



WRI AFRICA

REPORT

Applying an Integrated Urban Water Resilience Approach in Six African Cities

Insights on Implementation and Scaling

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Foreword

Africa's cities are growing rapidly, reshaping economies, infrastructure systems, and the lives of millions of people. Cities drive 70 percent of the continent's GDP, and nearly two-thirds of Africa's labor force work in water-dependent sectors. But today, over two-thirds of urban residents in Africa lack safe, affordable, and reliable water and sanitation services. By 2050, the continent's urban population is expected to double to 1.5 billion people, placing enormous pressure on water systems already strained by climate change, underinvestment, and fragmented governance. Across Africa, cities face an estimated \$66 billion backlog in water and sanitation infrastructure investment. How cities respond will shape how effectively water systems can adapt to growing climate risks while integrating resilience to their long-standing challenges.

Traditional approaches to urban water management are no longer sufficient to address the scale and complexity of today's challenges. Cities can't solve these problems within the water sector alone, or even within their own urban boundaries. Building resilience requires a broader approach that engages stakeholders across land use management, energy, transport, and infrastructure planning; the private sector; local communities; and the upstream watersheds and landscapes on which cities depend. Climate risks are further exposing the interconnected nature of these systems and the need for more coordinated, sustained approaches.

This report builds on over five years of experience in six cities in Africa, collaborating with partner organizations including the Ethiopian Institute of Architecture, Building Construction and City Development; Haramaya University; Bantu Design; Rwanda Young Water Professionals; Zutari; the South African Cities Network; Arup; and the Resilient Cities Network. It offers a practical framework for advancing urban water resilience through cross-sector collaboration, integrating planning, and locally grounded implementation. Drawing on work with these partners in Addis Ababa and Dire Dawa in Ethiopia, Kigali and Musanze in Rwanda, and Johannesburg and Gqeberha in South Africa, the authors reflect the experiences of cities working to strengthen resilience while improving everyday outcomes for residents. Despite differences in scale and context, the report

identifies common barriers and opportunities and outlines approaches for integrated policy, financing, and implementation.

At the center of this work is a simple but important idea: resilient urban water systems are built through partnership. The findings indicate that bringing together local governments, utilities, communities, planners, financial institutions, and other sectors can help cities move from reactive responses toward more coordinated, long-term solutions. The results of these partnerships include steering committees established in Ethiopian cities for cross-sector coordination, urban master plans initiated with the partnership momentum in Rwanda, and funding dedicated towards integrated programs for catchment rehabilitation in South Africa. The report also demonstrates the growing potential of innovative financing approaches and small- and medium-scale interventions to deliver tangible benefits while strengthening resilience over time.

The lessons in this report emerge from the Urban Water Resilience (UWR) in Africa Initiative, launched with support from the German Federal Ministry for Economic Cooperation and Development (BMZ). Since 2020, the initiative has evolved through collaboration and shared learning, helping shape a practical and adaptable approach.

Africa's water resilience gap is significant, but so are the opportunities to close it. The path forward will require sustained investment, coordination, and stronger integration of water resilience into broader urban development strategies. With deliberate choices, African cities can build systems that are more resilient, more inclusive, and better equipped to withstand future shocks while improving quality of life today.



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President & CEO
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Executive summary



Context

Between 2022 and 2050, Africa's total population is expected to more than double, reaching 2.5 billion people by 2050 (UNCTAD 2016). This rapid growth will increase pressure on African cities' existing water resources and infrastructure across the continent (OECD/SWAC 2020; UN DESA 2018). Moreover, climate change will have increasingly unpredictable impacts on water, with cascading risks related to livelihoods, economies, and public health.

Insufficient strategic urban planning for fast-growing African cities, paired with other critical challenges such as limited city water budgets has resulted in the loss of protection for most water resources, stripping away the ability to cope with too much (e.g., flooding) or too little (e.g., drought), and too dirty water (e.g., water pollution). This has significant impacts beyond a city's water sector, weakening protections for public health and critical sectors such as infrastructure, transportation, energy, industry, and agriculture. Moreover, large swaths of the population—especially people living in urban poverty—are still living without safe, affordable, and reliable access to water and sanitation. As highlighted in WRI's 2021 Pathways Report, "Water Resilience in a Changing Urban Context: Africa's Challenge and Pathways for Action", existing urbanization patterns, water supply systems, and governance and financial models will be unable to meet the unprecedented rise in demand and handle increasing water-related risks, especially under a changing climate (Workalemahu et al. 2021). The 2021 report proposed four priority pathways for action as a starting point for cities to build urban water resilience action.

Building off of this research, to ensure long-term water resilience, cities urgently need new approaches that connect local realities such as unequal service provision or aging infrastructure, all the way to basin-level issues, linking crosscutting urban issues like climate impacts and land use. The proposed integrated approach is important because it reduces the risk of treating urban water issues in isolation, enabling better decision-making, resource management, and investment outcomes.

About this report

This report shares insights, lessons learned, and recommendations from applying the UWR approach in six African cities between 2020 and 2025 to improve the accessibility, reliability, and protection of vital water resources. It is an opportunity to reflect on and share how cities can move from research to planning to on-the-ground action and sustained implementation. It examines the discussions and actions that resulted, thanks in part to city actors from different sectors and departments coming together to the same table to strategize around evidence-based priorities and actions, and to identify funding and financial resources to implement solutions. The authors highlight common themes across the participating cities, including shared priorities, barriers, and enabling conditions.

This publication focuses on the six cities that utilized the UWR approach from start to finish. Because the analysis did not compare these cities with others that did not implement the approach, it cannot conclusively attribute all observed outcomes solely to the approach itself. As a result, the ability to draw firm cause-and-effect conclusions is limited. Nevertheless, they provide a valuable starting point for supporting cities in prioritizing water resilience through research, policy integration, implementation, and financing.

HIGHLIGHTS

- In cities around the world, fast-growing urban populations and the climate crisis are placing severe pressure on already-stressed water systems, particularly in Africa.
- Many cities find it increasingly challenging to coordinate and to cope with too much or too little water, further exacerbating pollution, water scarcity, and social inequality problems.
- With local partners and city stakeholders, WRI piloted a multi-year Urban Water Resilience (UWR) in Africa Initiative, strengthening an enhanced UWR approach that convened public, private, and civil society water stakeholders to identify shared priorities, foster collaboration, and develop actionable solutions.
- This approach was based on previously completed research and engagement with city actors to identify priority actions, mobilize political support, deliver technical assistance, and unlock funding for on-the-ground implementation of projects.
- This report sheds light on the priorities and lessons learned across the six African cities where this approach was carried out. Implementation lessons across all cities emphasize the need to tackle water issues from a basin-level scale, leveraging frameworks to break down department silos, ensuring diverse and consistent stakeholder engagement, and identifying the most critical priorities shared amongst different stakeholders to use as engagement points going forward.
- Recommendations call for water management across water-using sectors; fostering trust-based partnerships; aligning policies, engagements, and tools connecting local and national levels; improving data systems; and mobilizing stakeholders for consensus-based high-priority projects.

This report builds on WRI's research and urban water resilience work in Africa which spans five years of deep engagements on the ground, from 2020 to 2025. Specifically, the UWR approach is the umbrella terminology used to describe the whole process WRI applied with partners to support cities from the initial research stage to quantitative and qualitative analysis, to action planning and development of a project pipeline, to on-the-ground implementation, and finally preparing project concepts scaling through additional funding and financing. WRI's partners, Arup and the Resilient Cities Network, played a critical role in implementing the approach, utilizing the methodology developed through the City Water Resilience Approach (CWRA)¹ to guide and facilitate the Assessment and Visioning workshop processes in each city. They also supported the development of the resulting City Characterization Reports, City Water Resilience Profiles, and Action Plans (Arup et al. 2019).

Additionally, WRI worked with local partners in each city who played a vital role in engaging city government stakeholders and fostering a collaborative process that strengthened local ownership and led to clear city commitments. This approach was undertaken in three capital cities and three secondary cities (i.e., a smaller city that is not the country's capital): Addis Ababa and Dire Dawa in Ethiopia, Kigali and Musanze in Rwanda, and Johannesburg and Gqeberha in South Africa. Partner organizations comprised the Ethiopian Institute of Architecture, Building Construction and City Development (EiABC) in Addis Ababa; Haramaya University in Dire Dawa; Bantu Design in Kigali; Rwanda Young Water Professionals in Musanze; and Zutari and the South African Cities Network in Johannesburg and Gqeberha.

This umbrella approach was developed with cross-sector stakeholders to address water-related issues through research, spatial analysis, technical analysis, and capacity building. The six pilot cities, of varying sizes and levels of urbanization, were selected to be part of the initial UWR cohort based on key selection criteria jointly developed by WRI and the donor, BMZ. The four criteria included: a diversity of water and urban risk characteristics of the six cities; a balanced cohort in terms of climatic, geographic, and water dependency contexts; institutional factors that demonstrate commitment and alignment between city, regional, and national government programs towards advancing water resilience in the region; and demonstrated interest with a signed letter of commitment and assigned point of contact in each city.

WRI's existing office presence across the region helped to support the relationship-building, as well as selection and commitments of the initial cohort. In each city, the CWRA's indicators and analysis methodology, developed collaboratively by Arup, the Organization for

Economic Co-operation and Development (OECD), the Resilient Cities Network, and the World Bank, were used to assess the city's water resilience and define visions for its future. The report discusses how this tested methodology was integrated into the overall approach and concludes by sharing lessons and recommendations for scaling to other African cities via coalition building, partnerships, and funding.

This publication is intended for city government decision-makers and public authorities in Africa, as well as officials in cities elsewhere facing comparable urban water resilience challenges; water and sanitation utilities; staff and experts of nongovernmental organizations (NGOs) involved in city partnerships and issues; the private sector; as well as urban water resilience researchers, international development partners, and academia.

Key findings

- All six pilot cities, independently through the stakeholder workshop discussions guided by the selected CWRA methodology (Arup et al. 2019), developed their own city vision statements and action plans that elevated four common priorities in achieving urban water resilience:
 - **Cross-sectoral stakeholder engagement and coordination.** Collaborating between and within both municipal, regional, and national government agencies and the private sector and other relevant groups promotes better water resource management.
 - **Adequate climate and water risk resilience planning.** City stakeholders emphasize the importance of embedding hazard and vulnerability assessments directly into development planning cycles, ensuring risk is a foundational input to water infrastructure and related decisions rather than a parallel or reactive exercise. Mechanisms mentioned in cities' action plans to reinforce this risk and development planning include integrated planning, inclusive governance, open communication channels, flexibility, and innovation.
 - **Robust data for data-driven decision-making.** Access and investment for reliable, up-to-date, and open urban water resilience data is important for all six cities.
 - **Improved and resilient water infrastructure and management.** Cities stress the need for proactive maintenance, sustainable financing, and resilience guidelines for water infrastructure.
- It was important to secure city commitment letters, build trust and credibility amongst city leaders, and deepen support to prioritize advancing urban water

resilience in each city. It was also vital to integrate resilience projects within the fold of city priorities and policies, aligning with existing processes to ensure local ownership and institutional buy-in.

- Nearly all the pilot cities, independently through stakeholder workshop discussions, emphasized five main challenges to UWR planning:

- Inadequate government coordination around water issues.
- Insufficient awareness and dissemination of knowledge beyond expert groups.
- Technical capacity gaps.
- Scattered or unavailable data needed for decision-making.
- Insufficient finance.

- While each city's unique hydrological, socioeconomic, and governance landscape shaped its experiences, eight overarching lessons emerged that highlight systemic barriers and opportunities for adaptive management:

1. **Integrated and watershed-level planning is difficult to execute yet necessary to effectively tackle the root causes of cities' water challenges.** Institutional silos, fragmented mandates, and resource constraints make it difficult to tackle interconnected urban issues like urban sprawl as well as climate shocks and stresses.
2. **Workshops and analysis methodologies can help break down silos and bring together different departments; however, they are often insufficient on their own to overcome existing mandates, and government systems.** City departments also need to have regular follow-up conversations and

clear commitments on how to move forward in a collaborative manner.

3. **The UWR approach was especially helpful and valuable for cities that lack the resources and staffing available to their more centralized capital city counterparts.** The three secondary cities in the study, which benefit from fewer financial and human resources than their capital city counterparts, used the planning tools to develop priorities and establish commitments for strengthening urban water resilience.
4. **Diverse, continuous, and participatory stakeholder engagement enhances alignment and sustainability.** It is important to have a clear framework, methodology, and the right tools for discussions, and to create spaces for deliberations, private if necessary, where all groups feel safe addressing problems and solutions.
5. **City-led stakeholder engagement approaches must create spaces to both recognize a diversity of perspectives, including those that are less dominant, and develop consensus-based solutions.** Priorities and challenges may differ by stakeholder group, and not everyone may feel comfortable sharing information in large group settings.
6. **Data, particularly from the city's official individual reports, which used hazard scans, spatial mapping, and trend analysis of the city's water assets, helped spark useful discussions and highlight what cities could achieve.** Clearly stated priorities and actions also helped make the case for city leadership to invest in urban water resilience.
7. **Monitoring key hazards and developing accessible data dissemination systems emerged as**



foundational for evidence-based decision-making, yet persistent gaps in tracking, data sharing, and quality hinder progress across all cities. Shared data platforms and geographic information system (GIS) mapping, integrated with accessible national portals, can help address these challenges and support more coordinated decision-making.

