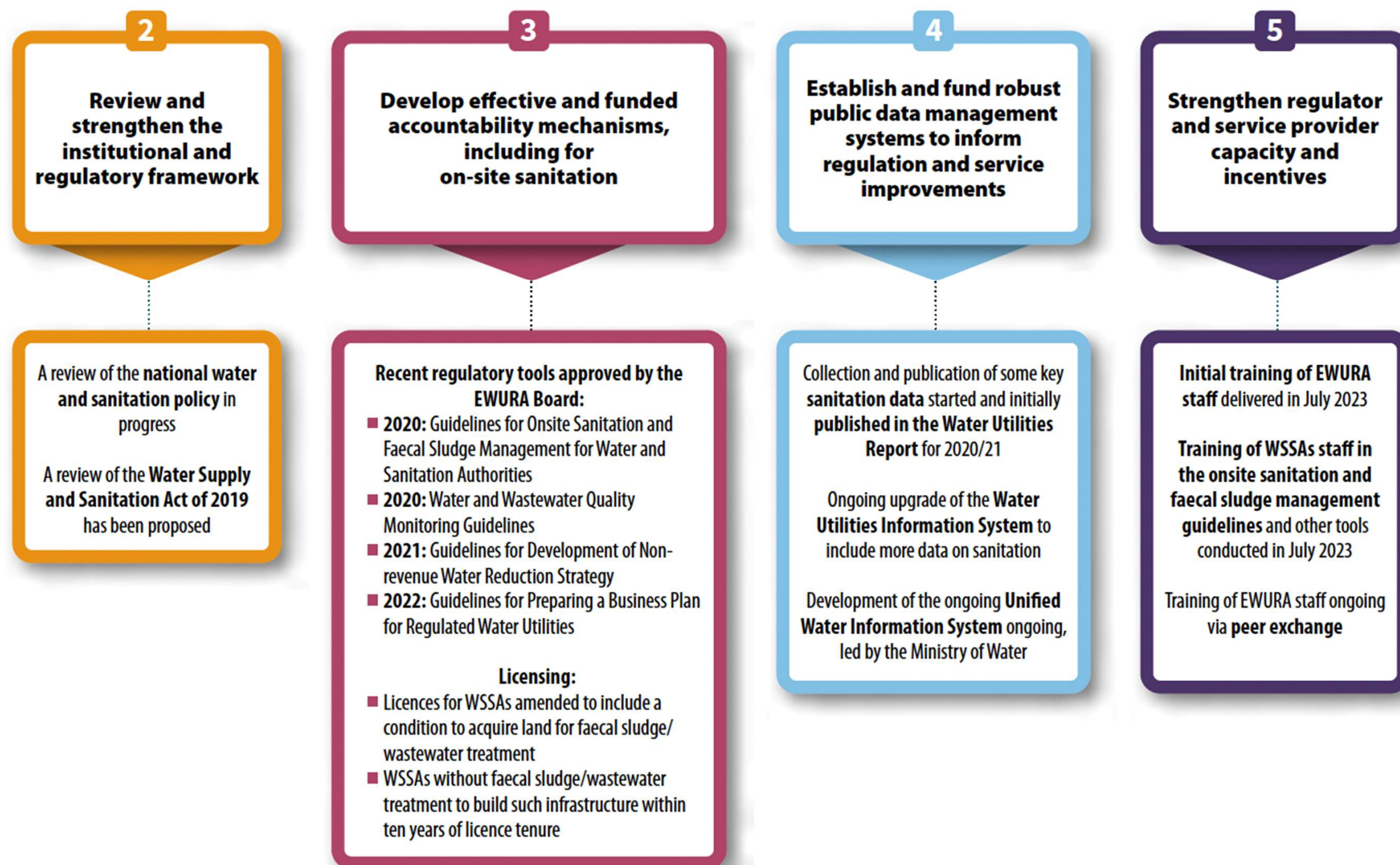
- Roadmap aims to **support countries to advance** from little or no sanitation regulation, to functional regulatory systems
- Draws upon experiences of countries in Africa, Asia, Europe and Latin America
- Mixed methods approach, using **key informant interviews with regulators** and literature review
- Sets out **principles and key milestones** towards high-performing sanitation regulation
- Milestones annotated with **short case studies** showcasing inspiring regulatory initiatives from **across income categories and regions**
- Two examples of **whole-roadmap implementation** – early stage (Tanzania) and mature stage (Portugal)
- Addresses **prior enablers** for successful implementation of the roadmap
- Published by WHO, ESAWAS, UNICEF, WSUP

Roadmap: Structure and key milestones

ACTIONS FOR IMPLEMENTATION



Example of whole roadmap implementation – early stage: Tanzania



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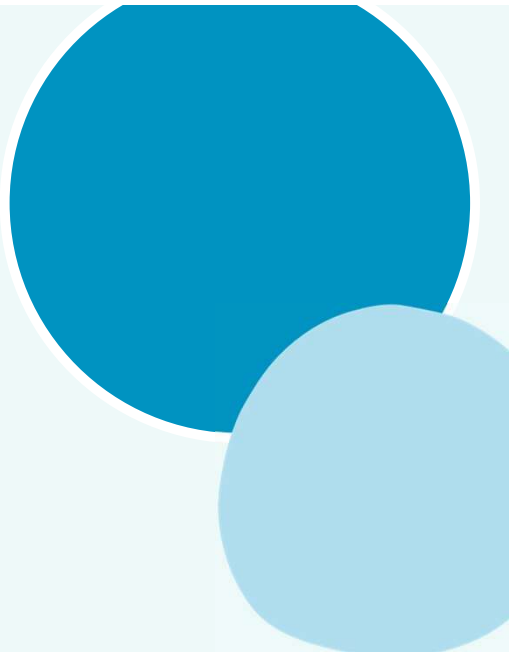
<https://iris.who.int/handle/10665/381399>

Thank you!



Session 2

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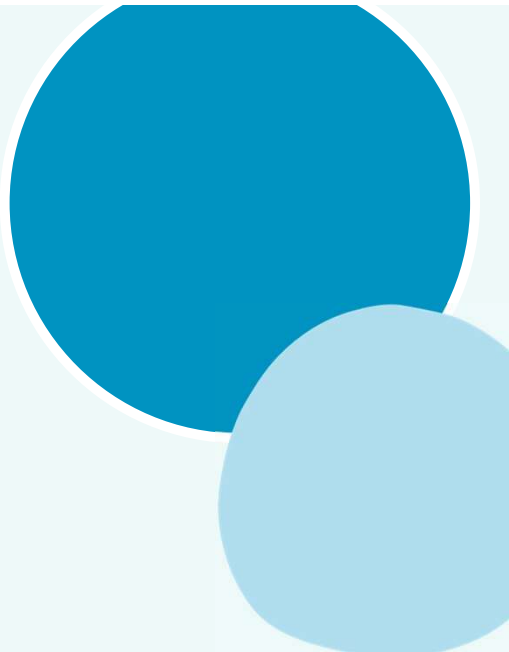


Q&A and Discussion



Session 2

Innovations, Tool, and Sector Updates



Lunch Break