8. **Beyond identifying main challenges and priorities, a lesson involving the UWR approach was to take it one step further and identify, via stakeholder consensus, the most critical of these priorities to use as engagement points to sustain action going forward.** These more targeted priorities can serve as entry points to develop concrete, actionable project concepts to kick off implementation and raise additional funds.

Recommendations

The report lays out nine recommendations for urban water resilience stakeholders in Africa, especially city and national officials, as well as NGOs and water service providers. These include:

- **Adopt government-led integrated city- and basin-level planning and management.** National governments should unify mandates, resources, and tools to promote cross-sectoral collaboration and coordinated engagement at the watershed level, enabling more effective action on urban water resilience issues across cities and their surrounding regions (dubbed the “city-region”). This measure will also strengthen water authorities’ ability to engage with other water stakeholders. City departments should work together to revisit and reform mandates that may be reinforcing fragmentation or limiting cross-departmental collaboration.
- **Foster trust-based partnerships and trust-based stakeholder engagement.** It is important to support, recognize, and ally with leadership at the city and community levels to co-create partnerships and knowledge grounded in the everyday realities of water challenges. Collaboration among government officials, local communities, NGOs, and research partners is key to successful implementation.
- **Establish and monitor progress on urban water resilience metrics and outcomes.** City officials should establish urban water resilience baselines in their respective jurisdictions to monitor progress and improvements towards enhancing climate resilience, water access, and quality.
- **Bundle gray and green infrastructure elements to create financing opportunities and facilitate access to funding.** Investing in “green plus gray” approaches—where gray infrastructure refers to traditional engineered systems like pipes, pumps, and treatment facilities, while green infrastructure uses natural processes such as wetlands, urban green spaces, or permeable pavements—can build greater resilience to a wider range of extreme conditions, both to too much water and too little water, while at the same time boosting innovative thinking.
- **Build capabilities to leverage expertise on building equitable and resilient urban water systems.** Stakeholders in the water sector need to apply an intentional social equity lens to urban water resilience activities to ensure there is an equitable distribution of benefits in particularly vulnerable and underserved communities.
- **Strengthen locally rooted, collaborative urban water governance.** Urban water resilience stakeholders need to shift governance systems from fragmented approaches to an integrated, systemic, and collaborative approach that is decentralized and based on local realities.
- **Shape policies and frameworks that connect the local to the national level.** Shaping policies at the local level and connecting them to national policies can help create a cohesive strategy that addresses the unique water challenges faced by cities.
- **Develop better monitoring of key hazards and accessible data systems to improve decision-making.** Cities and stakeholders involved in data provision services should create reliable, high-resolution data on hydrology, climate projections, land use, topography, water demand, infrastructure performance, and social vulnerability. With better data interoperability and visualization tools, cities can run scenario analyses to compare benefits, costs, cobenefits, and progress towards long-term resilience outcomes across projects.
- **City officials, with support from finance-focused organizations, should develop and prepare high-priority urban water resilience projects to ensure they are investment-ready and positioned for implementation.** Using water action plans developed from the UWR approach, stakeholders should gather to build consensus around specific priorities and then mobilize these for joint fundraising and implementation.



Introduction



Africa's cities face the dual challenge of rapid population growth and intensifying climate impacts, both of which are putting unprecedented pressure on existing water infrastructure and exacerbating the vulnerability of population groups that already lack access to safe water. In this continent where the urban population is anticipated to double by 2050, two-thirds of African cities are at “extreme” risk of climate- and water-related shocks like prolonged droughts, heatwaves, and intense floods (OECD et al. 2025; UN-Habitat 2024). Asian and Latin American cities face this dual threat as well, yet a much higher proportion of cities already have the infrastructure in place to support their current populations. This is not the case in most African cities (OECD and UN-Habitat 2026). The sixth Intergovernmental Panel on Climate Change (IPCC) Assessment Report flagged African cities as hot spots of increasing climate vulnerabilities (Trisos et al. 2022), especially in unplanned and informal settlements. As a result, cities need to devise and implement strategic and integrated urban planning approaches to address the current water challenges faced by large portions of their populations, many of whom are living in poverty, and to protect vital water resources for current and future generations.

Rapid and unplanned urbanization, climate-related risks, resource-constrained water management, and inequitable distribution of infrastructure and services are creating a vicious cycle of water insecurity for urban residents across Africa. Current urbanization trends are degrading water catchments, diminishing water resources and disrupting natural hydrological flows, stripping away the ability of city-regions to cope with both scarcity and flooding. Climate change is contributing to both increased water scarcity as well as flood risks across the continent and greater inter-annual variability, making it harder to plan how to use water (Trisos et al. 2022; Wilson et al. 2022). These escalating water challenges disproportionately impact the most vulnerable groups, such as informal settlement dwellers, women, children, and marginalized communities because they have the least socioeconomic capabilities and resources to adjust to shocks. Cities are therefore challenged to build urban water resilience, where communities have the safe, reliable, and affordable water they need to survive and thrive through sustainable, adaptive, and resilient urban water systems (see the expanded definition in Box 1) (Workalemahu et al. 2021). With aligned visions, support and collaboration, African cities have the potential to play a leading role in safeguarding their populations from these converging water challenges.

BOX ES-1 | WRI's working definition of Urban Water Resilience

Urban Water Resilience means equitable access to safe, reliable, and affordable drinking water and sanitation; flood-protected neighborhoods; and healthy regional watersheds resulting from water-sensitive infrastructure and aligned city and regional development, enabled by governance, planning, and finance systems that continually adapt to changing local contexts and climate risks

Source: Workalemahu et al. 2021.

From 2020 to 2025, the World Resources Institute (WRI) conducted a series of research and deep engagements focused on urban water resilience aimed at applying a unified UWR approach across a cohort of pilot cities in Africa. As a first step in the development of this approach, WRI, in collaboration with experts and partners with a deep knowledge of the state of water needs and current practices in Africa, developed the framing report, “Water Resilience in a Changing Urban Context: Africa's Challenge and Pathways for Action” (Workalemahu et al. 2021). This publication, also referred to as the Pathways Report, contextualized the water resilience challenges and opportunities in rapidly growing African cities, discussed the rising role of cities in climate action, and identified four priority pathways for building water resilience in cities. These four pathways are as follows:

- **Plan for water: mainstream risk-informed land management and water-sensitive urban development.**
- **Prioritize the most vulnerable: increase equitable access to safe water and sanitation.**
- **Create change at scale: develop innovative institutions and pursue partnerships for water resilience.**
- **Get finance right: increase and align water-resilient investments across sectors.**

Following this research, WRI's UWR in Africa Initiative (described in Box 2) identified three converging challenges for city leaders in Africa: **constrained resources limiting the extension of water and sanitation services for growing populations; managing watershed risks largely outside city jurisdictions; and designing for climate resilience.** These challenges represent a significant threat to sustainable urbanization in the region. But this moment of explosive urban growth also presents an opportunity

to “get water right”, especially because cities are uniquely positioned to drive change at the local level. More specifically, cities are well-positioned to drive action on urban water resilience and other matters because they can tailor plans and policies to local risks, develop priorities that are backed by residents and communities, and often implement solutions and resource mobilization more nimbly than national governments (Doust et al. 2022; OECD n.d.). These actions require a systemic approach through greater integration and coordination, bringing together actors both vertically and horizontally (van den Berg et al. 2021). How African countries handle this opportunity has immense potential for informing urban practice and the creation of more resilient systems across the world. It could form the bedrock for collaborative resilience-building against future challenges that transcend boundaries, sectors, and government agencies. Now is the time to invest in urban water resilience that ensures cities and communities across the continent are prepared for current and future challenges.

The UWR Initiative in Africa has worked with key stakeholders over the past five years to help cities address their water risks and vulnerabilities through research, spatial analysis, technical assistance, and capacity building to undertake strategic planning, identify place-based interventions, and secure funding and financing resources to implement solutions. Within the initial cohort, this work placed equal value in supporting both primary and secondary cities, as smaller cities play an important role in absorbing population growth and internal migration in Africa. WRI, with local and global partners, secured city commitments, collaborated on and implemented a methodology for performance-based assessment of water resilience needs, and developed a program delivery strategy to support

strategic planning in multiple cities. Through the completion of this process, WRI has built trust and credibility for the approach, reflected by interest from other cities, and has received deep commitment from city leaders to implement the resulting water action plans.

In this report, the umbrella terminology “Urban Water Resilience approach”, or more simply, “UWR approach,” is used to describe the whole process the WRI UWR in Africa Initiative applied with partners to support cities. This process spans the full project cycle—from the initial research stage, to quantitative and qualitative analyses, to action planning and project prioritization, through on-the-ground implementation, and finally to the development of project concepts that can be scaled through additional funding and financing. Throughout the duration of WRI’s process to develop and validate the UWR approach, continuous on-the-ground research and stakeholder engagement contributed to the project’s understanding of the water challenges cities in Africa are facing. In-depth on-the-ground consultations revealed the need for analytical tools and technical support to advance risk-based planning in the water sector, the need for coordinated capacity building programs across a diverse range of expertise to advance plans towards implementation, and the critical need for new financing approaches to address the investment and financing gaps in the water sector.

Through this defined process of research, spatial analysis, and stakeholder consultations, WRI and partners completed baseline reports, referred to as City Characterization Reports (CCRs), in an initial cohort of six cities: Addis Ababa and Dire Dawa in Ethiopia; Kigali and Musanze in Rwanda; and Johannesburg and Gqeberha in South Africa.

BOX 2 | The UWR in Africa Initiative and the resulting UWR approach

The UWR in Africa Initiative kicked off in January 2020 with three initial years of funding from the German Federal Ministry for Economic Cooperation and Development (BMZ). Since its inception in 2020, the program has grown as a strategic initiative of WRI’s Ross Center for Sustainable Cities, positioning the organization to expand and scale the UWR approach across new geographies in the future. The UWR Initiative built the foundation for a larger urban climate resilience program in Africa through the African Cities Water Adaptation Fund (the ACWA Fund) and the ACWA Platform, in partnership with several other international, pan-African, and local partners.

In this report, the “Urban Water Resilience approach,” or more simply, “UWR approach,” encapsulates the entire methodology from research to engagement, prioritization, validation, and implementation utilized by the UWR in Africa Initiative and its partners, including the ways stakeholders can strengthen and scale resilience across new geographies. Amongst its outcomes, the approach also directly led to the creation of the Scaling Urban Nature-based Solutions for Climate Adaptation in Sub-Saharan Africa (SUNCASA) project which began in the year 2023 and utilized the city priorities identified in the UWR approach to develop on-the-ground implementation programs.

Source: [Source here](#).

FIGURE 1 | Map of the six cities involved in the pilot cohort



Source: WRI.

This exercise, utilizing the selected City Water Resilience Approach (CWRA) methodology and framework (described in further detail below, and in Arup et al. 2019), helped each city identify the factors that contribute to the resilience of city water systems and those increasing their vulnerability. To move from this challenge identification step into actionable solutions, a strategic visioning and action planning process was undertaken in each city with a diverse group of stakeholders. The stakeholder engagement process was structured to develop strategic water resilience city profiles and action plans for both the city and its surrounding region (referred to as the “city-region”). The plans were intended to serve as a foundation for identifying, prioritizing, and funding a portfolio of resilience projects as part of the broader UWR approach.

WRI’s UWR in Africa Initiative worked with a set of global and local partners, including Arup and the Resilient Cities Network, to help cities overcome barriers to water resilience. The initiative supported cities by identifying water resilience challenges and pathways, demonstrating evidence-based solutions, developing a unique and contextualized vision of success, and enhancing local capacities to integrate resilience into project planning and decision-making processes.

Beginning in the six pilot cities, the initiative aimed to utilize and scale one common approach to support this cohort in identifying and prioritizing strategic actions that build resilience with a long-term goal of increasing urban access to high-quality water and protecting residents from water hazards. At the start of the initiative, three goals were outlined to clearly define the trajectory of this unified approach.

Goals of a unified UWR approach

Goal 1—To develop capacities in the water sector to mainstream risk-based planning at the city-region scale to address current and future risks. The WRI initiative team conducted a deep landscape review and selected the CWRA, a framework tool developed through a partnership involving Arup, the Organization for Economic Co-operation, the Resilient Cities Network, and the World Bank, as the base systematic methodology for the assessment and visioning steps in each city. Building off of this strong foundation of the CWRA methodology, WRI conducted additional research and geospatial analysis to provide cities with the evidence base for assessing their water risks and stresses. This research and geospatial analysis helped cities assess and identify interlinked urban, water, and climate system stresses. Once a strategic city

action plan was developed, WRI supported the process of gathering key stakeholders to validate the actions and identify a pipeline of priority projects for financing.

Goal 2—To reduce fragmentation by bringing together actors, who usually operate in isolation, working across water supply, distribution, source management, hydropower-energy, agriculture-irrigation, stormwater, and sanitation systems, as well as experts in governance, asset management, and climate modeling. To scale the impact of the UWR approach, WRI formed a centralized coalition of partners and experts to provide coordinated programs as well as targeted technical assistance and capacity building in cities. This pan-African coalition has been designed to enable resource mobilization, facilitate learning, support integration across priorities and activities, and scale urban water resilience implementation efforts across city, national, regional, and global actors. Additionally, the network of partners developed a joint agenda for urban water resilience, validating and expanding upon the priority pathways defined in the original Pathways Report (Reos Partners 2022).

Goal 3—To address the funding and financing gap in the water sector, especially projects that demonstrate high resilience benefits and have low capital needs. African cities need game-changing solutions, as well as the resources to deliver them. There is an identified need to promote and scale sustainable water investments in cities across the continent, filling a major financing gap in the water sector. As a final part of the approach, WRI developed the concept and architecture of a catalytic fund to leverage public funding to unlock and scale private sector investment in emerging low carbon resilience solutions in the water sector. Addressing the financing gap is a large piece of the puzzle to achieving water resilience. This process helped to identify the opportunity and need to set up a dedicated financing mechanism in the form of a blended finance fund focused specifically on aggregating and financing small- to medium-scale water projects in cities.

To achieve urban water resilience, cities should connect municipal realities with basin-level issues and link water to crosscutting urban issues such as land use, social inequity and economic development. Cities should take a regional approach, integrating risk-informed land and water resource management and water-sensitive urban development. They should work to ensure equitable access to safe, reliable, affordable and sustainable water supply while strengthening measures to protect regional watersheds. These efforts should be supported by new governance models, institutions, and partnerships that incorporate local knowledge and context, and align city and regional development. Lastly, these changes should be backed by sustain-

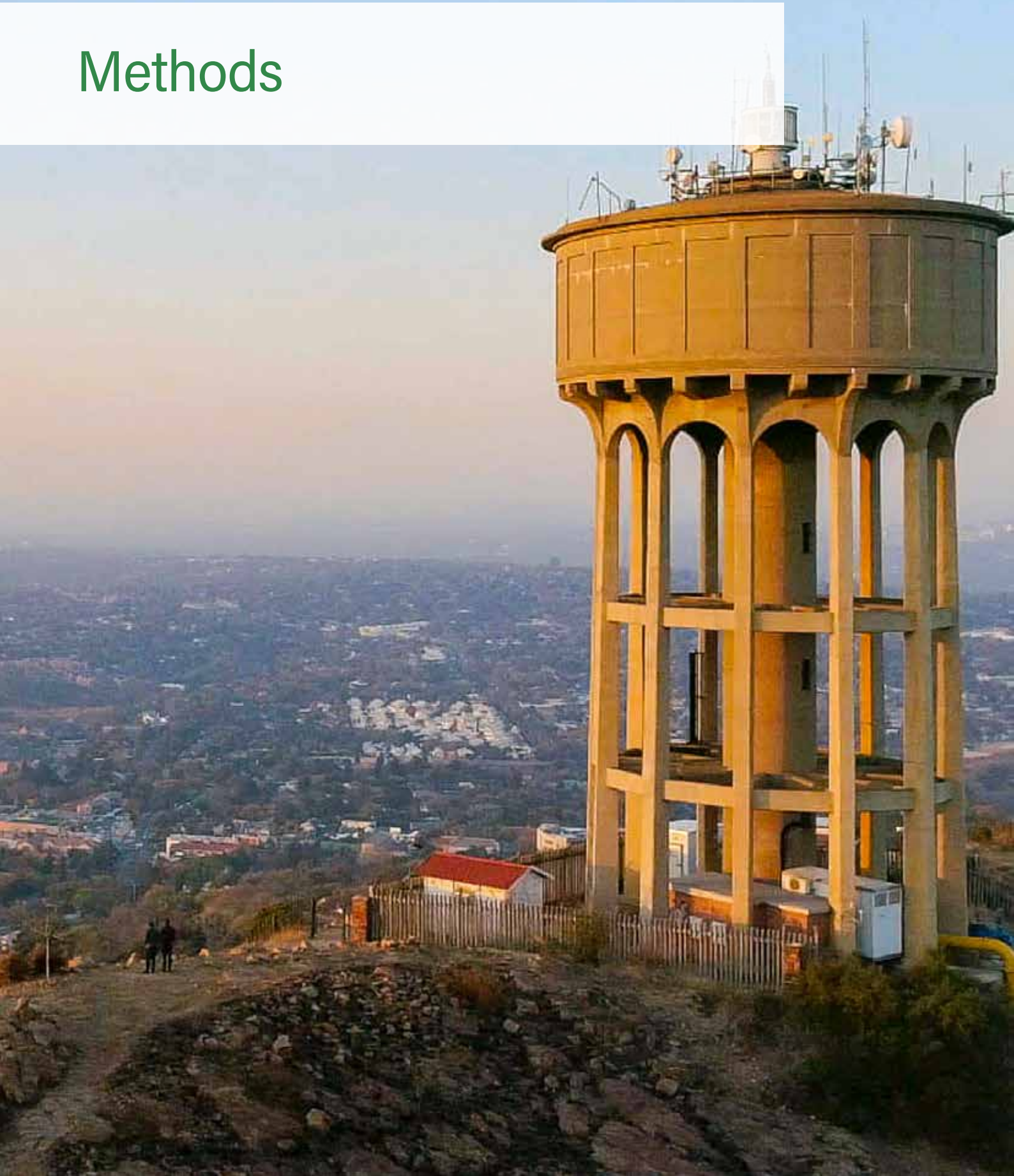
able financial investments and arrangements, aligned across sectors, that holistically build resilience.

The goal of this report is to consolidate key insights and lessons learned from applying the UWR approach in six African cities, and to the extent possible, demonstrate how these cities have moved from strategic engagement and planning with a variety of actors, towards implementing priority activities and projects on the ground. The authors discuss the unique and shared challenges and priorities across the six cities, plans for scaling and future engagement, and recommendations based on the reflections and lessons from applying the UWR approach. This report will further develop and document the evidence base and support dialogue among key stakeholders. It aims to advance national and regional policy alignment and investment to promote implementation of urban water resilience interventions within and beyond the cohort of six cities. Ultimately, transitioning to a water-resilient city requires collaborative action, alignment, and documenting lessons learned, which this report supports.

The publication is organized into seven sections. The Introduction provides the context for the report. "Methods" outlines the data collection and analysis methodologies used in the UWR approach which describes the strategy and where it has been applied. "Moving from planning to implementation" highlights examples of successes in moving from strategy to sustained implementation. "Insights and lessons from applying the UWR approach" presents key insights from applying the UWR approach, while "Scaling the UWR approach" explores opportunities for further expansion efforts via coalition building, funding, and financing instruments to address city priorities. Finally, "Recommendations" synthesizes best practices, and common drivers that emerged from implementation of the approach.



Methods



The research question guiding this report and its methodology is, “What insights and lessons can African cities draw from the experience of applying the UWR approach to advance water resilience?” Secondary questions comprise the following:

- What obstacles do African cities face when implementing and scaling urban water resilience approaches?
- What does an analysis of these six cities’ UWR priorities reveal, especially with regard to common issues and opportunities for finance and implementation?
- What concrete outcomes, if any, have been achieved so far through the UWR approach?

To answer these questions, the authors primarily relied on qualitative research methods, including a review of existing literature and city documents produced through and alongside WRI’s UWR in Africa Initiative. They also conducted interviews with staff from WRI, international and local partner organizations, as well as stakeholders who participated and were involved in the approach. In addition, the analysis drew on the authors’ collective experience in implementing the UWR approach.

Data collection

- **Document and literature review:** Source documents include the 2021 Pathways report, which provides an overview of the main challenges facing each city, as well as the CCRs, City Profiles, and Action Plans developed for the six cities covered by this research. These reports include important contextual information on each city as well as their visions, actions, and priorities. Additionally, authors made use of the wealth of information WRI has collected and documented for the pilot cities and urban resilience more generally, in the shape of workshop notes, presentations, and other project materials from the last several years of the program. This information was compiled into a City Synthesis document for each city to assist in the development of this report.
- The authors also conducted a **small-scale review** of urban water resilience literature in Africa and globally to update the socioeconomic and political contexts outlined in the 2021 Pathways report, ensuring inclusion of the latest research and statistics. This review covered materials published in 2020 or later, including the latest UNEP adaptation gap findings, and included key search words such as:

- “urban water resilience” AND “(name of city)” (same search for other case study cities)
- “city water resilience” AND “(name of city)” (same search for other case study cities)
- “urban water resilience” AND “best practices”
- “city water resilience” AND “best practices”
- **City data:** The baseline discussion for the six cohort cities was envisioned to have two levels:
 - The first level of city data envisioned was a baseline with regard to the state of practice, action, and finance on water resilience activities before and after the UWR approach was applied. Much of the UWR work was to develop action items that could further be developed into projects. The authors reviewed how many actions were identified, how many vision statements this led to (as part of the CWRA methodology, see Arup et al. 2019), and the resulting developed pipeline of projects or other changes in each city. Some of these projects were incorporated into the SUNCASA proposal, which resulted in on-the-ground implementation currently taking place in three of the cohort cities. Other projects have been prioritized for funding as part of WRI’s GGI Accelerator which aims to attract financing for projects utilizing nature-based solutions (NBS). All actions were compiled into a City Profile and Action Plan (referred to in short as each city’s “Action Plan” throughout this document). All action plans were signed by the city to demonstrate commitment to UWR as a priority going forward. In Kigali, the entire Kigali Action Plan was integrated into the city’s Resilience Roadmap, while in Johannesburg, the Johannesburg Action Plan was integrated into the city’s water security strategy’s implementation planning. In Musanze, one action identified was for the city to develop a stormwater management master plan. Following the validation workshop, the development agency, Enabel, provided funding for Musanze to conceptualize and design a stormwater master plan, which was then further developed through a project funded by the World Bank and implemented by the Rwanda Water Resources Board. Additionally, cities have committed their own funding to new priorities. An example is in Addis Ababa where commitments have been made to implement identified NBS projects for urban resilience.
 - The second level of city data was, to the extent possible, to draw a baseline of actual indicators of access to water, water quality, level of climate risk, etc., which impact water security and resilience. Data were sourced from the World Resources Report

database (site of WRI's flagship publications), the 2021 Pathways report, Aqueduct, WRI's Cities Data Dashboard, and staff involved in the UWR approach to provide an aggregate picture for African cities. However, data were too limited, incomplete, or incomparable across cities to form an adequate baseline. Therefore, this dimension was not included. Nevertheless, the section outlining the approach used in this report includes contextual data and statistics for each city, providing an overview of existing water- and climate-related vulnerabilities. This includes summarizing the analysis completed as part of the selected CWRA methodology. The methodology employs a developed and tested framework that provided a way to assess a city's current practices through 62 qualitative and 40 quantitative indicators. These indicators, designed by Arup and partners, were broken down into four dimensions: leadership and strategy, planning and finance, infrastructure and ecosystems, and health and well-being. Their aim was to assist cities in measuring the performance and assessing the overall resilience of their current water systems. At the end of the process, each city was given the full analysis with all the compiled scores from the diverse set of stakeholders who participated in the exercise. More information on this methodology, including its development and validation process, can be found on the Arup website (Arup et al. 2019).

- **Interviews** were a critical component of the methodology. While the existing documentation was reviewed extensively, many of the reflections and lessons emerging from the implementation of the UWR approach were not captured in official city documents or other written sources. As a result, these insights were gathered primarily through interviews and the firsthand experiences of the authors and practitioners involved. Authors conducted eight interviews lasting approximately 45–70 minutes each. The full questionnaire is available in Appendix A.
- **The collective experiences of the authors** working on water resilience issues in African cities: Through funding provided for the UWR in Africa Initiative, WRI built the team's capacity and city experts were hired across Ethiopia, Rwanda, and South Africa to facilitate and strengthen the UWR approach. This team worked both in-person and remotely (due to COVID-19 restrictions) with city stakeholders, sharing information on the processes of the approach, organizing workshops, collecting data on feedback, commitments, and validation, and conducting follow-up activities as necessary (Figure 2). The authors of this report played a key role in applying the UWR approach across the six cities. As a result, the report draws on

FIGURE 2 | Due to the COVID-19 pandemic, teams had to be flexible with different facilitation tactics in accordance with each city's restrictions at the time. This photo captures measures taken in Addis Ababa during the Visioning Workshop.



Source: World Resources Institute.

their firsthand experience, documenting lessons and insights gained throughout the process—from research and analysis to planning and implementation.

Analysis

A comparative synthesis and analysis of cities' implementation of the UWR approach involved:

- A **thematic and content analysis** based on available city-related documentation and semi-structured expert interviews to identify the main priorities, operational challenges, successful (and unsuccessful) intervention components, enabling factors, lessons learned, and other patterns in the cities. Authors identified relevant themes and listed these with as much detail and causality between planning and action as possible to assist with parallel process tracing (Collier 2011). Cities' priorities were visualized in a heat map (see Figure 13).
- **Tracking emerging and recurring themes** present in one or more cities, and developing a table (e.g., using Excel) for cross-comparison. The table captured key factors contributing to success (e.g., strong and sustained political leadership, flexible financing, existing financing mechanisms), challenges, and lessons. These were grouped into thematic categories and discussed in the section on insights and lessons learned from applying the UWR approach. The report does not assess effectiveness or full impact, since these outcomes have not yet fully materialized. However, it seeks to illustrate

how conditions have changed in the cities before and after application of the UWR approach by tracking selected indicators that may signal interim progress or emerging impacts. Indicators checked included:

- Number of city action items developed by city stakeholders in each pilot city before and after the UWR approach was applied.
- Number of urban water resilience vision statements developed by city stakeholders before and after the UWR approach was applied.
- Number of city-level UWR action items in each city that developed into projects before and after the UWR approach was applied.
- Increase in the amount of financing that can be traced to the UWR approach.

9. **Discussions between co-authors and broader WRI water resilience experts on the emerging themes and patterns.** These conversations helped interpret and expand the findings, while also offering insights into underlying causal relationships. They were useful for outlining the evidence to demonstrate how cities moved from strategy and planning to piloted initiatives and sustained implementation, spotlighting the factors that enabled and spurred implementation alongside any cobenefits experienced thus far, especially to vulnerable groups. The authors were able to incorporate concrete outcomes, including the SUNCASA project and community involvement, stakeholder engagement, and participatory processes, with support from WRI experts working on SUNCASA and advancing other tangible outcomes of the UWR approach to date.

Limitations

It is important to acknowledge the limitations of this report. One of the primary limitations was the difficulty in establishing a comprehensive city-level quantitative baseline for current water resilience across the six pilot cities. Limited availability, consistency, and comparability of city-level data constrained the authors' ability to systematically assess changes in urban water resilience indicators over time, or determine whether resilience outcomes measurably improved following implementation of the UWR approach. In many cases, relevant datasets were incomplete, outdated, non-existent, fragmented across institutions, or unavailable at the spatial and temporal resolution needed for rigorous evaluation.

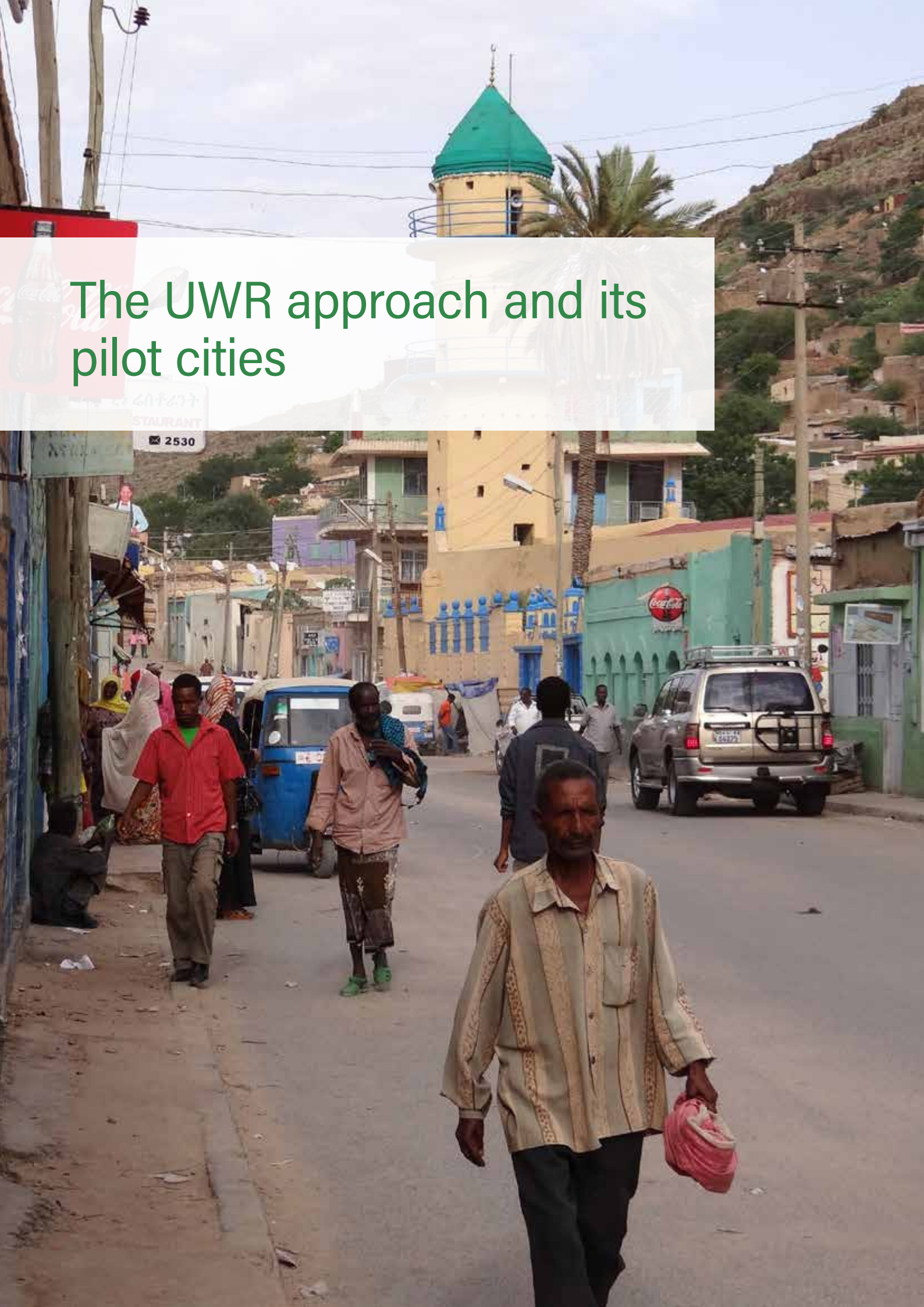
Moreover, the relatively short timeframe between implementation of UWR activities and this assessment may not have allowed sufficient time for measurable resilience outcomes to materialize in the pilot cities. Many urban water resilience interventions—particularly those involving governance reforms, institutional coordination,

infrastructure planning, or behavioral and policy changes—typically produce impacts over longer time horizons and are influenced by a wide range of factors. As a result, several observed outcomes may currently reflect early enabling conditions, strengthened stakeholder engagement, improved planning processes, or increased institutional awareness rather than fully realized resilience impacts. Additionally, the authors recognize that not having contrasting cities where the UWR approach was not followed limits the attribution of observed changes to the approach itself. When gathering information for possible attribution or correlation, the authors therefore focused on gathering inputs on progress and implementation to date that could be directly linked to the UWR approach, including the design and funding of related projects and interventions, as well as changes in government policies to achieve cities' goals as stated in their vision statements.

In the following years, gathering evidence on the quantitative changes taking place will be important to identify the magnitude of progress and the changes attributable to the adoption of the UWR approach itself. As much as possible, authors make clear linkages from the UWR approach to the policy, implementation, or finance-based outcome in each city to avoid over-attributing the observed outcomes of the approach.

Another limitation of the study is the relatively small interviewee sample for the lessons learned portion of this report. This was due to time and funding constraints that did not allow for a formal re-engagement process with all stakeholders across the pilot cities, particularly given their substantial involvement in the UWR approach itself, including the validation workshops that took place in each city. Interviewing a larger and more diverse group of participants would have yielded deeper insights and a broader range of examples, enhancing understanding of the lessons learned from applying the UWR approach. To address this limitation, the authors reviewed existing literature on similar lessons learned for this sector and type of approach to, as much as possible, validate with external sources.

The UWR approach and its pilot cities



WRI launched the UWR in Africa Initiative in 2020 to collaborate with and support African cities with their adaptation to current and future water risks, including climate risks, and to improve access to sustainable and durable water supply and services across sectors and users. The objective of this initiative was to work with cities to overcome barriers and vulnerabilities through research, technical assistance, knowledge sharing, and partnerships for collective action. To accomplish this, the initiative planned to roll out one unified implementation approach across a cohort of pilot cities. This process included initiating research to identify pathways for change (i.e., policy, planning, governance interventions); working with a diverse group of city stakeholders to map key water, climate, and development risks facing the city; setting targets and owners for action; and catalyzing implementation of priority actions through various capacity-building programs including providing technical assistance and supporting knowledge exchange; as well as soliciting commitments from regional and national stakeholders to create an enabling environment. Figure 3 visualizes the elements that make up the unified implementation approach, which became known as the UWR approach.

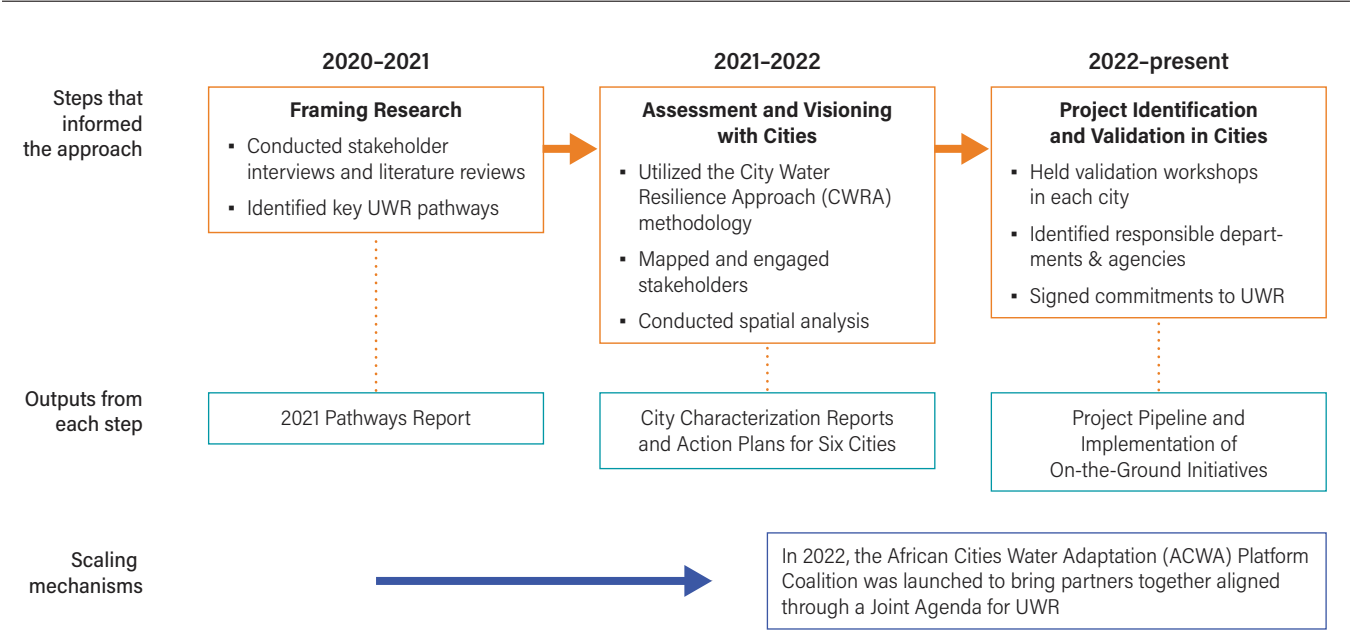
By developing a program delivery strategy to support integrated planning in multiple cities, this process enabled the six African pilot cities to identify and commit to over 100 place-based policy, program, and infrastructure interventions to build water resilience. The identified actions address the entire water system encompassing both the city and its upstream catchment areas. They are designed to

address shocks and stresses affecting the system, as well as those arising from it.

The strategic UWR approach began with framing. In close consultation and interviews with pan-African and in-country organizations and partners across cities such as Addis Ababa, Cape Town, Kampala, and Nairobi, the WRI team developed a roadmap for action within the 2021 Pathways Report. This roadmap identified key pathways to strengthen climate and water resilience, engaging both national and city leaders to understand the support required for implementation, while also building a network of high-level political actors to increase ambition. This framing research was compiled into a report entitled, “Water Resilience in a Changing Urban Context: Africa’s Challenge and Pathways for Action”, also referred to as the 2021 Pathways Report (Workalemahu et al. 2021). The publication assessed the current state of knowledge and developed an Africa-centric body of evidence and case studies, through engagement, data sharing, and consultations. Specifically, it provided robust research to enhance awareness and understanding of urban water challenges and pathways, especially for actors in the urban development and water spaces.

Key barriers to addressing urban water challenges identified by the framing research include: a lack of capacity and data to prepare for risks; adherence to business-as-usual practices, and reluctance or lack of knowledge to take up new approaches; limited coordination across jurisdictions and siloed sectoral practices; as well as limited financial resources and accumulated debt (Workalemahu et al. 2021).

FIGURE 3 | Elements of the UWR approach



Source: Authors 2026.

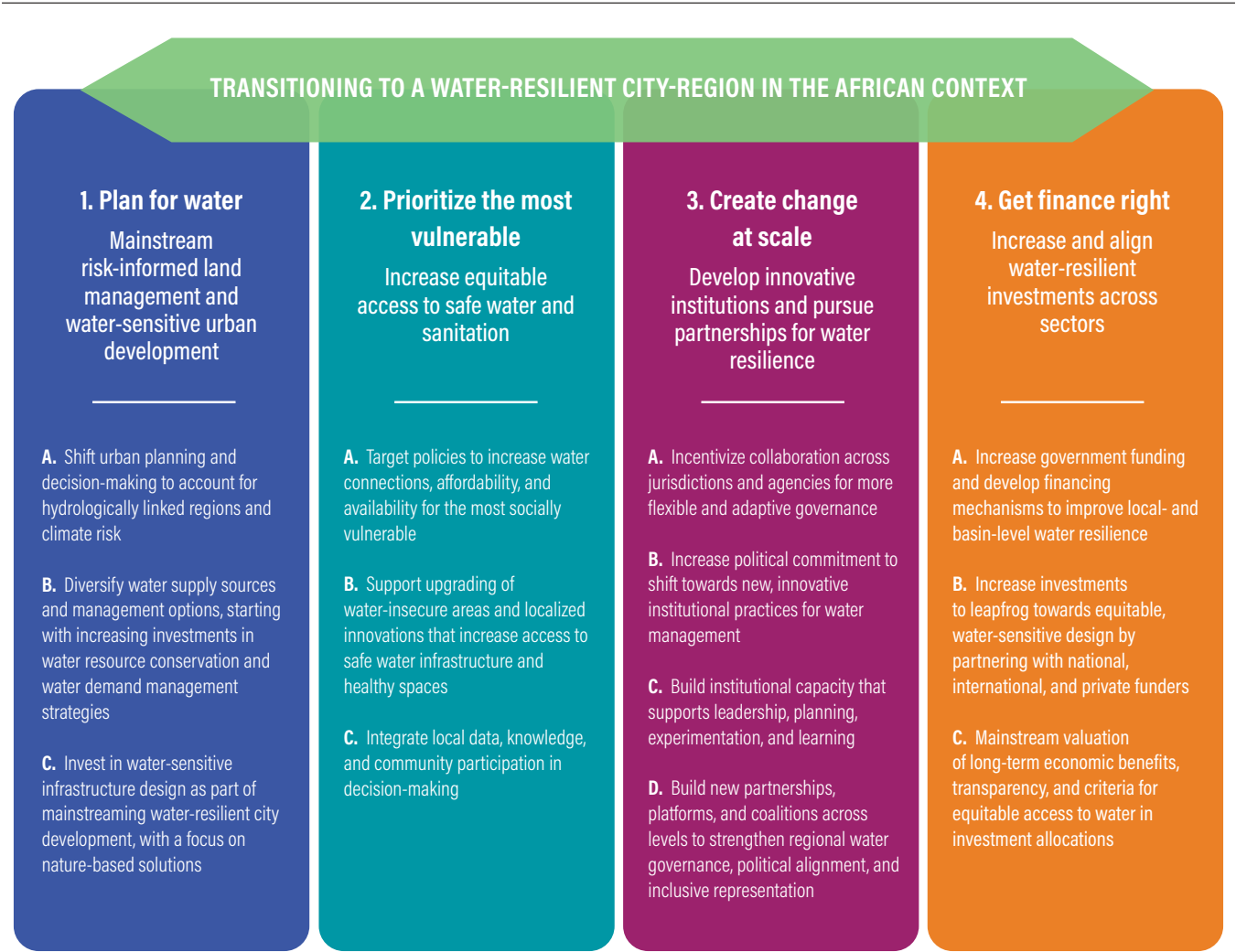
The 2021 Pathways Report provided a roadmap for strengthening urban water resilience in rapidly growing African cities facing increasing (formal and informal) development pressures. It identified pathways to help cities manage both unanticipated shocks and chronic, day-to-day stresses while ensuring the delivery of equitable, affordable, and safely managed water services. This roadmap requires actors to connect the realities of cities with basin-level issues and link water to crosscutting urban issues, such as land use, social equity, and service provision. There is a need to enable action on the regional scale, shifting water practices for hydrologically linked areas.

This research highlighted the importance of prioritizing the most socially vulnerable groups, tackling social and political barriers that leave these groups most exposed to water-related shocks and stresses. Most importantly, the report emphasized that cities could drive change towards a new approach as they are centers of innovation and

political ambition that can lead action across stakeholders and multiple levels of government. The four pathways are identified in Figure 4.

Following the framing of key challenges, opportunities and state of current practice, the next step of the approach was to build partnerships with a shared vision for strengthening water resilience action through empowering cities, as cities are well-situated to drive change at the local level. As such, WRI partnered with a cohort of six cities and their regional and national governments to provide support toward advancing city water resilience agendas. WRI worked with each city in partnership with Arup and the Resilient Cities Network, utilizing the methodology outlined within the CWRA, a step-by-step guide developed by Arup. The local partner organizations included the Ethiopian Institute of Architecture, Building Construction and City Development (EiABC) in Addis Ababa; Haramaya University in Dire Dawa; Bantu Design

FIGURE 4 | Four pathways for transitioning to a water-resilient city-region in the African context



Source: Authors of WRI’s 2021 Pathways Report.

in Kigali; Rwanda Young Water Professionals (RYWP) in Musanze; and Zutari and the South African Cities Network in Johannesburg and Gqeberha, respectively. The engagement with each city followed the same structured multi-stakeholder planning process outlined through a number of distinct steps (Arup et al. 2019).

Steps in the UWR multi-stakeholder planning process

Step 1: Understanding the system

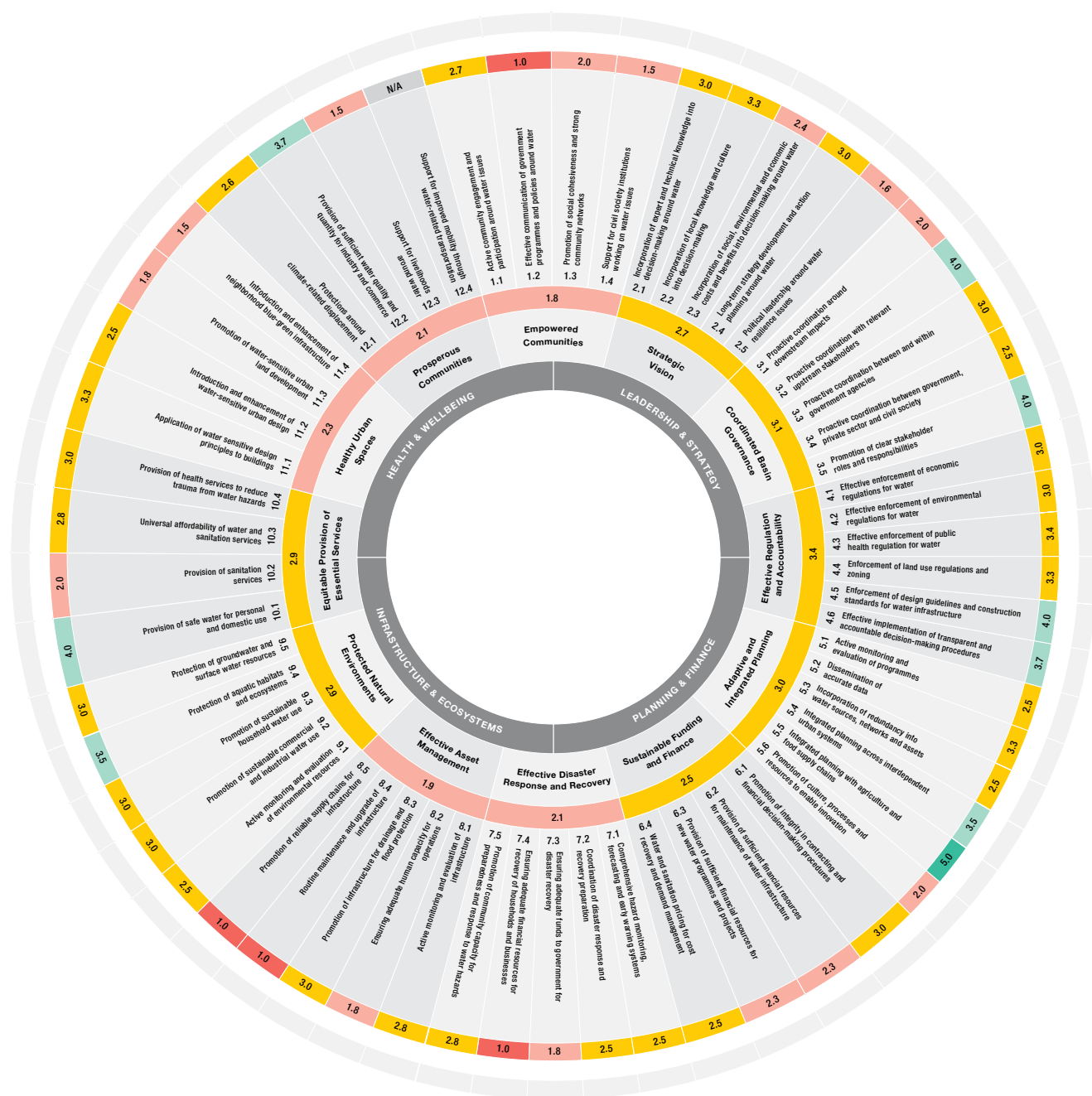
The project team worked with the identified local partner organization in each city to compile and process data to prepare a CCR. The report defined the water basin of the city including key water assets, the urban water systems and its governance structure, as well as the interdependencies with other systems such as energy, agriculture, or transportation. It identified the factors contributing to the resilience of the city water system and those increasing its vulnerability. The CCRs utilized WRI's expertise in spatial mapping and trend analysis of the city's blue-green and gray assets, as well as hazard scans to assess areas that may experience water shortages, flooding, and other impacts due to climate change and development-related decisions. These baseline reports provided the framing for a deeper assessment in Step 2.

Step 2: Assess Urban Water Resilience

The project team implemented multi-stakeholder assessment workshops in close cooperation with local stakeholders. The objective of this step was to assess the city's current practices and risks using CWRA, whose methodology includes a performance-based framework, and the OurWater governance stakeholder mapping tool. The workshops each gathered over 30 subject matter experts from government, academia, civil society organizations (CSOs), development partners, and the private sector to participate in roundtable discussions. The stakeholder mapping process highlighted the reason for engagement, power/influence, engagement approach, and responsibilities related to water resilience. The assessment process brought together these stakeholders to generate a qualitative and quantitative understanding of the city's key water resilience challenges and opportunities. Workshop participants collectively assessed their city's overall water resilience baseline by scoring the indicators identified in the CWRA on a scale of 1 (poor) to 5 (optimal). The indicators fall within four dimensions: leadership and strategy; planning and finance; infrastructure and ecosystems; and health and well-being (Arup et al. 2019).



FIGURE 5 | An example of the scoring wheel methodology from Arup's City Water Resilience Approach



Note: This indicator scoring wheel is the result of the Gqeberha assessment workshop.

Source: Gqeberha City Water Resilience Profile & Action Plan, 2023.

Step 3: Develop an Action Plan

To move from challenges into action, this step reconvened workshop participants in each city to develop a city action plan informed by the completed qualitative and quantitative assessments. WRI and partners guided city stakeholders through a problem framing and visioning workshop to create a shared vision of urban water resilience tailored to each city (Figure 6). The goal of this step was to identify and develop interventions that have multi-stakeholder buy-in to address the city's specific challenges. Follow-on work included validating priority actions in each city-region, identifying action owners, building a project pipeline, and highlighting potential implementation pathways for African cities to build water resilience. Each action plan was signed by a representative from the city to demonstrate their commitment to and ownership of the final City Water Resilience Profile and Action Plan.

Throughout this process, WRI's targeted technical assistance offer included areas such as: enhancing spatial planning processes inside and outside of the city jurisdiction for improved water and climate resilience; improving land development regulations and incentives; helping cities and basin actors reduce future vulnerabilities to water and climate shocks and stressors through basin governance systems; helping cities and basin actors mainstream climate resilience and NBS into infrastructure design processes; and helping cities to develop bankable project proposals that can attract funding.

The cohort cities

The six cohort cities were selected based on four key criteria including representation of diverse water and urban risk profiles; a balanced cohort in terms of climatic, geographic, and water dependency contexts; institutional factors that demonstrate commitment and alignment between city, regional, and national government programs towards advancing water resilience in the region; and demonstrated interest from the city with a signed letter of commitment and assigned point of contact. The point of contact identified in each city was key to assisting with program coordination between WRI and the local and global partners.

Addis Ababa, Ethiopia

Addis Ababa was the first city where the UWR approach was implemented. For this work, the team collaborated directly with the Addis Ababa Resilience Project Office, which identified water resilience as a priority area of intervention in the city. More specifically, the goal identified in Addis Ababa was to support Action 32, "Build a Water Resilient City" within the Addis Ababa Resilience Strategy released in 2020 (Global Resilient Cities Network 2020).

FIGURE 6 | Stakeholders participate in a breakout discussion during the Visioning Workshop in Gqeberha, applying the CWRA visioning methodology



Source: Zutari 2022

As Ethiopia's historic capital, Addis Ababa is home to nearly 5.9 million people and is growing rapidly. As the city expands, it faces mounting climate challenges that are straining infrastructure and threatening its most vulnerable communities. Informal settlements—many located along flood-prone riverbanks—are particularly at risk. In March and April 2023, heavy rains and devastating floods affected around 240,000 people in Ethiopia, with 29 reported deaths (The United Nations Office for the Coordination of Humanitarian Affairs (UN OCHA) n.d.). Rising temperatures, erratic rainfall, and more frequent extreme weather events are placing enormous pressure on public health, livelihoods, and essential services.

Addis Ababa's recent challenges with unchecked urban development have become one of the biggest stressors on the city's water system, increasing its vulnerability to flooding due to expanding impermeable surfaces and insufficient drainage systems (Workalemahu et al. 2021). Although addressing potential water-related tensions between the city and neighboring communities was beyond the scope of this study, such tensions should be considered in water planning and management processes.

Further, climate change is expected to complicate the city's ability to meet its water needs due to shifts in the timing, intensity, and spatial distribution of rainfall. In Addis Ababa, both water access and continuity of supply remain major constraints to UWR, despite expansion of the piped network. Non-revenue water (NRW) is water that has been produced and is "lost" before it reaches the customer; for example, through leaks, theft, or metering inaccuracies (van den Berg 2015). In Addis Ababa, NRW levels are high, approximately 40–42 percent, and largely due to leaks, aging infrastructure, illegal connections, and limited maintenance capacity. This significantly reduces the volume of treated water that reaches consumers, with an estimated 5 million cubic meters (m³) lost per month

(World Bank 2020). Consequently, many households receive piped water only two to three times per week, with more severe intermittency in peripheral and high-elevation neighborhoods where system pressure is weak (Figure 7). Rapid population growth, underinvestment in infrastructure expansion, groundwater over-abstraction, and climate variability further exacerbate supply unreliability. Intermittent distribution also increases contamination risks through pressure fluctuations and household storage practices, disproportionately affecting low-income communities. Together, these structural, technical, and environmental factors explain why sustaining continuous and equitable water supply has remained a persistent challenge in Addis Ababa.

The aim of the approach for Addis Ababa was to strengthen the city's capacity to manage its public water supply system more effectively and improve service delivery, particularly for the urban poor. It also sought to minimize waste, maximize resource efficiency, protect ecosystems, prevent pollution, and ultimately support the city's transition towards greater resilience and prosperity. WRI developed a series of spatial data narratives for the city, including built-up growth, land use, population, and vegetation trend analysis for city-level analysis. The team also looked at

surface water loss, forest cover loss, and precipitation trends and scenarios for the basin and sub-basin levels. The group then worked closely with the Resilience Project Office and other city authorities to develop the resilience profile based on workshop findings. In parallel, the French Development Agency (AFD) provided additional funding to WRI and EiABC to support the city of Addis Ababa to develop a Strategic Solutions NBS Framework. Designed as a rapid assessment tool, the framework helped identify priority areas for NBS interventions to address current climate risks and strengthen urban resilience. This work is ongoing with the Addis Ababa Urban Beautification and Green Development Bureau to explore opportunities to target needs such as flood mitigation and river management.

The final Addis Ababa City Water Resilience Profile and Action Plan was informed by several years of research related to water resilience, shocks, and stresses. Preliminary research was undertaken in Addis Ababa to form the basis of the CCR. The EiABC was contracted as the local partner to help deliver this work and research Addis Ababa's unique context. The CCR findings demonstrated that the city and water system on which it depends are vulnerable to a wide range of shocks and stresses, including man-made

FIGURE 7 | Water tanks across Addis Ababa's buildings help residents circumvent poor water supply and meet the rising demand of the city's growing population



Source: Fikresilassie et al. 2025.

ones such as inequitable economic transformation and rapid urbanization. The assessment underscored the need for continued efforts to identify and implement actions that complement the Addis Ababa City Administration's multifaceted approach in addressing critical urban challenges focusing more specifically on building water resilience.

Dire Dawa, Ethiopia

Dire Dawa is Ethiopia's second-largest city and has been facing mounting pressures from rapid urbanization, worsening water and housing shortages, and escalating climate risks. Flash floods, extreme heat, soil erosion, and severe groundwater depletion—wells now reach depths of up to 600 meters (m), compared to nearly 100 m in earlier periods—pose serious challenges not only for the city but also for surrounding towns (Kebede et al. n.d.-a). With a projected 50 percent population increase by 2037 and launch of an Industrial Park and Free Trade Zone in 2025, demand for water and resilient infrastructure is expected to rise significantly. At the heart of these challenges lies the degradation of the Dechatu River catchment, driven by unplanned expansion of the city, deforestation, agricultural expansion, and loss of native vegetation.

Dire Dawa faces growing water-related risks due to both scarcity and flooding. The CCR exercise, conducted in partnership with Haramaya University, identified the following key challenges: limited water coverage (77 percent), aging infrastructure, low revenue collection, and unregulated groundwater extraction leading to severe depletion (Kebede et al. n.d.-a). Dire Dawa is particularly vulnerable to flash flooding from the Dechatu River that flows through the center of the city (Figure 8). Intense rainfall in the upstream catchments, combined with deforestation, reduced vegetation cover, and rapid runoff, makes the city vulnerable to frequent and destructive flash floods. These floods threaten lives, damage infrastructure and property, and disrupt essential services, highlighting the urgent need for improved catchment management, urban drainage, and flood preparedness measures (Kebede et al. n.d.-a). In Dire Dawa, water scarcity is driven not only by limited water availability, but also inadequate and unreliable infrastructure. Low access rates are often the result of infrastructure constraints and failures, such as power shortages and pump breakdowns, which reduce system performance and disrupt regular supply of water.

The City Water Resilience Profile and Action Plan report was a key step for the city of Dire Dawa on its continuous journey towards overcoming its water challenges, strengthening its capacity to manage the water supply while building water resilience for years to come. Scaling up these urban water resilience efforts across different sectors can significantly enhance groundwater recharge, reduce runoff, and build a more water-resilient Dire Dawa city.

FIGURE 8 | The Dechatu riverbed in Dire Dawa remains dry for most of the year, and floods during the short rainy season



Source: World Resources Institute 2023.

Kigali, Rwanda

Flooding and landslides are the climate hazards of greatest concern in Kigali, both of which are heavily influenced by the country's predominantly rugged and steep topography (Figure 9). Widespread unplanned urbanization has led to the expansion of settlements and developments into high-risk areas that are vulnerable to flooding and landslides. At the same time, the expansion of impermeable surfaces and loss of natural areas have increased the frequency and intensity of flooding and landslide risks, particularly in the northern and western parts of the city. In the urbanized areas, open and green spaces are very limited, partially due to the unplanned manner of urban growth. Wetlands constitute the only remaining large open green spaces within the densely urbanized city center, and most are currently used for agricultural purposes. These wetlands perform critical environmental functions such as purifying, storing and releasing water, as well as buffering the impacts of floods. Ongoing efforts by the government include rehabilitation of these urban wetlands to restore

their ecological functions. Due to insufficient sewage treatment and drainage capacity as well as unsustainable (urban) agriculture, pollutants are transported into the wetlands and cause further degradation.

In Kigali, the objective of the UWR approach was to contribute to the implementation of the Kigali Master Plan 2050 and the Kigali Integrated Development Strategy (IDS) 2018–2024. This work builds on the Resilience Baseline Assessment and Roadmap developed by the Kigali City Resilience Unit and Chief Resilience Officer as part of Kigali’s resilience journey, which began when the city joined the Resilient Cities Network. The aim was to strengthen the city’s capacity to manage the public water supply system more effectively, improve water service provision particularly for the urban poor, minimize waste and make the most of resources while at the same time protecting ecosystems and preventing pollution, and reduce water scarcity, all towards helping Kigali to become a more thriving, resilient city.

Here, WRI worked with the city, specifically the Chief Resilience Officer, to conduct the UWR approach. The preliminary research culminating in the Kigali CCR was undertaken by Bantu Design in close collaboration with

FIGURE 9 | An example demonstrating the common problem of landslides and erosion in the City of Kigali



Source: World Resources Institute, 2024.

the Chief Resilience Officer. As a parallel process, AFD provided additional funding for WRI and RYWP to develop a Strategic NBS Framework with the city of Kigali. This framework leveraged data tools and rapid analysis to support further decision-making on NBS and GGI to address water risks.

Musanze, Rwanda

Musanze’s economy is quickly growing and undergoing fast urban transformation. The three main aspects contributing to the fast economic development of the city include the fact that it is an attractive area for tourists, an agricultural area (with fertile land) and a growing residential area (due to its cool ambient temperatures). Natural hazards that affect Musanze are mainly floods, stormwater runoff, landslides, and occasional earthquakes. Flooding is largely driven by the region’s steep terrain and inadequate drainage infrastructure. In addition, Musanze’s geology is complex due to underlying volcanic rock formations which have created a complex network of caves with poorly understood subsurface interconnections.

The main goal of the approach for Musanze was to align all plans and efforts in the city to ensure that it achieves long-term water resilience. A first meeting was conducted with key district officials to validate the stakeholder mapping and incorporate valuable input on additional stakeholders to include due to their relevance to urban water resilience. Intensive research was conducted by RYWP in partnership with WRI and in close collaboration with the city’s district leaders to develop the CCR. Discussions with local experts and stakeholders allowed a deeper understanding of the shocks and stresses that the city is confronting, including both upstream and downstream dynamics. Two workshops were held to develop the Musanze City Water Resilience Profile and Action Plan, including an assessment and a visioning workshop. Both events were held for a consecutive period of five days, with one day in between for facilitators and notetakers to pre-process the findings from the assessment workshop and to prepare for the visioning workshop. At the close of the proceedings, the team had identified 11 clear opportunities, which were further assessed, refined, and consolidated into a validated set of visions reflecting the priorities for Musanze’s resilient future as defined by its stakeholders.

Johannesburg, South Africa

The city of Johannesburg lies at the watershed divide and sources of two catchment areas and yet lacks a significant water body that can act as a source to meet its water needs. The city is therefore reliant on neighboring catchments for regional water supply, as well as on the neighboring country of Lesotho, through international water supply treaties. Additionally, this supply system is mainly reliant

on surface water, which is largely vulnerable to climatic extremes, while alternative supply sources such as groundwater remain largely unexplored. Even though the city has experienced multiple near-Day-Zero threats of taps running completely dry, Johannesburg continues to experience high levels of NRW estimated at 46 percent, with physical water losses (terminology referring to losses through leaks before it reaches the customer) accounting for 36 percent of that (City of Johannesburg 2022). NRW also includes apparent, non-physical losses such as theft or metering inaccuracies, as well as deemed consumption under flat-rate billing systems. The tightening and upgrading of current water billing systems is identified as one of the key instruments for reducing the non-physical water losses.

While Johannesburg receives its water supply from neighboring catchments, its own water sources continue to be in a dire state. The city's two major rivers, the Jukskei and Klip, once a vital lifeline feeding into the two catchments downstream and protecting the area from flooding, are now overwhelmed by pollution, sewage, invasive alien plants, and waste—threatening its related ecosystem and the health and safety of over 5.6 million people, especially those living in informal settlements situated in floodplains. Fast-paced urban growth and degrading infrastructure have turned the urban rivers into a public health hazard. Johannesburg's topography, challenges with stormwater management, clogging of the rivers by alien invasive plants and waste because of constrained solid waste management leads to severe flooding during rainy seasons. Floodplains aimed at buffering citizens and infrastructure are increasingly becoming hot spots for establishment of informal settlements, while increase in impermeable surfaces and inadequate drainage systems further aggravate flooding. The combination of climate change and further construction pressures are expected to exacerbate the situation in the years to come.

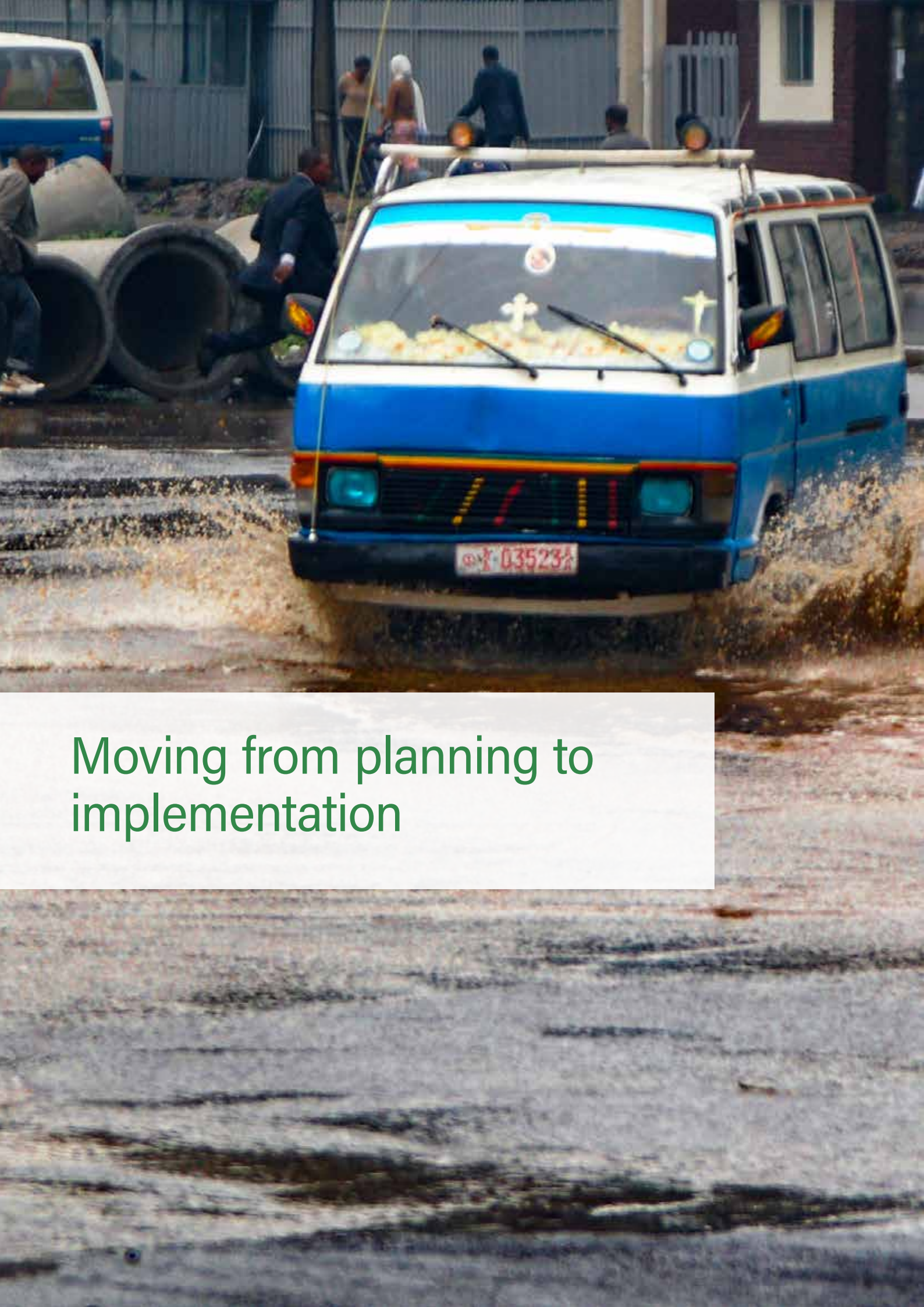
The City of Johannesburg faces the challenge of extending water access to all its inhabitants amid rapid population growth and a rising number of informal settlements. The goal of the UWR approach here was to bring together a diverse group of stakeholders to look at the city's water system in an integrated manner and adequately manage catchment degradation trends before it is too late. This approach was conducted in partnership with the national Departments of Cooperative Governance and Traditional Affairs (COGTA) and Water and Sanitation (DWS), the Environment and Infrastructure Services Department within the City, the South African Cities Network (SACN), and

Zutari. The UWR approach set out to complement the city's existing and ongoing work in developing a Water Security Strategy and the benchmarking exercise the city completed using the Water Sensitive City Index. The approach was introduced to address gaps identified by the officials during the benchmarking exercise. It also aimed to facilitate complementarity and alignment with other water programs across city entities, including Joburg Water and the Johannesburg Roads Agency, ensuring that benefits to the city are considered in totality and fully realized. Specifically, the Water Security Strategy addressed 42 of the 57 sub-goals of the CWRA methodology. It became clear that it was important for officials to address the gaps such as improving productivity and resource efficiency, sustainable funding and finance, and effective regulation and accountability.

Gqeberha, South Africa

In May 2022, officials in Gqeberha (formerly Port Elizabeth) warned that the city was just weeks away from “Day Zero”, the point at which taps would run dry. Although emergency measures were taken to avert the crisis, the water situation in Gqeberha remains a persistent and looming threat. As South Africa's sixth-largest city, a central part of the Nelson Mandela Bay Municipality (NMBM) and part of the western Kromme Catchment, Gqeberha has grappled with prolonged droughts and critical water shortages that edge closer to this crisis point. Available water is subject to NRW losses of approximately 28 percent, largely attributed to physical losses from leakages (NMBM 2022). These risks are compounded by biodiversity loss and water basins degraded by the rapid spread of invasive alien plant species that outcompete native species and clog waterways, straining the city's natural and built systems (Beyer et al. 2025). The impacts are particularly severe in the city's informal settlements, where inadequate infrastructure leaves communities exposed to these growing climate threats.

The main objective of the UWR approach in Gqeberha was to ensure city water managers were considering climate change-related risks in planning for future water availability, as well as addressing long-term solutions for the extreme drought risk the city was facing at the start of the project. Following the 2022 drought, additional stakeholder engagements were held in Gqeberha before conducting any official CWRA workshops to discuss if this process could be adapted to address the urgent drought conditions and support the development of holistic, sustainable solutions. The Director of Water and Sanitation for the NMBM



Moving from planning to
implementation

was assigned to lead this project in partnership with WRI, SACN, and Zutari.

This section describes how cities moved from strategy and planning to piloted initiatives and sustained implementation, describing tangible outcomes such as the development of the SUNCASA project which emerged from the UWR approach, as well as aligned coordination under the GGI Accelerator. Factors that enabled and spurred implementation of both the UWR approach and on-the-ground action are also highlighted.

Implementation progress across the pilot cities

Throughout the execution of the UWR approach, stakeholders across all six cities emphasized the importance of ensuring that the reports developed during the process would not just remain on the office shelves of policymakers. A common pitfall experienced for assessment-based approaches is to conduct the assessments and then proceed to not utilize this research and information to move towards action. While this may complete donor deliverable requirements, it fails to be impactful for decision-makers in each geography. This concern was raised at the beginning of the assessment process: how could the teams ensure that the strategic planning efforts would be utilized once the process was finalized? To address this, the approach focused on the significance of moving from strategic plans to implementation. Specifically, the approach ensured the results were laid out clearly as actionable next steps in terms of policy, program, and project priorities that the city aimed to implement. These actions were then transformed into prioritized projects validated by key government

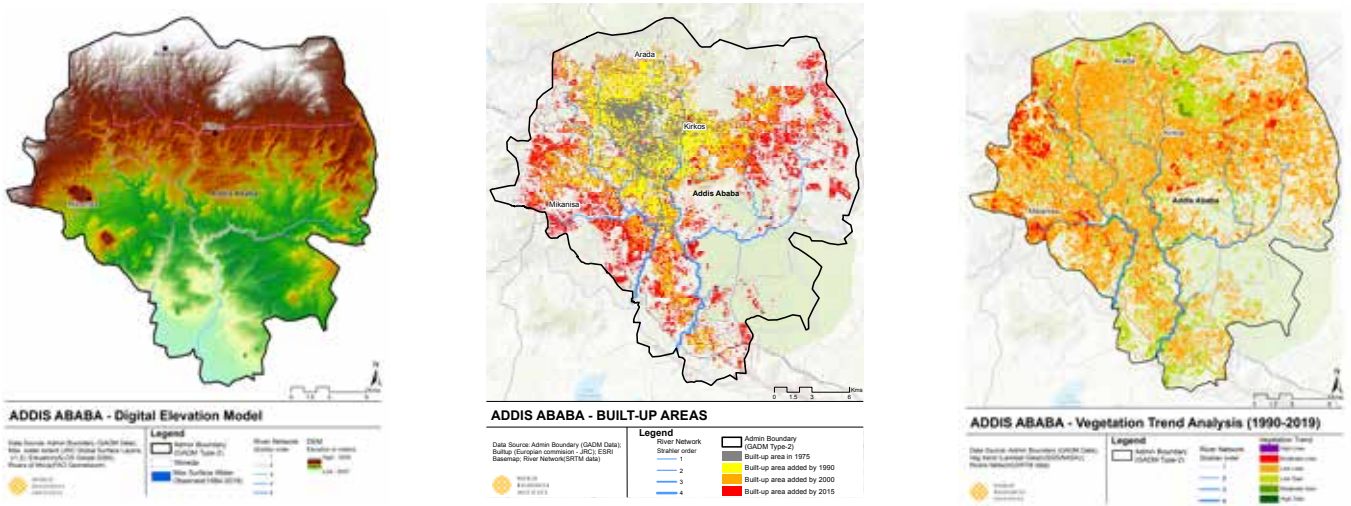
stakeholders. In addition, responsible agency leads in each city were identified to move these strategic actions forward, and the city provided approval of the resulting prioritized projects to attract funding for water resilience implementation.

For five of the six cities, applying the UWR approach resulted in the creation of geospatial and hazard risk mapping, integrated into each city's CCR, to identify and understand interlinked water resilience risks and aid in planning (such maps already existed in Johannesburg). Rapid spatial mapping and trend analysis shed light on each city's blue-green and gray assets, such as surface water, built-up areas, impervious surface, precipitation trends, and lifeline essential infrastructure. The hazard scans helped assess the urban areas that may experience water impacts through hazard risk maps for flooding and water supply. These maps could now serve as important tools for urban water resilience decision-makers. Figure 10 provides a snapshot of these maps.

The UWR approach methodology was key to mobilizing political support, delivering technical assistance, and unlocking funding and finance to effectively streamline the process of moving from planning to implementation for each city's unique context. Through this process, it was important to secure city commitment letters, build trust and credibility amongst city leaders, and deepen support to prioritize advancing water resilience in each city. It was critical to integrate resilience projects within the fold of city priorities and policies, aligning with existing processes to ensure local ownership and institutional buy-in.

A validation exercise was completed in each of the pilot cities as part of the approach. This validation resulted in utilizing the cities' water resilience profiles and action plans

FIGURE 10 | UWR approach resulted in the creation of spatial maps such as these for Addis Ababa



Source: World Resources Institute, 2021.

to confirm a pipeline of projects. About 30 participants attended each of the project validation workshops that took place in each city. Government officials also attended to ensure commitments were made, and points of contact identified for the prioritized projects. For example, at the Validation Workshop in Kigali in June 2022, the then Mayor, Lord Pudence Rubingisa, officially launched and signed Kigali's Water Resilience Profile and Action Plan (Figure 11).

This city validation process led to the finalization of a project pipeline consisting of eight projects in Addis Ababa, eight in Dire Dawa, eight in Kigali, six in Musanze, 11 in Johannesburg, and eight in Gqeberha. A City Project Identification Form was completed for each of these 49 projects to screen their readiness to develop financing solutions and secure funding. A common theme across the pipeline of urban water resilience projects was a focus on utilizing NBS and green infrastructure to address the city's water resilience. The identification of this priority through the project validation exercise led to securing funding for an NBS pilot program across Dire Dawa, Kigali, and Johannesburg, dubbed the Scaling Urban NBS for Climate Adaptation in Sub-Saharan Africa (SUNCASA) program. It is described in further detail below.

Funding on-the-ground implementation

The cohort of pilot cities have continued their journey to urban water resilience implementation through initiatives such as SUNCASA and the GGI Accelerator, and at times through changes in policy and decision-making.

SUNCASA

Following the validation phase and development of the project pipeline, the UWR approach successfully advanced a set of NBS pilot projects, which formed the foundation of the SUNCASA program in three of the six cities. SUNCASA, co-developed by WRI and the International Institute for Sustainable Development (IISD), is currently active in Dire Dawa (Ethiopia), Kigali (Rwanda), and Johannesburg (South Africa), and leverages the UWR approach's participatory planning methods, hazard mapping, and green infrastructure strategies to strengthen urban resilience. This three-year program (2023–2026) aims to demonstrate how cities can translate analysis and strategy into tangible action through NBS.

In Dire Dawa, SUNCASA has implemented green corridors and NBS interventions through community-led afforestation, reforestation, and agroforestry, as well as riverside buffers that directly address flash flood management, urban heat island (UHI) reduction, and groundwater recharge. Strategic tree planting and green infrastructure along flood-

FIGURE 11 | The at-the-time Kigali Mayor, Lord Pudence Rubingisa (center), participating in the Validation Workshop in June 2022



Source: World Resources Institute, 2022.

prone areas have been prioritized as activities to enhance climate resilience while improving ecosystem services and community well-being. Project partners include the Dire Dawa Administration, Hararghe Catholic Secretariate, and Haramaya University.

In Kigali, the project is focused on restoring urban green areas on steep slopes through community-led NBS activities that include afforestation, reforestation, and agroforestry, as well as riverside buffers that reduce Kigali's flood risk and enhance public awareness of ecosystem services. Participatory design and community engagement ensured that interventions were locally relevant and sustainable for long-term community ownership. Project partners include the City of Kigali, RYWP, Albertine Rift Conservation Society, Association of Widows of the Genocide (AVEGA-Agahozo), and Rwanda Forest Authority.

In Johannesburg, SUNCASA has prioritized riparian buffer zone development, management of water pollution, and removal of alien invasive species to reduce flood impacts and improve water quality for the surrounding communities. Green infrastructure interventions expanded green spaces in Johannesburg's dense, heat-vulnerable neighborhoods, bringing nature back into the built environment, and improving urban water management. These interventions also created multifunctional recreational spaces and art installations that were co-designed with local communities. Partners include the City of Johannesburg's core departments, Johannesburg City Parks and Zoo, Women for Climate Justice Southern Africa (GenderCC SA), the Johannesburg Inner City Partnership, Water for the Future, Alexandra Water Warriors, Zutari, and the Johannesburg Roads Agency.

Across all three cities, SUNCASA has emphasized inclusive engagement, involving local communities who

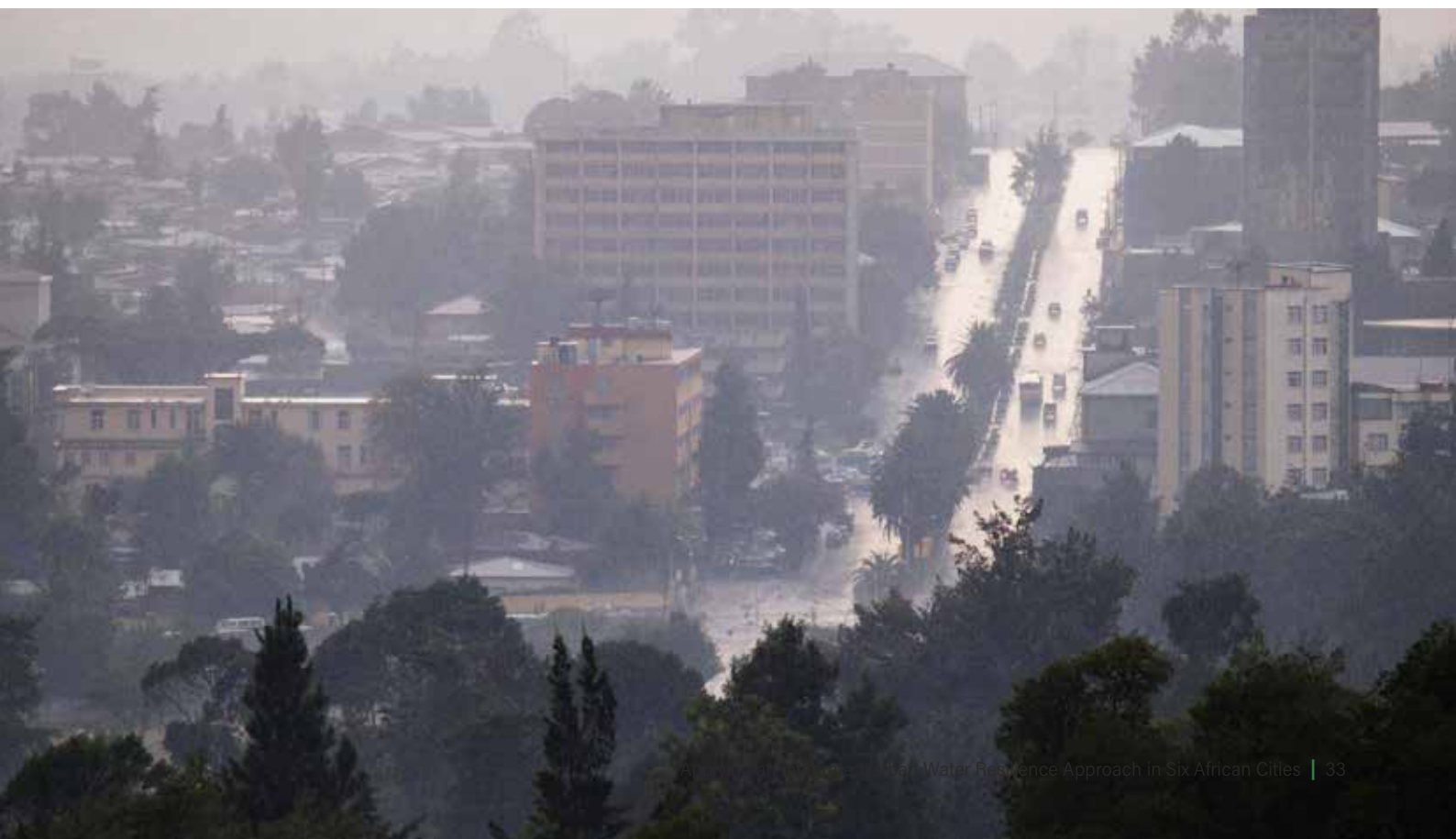
live within and around the selected project sites, city administrations, nongovernmental organizations (NGOs), and private sector actors in co-design, planning, and monitoring. This participatory approach ensured that NBS interventions were locally relevant, sustainable, and responsive to the needs of vulnerable groups such as women, children, and the elderly.

SUNCASA has delivered concrete outcomes, including the restoration of over 2,500 hectares (ha) of urban and peri-urban landscapes. Stakeholders trained in NBS design and maintenance exceed 550 individuals across the three cities (IISD 2026). Beyond ecological resilience, the project aims to provide social and economic cobenefits, including green jobs, improved access to green spaces, improved women's agency and all-inclusive gender empowerment, reduced flood and heat exposure, enhanced recreational opportunities, and strengthened local governance capacity.

The experience and successes of the UWR approach provided a strong foundation for SUNCASA by offering practical tools and methods for stakeholder mapping and engagement across the water sector and governance levels, co-development of urban resilience action plans, and prioritization of interventions based on local hazards and needs. This foundation supported cities to move beyond the UWR planning stage to implement pilot initiatives on the ground. However, the authors recognize that further evidence is needed to fully assess the effectiveness of the UWR planning approach, particularly through comparative analysis with cities that have not undergone the process.

Strong partnerships and relationship building were key to keeping momentum and mobilizing commitments to scale identified actions into a robust NBS implementation program. The SUNCASA project was co-designed with environmental management, forest management, agriculture and climate change agencies, as well as local implementing and technical partners across the three cities. Local actors were involved throughout all stages of co-design to ensure that NBS were tailored to each city's context, using both the developed CCR and City Water Resilience Profile and Action Plan for guidance. For effective movement from planning to SUNCASA implementation, the approach includes liaising with various city agencies to support data collection, supporting the mobilization of city stakeholders, and coordinating regulatory and political approvals needed to ensure successful NBS implementation.

The UWR approach laid crucial groundwork for city-wide NBS planning for climate and water resilience. It demonstrates that through the development of the six strategic water action plans, key interventions have been built into prioritized projects in each of the six cities. This final stage of the UWR approach was critical in translating plans and reports into tangible actions and measurable impacts on the ground. SUNCASA is just one example of this impact. It has become clear that urban water resilience is becoming a priority for cities. A clear example of this is found in Kigali where wetland restoration was identified as a priority within the city's Action Plan, and in 2025 the Rwanda Environment Management Authority (REMA) launched the process of developing a long-term management strategy and business plan for five



key wetlands in Kigali. A key example of how cities that participated in the UWR approach are now taking the lead.

Outcomes in each of the pilot cities

Addis Ababa

The UWR approach helped raise awareness across sectors regarding the city’s contextual challenges towards achieving urban water resilience. It provided an additional layer

KEY TAKEAWAY

Addis Ababa is turning to smart metering and leak detection technology to tackle non-revenue water and improve cost recovery.

of momentum and support to influence sectoral plans and programs. Through this flexible approach, a mindset shift was evident amongst the participating experts and officials (see Figure 12).

Addis Ababa officials acknowledged that effective water management requires a multi-level governance approach that bridges national, regional, and city-region institutions. By aligning strategies, policies, and resource allocation across these governance levels, stakeholders can collectively address barriers such as fragmented decision-making, limited data integration, and competing sectoral priorities. This multi-tiered engagement also creates opportunities to mobilize investment, harmonize policy implementation, and strengthen resilience through coordinated planning, thereby enabling more sustainable water management across the country.

Addis Ababa also explored the feasibility of establishing a Water Fund as a sustainable financing mechanism to protect and manage the upstream landscapes, particularly in Oromia Region and Shaggar City, that serve as the primary water sources for the Gefersa reservoir and surrounding well fields. These landscapes play a critical role

FIGURE 12 | UWR approach outcomes across the pilot cities

Addis Ababa	Dire Dawa	Kigali	Musanze	Johannesburg	Gqeberha
▪ Mindset shift to acknowledge the cross-sectoral nature of the city's water issues ▪ Exploring the establishment of a Water Fund as a sustainable financing mechanism	▪ Established Steering and Technical Committees for cross-sector coordination and governance oversight ▪ Introduced a Payment for Ecosystem Services mechanism, the Green Legacy Initiative Special Fund Proclamation, and the allocation of municipal resources for monitoring NBS interventions ▪ SUNCASA program has restored the Dechatu catchment, creating jobs, reducing flood risks and urban heat island effects	▪ Secured \$39.1 million from the Green Climate Fund to build climate resilience in the Nyabarongo River through forest and landscape restoration ▪ Secured a \$9 million grant from the World Bank and Global Environment Facility for integrated landscape management ▪ Implemented SUNCASA program to restore critical upstream areas to reduce flooding, landslides, and erosion	▪ The UWR approach helped initiate the city's stormwater master plan concept, which led to funding to develop a comprehensive version ▪ An eco-tourism and restoration park on a city wetland has advanced significantly. NBS and resilience measures and community engagement are integrated into the plan	▪ Raised awareness of the importance of integrated river catchment management through a collaborative approach ▪ Creation of the Transformative Riverine Management Programme and business case. In 2025, the city dedicated \$3 million for river catchment rehabilitation ▪ Developed and prioritized a groundwater monitoring program	▪ Developed a pre-feasibility analysis of NRW Performance-based contracts (to address sustainable financing for urban water resilience) ▪ Strengthening its climate resilience through targeted strategies such as, the Climate Change and Green Economy Action Plan and the Integrated Development Plan

Note: Details on the initial and medium-term outcomes are discussed below.

Source: Authors 2026.

KEY TAKEAWAY

Dire Dawa turned a resilience plan into action: 605 hectares restored, 880,000+ trees planted, and thousands of green jobs created through SUNCASA.

in delivering essential ecosystem services such as water filtration, regulation, and recharge that directly support the city's water security. Discussions are ongoing between the administrations of Addis Ababa and Shaggar City, as well as public sector institutions, private sector stakeholders, and communities to invest in a Water Fund to ensure long-term watershed restoration, reduce sedimentation, improve water quality, and enhance climate resilience for the city's growing population.

Addis Ababa is actively prioritizing advanced technologies and infrastructure solutions to reduce NRW, which currently poses a major challenge to water service efficiency and financial sustainability. The city is considering several approaches including the deployment of modern leak detection systems, rehabilitation and upgrading of aging water infrastructure to prevent physical losses, and the introduction of smart metering technologies that improve billing accuracy and reduce revenue losses from delayed or uncollected user fees. These efforts are aimed at enhancing operational performance, improving cost recovery, and ensuring that water resources are used efficiently to meet the growing demand of the city's population.

Dire Dawa

The UWR approach has significantly shaped Dire Dawa's urban resilience planning by promoting integrated water management and NBS. The work and achievements in Dire Dawa demonstrate how water resilience planning can move from externally supported programming to institutionalized city practice. Following the completion of the Dire Dawa City Water Resilience Profile and Action Plan, the city administration adopted a collaborative governance model, bringing together the Mayor's Office, Agriculture Bureau, Environment and Climate Authority, and Beautification Bureau to mainstream urban water resilience into city planning. This marked a shift from siloed approaches, embedding water resilience and NBS into the administration's broader development agenda.

Post development and validation of the action plan, the administration established dedicated offices and focal persons to oversee resilience initiatives and active collaboration with partners such as WRI, Haramaya University, and civil society organizations (CSOs). Key measures implemented to-date include introduction of a payment for ecosystem services (PES) mechanism to sustain NBS financing, the Green Legacy Initiative Special Fund Proclamation to formalize policy and funding support, and the allocation of municipal resources for monitoring NBS interventions. The establishment of steering and technical committees further institutionalizes cross-sector coordination and governance oversight. Prioritizing NBS and green infrastructure as an appropriate action to achieve urban resilience is increasingly

being reflected in political discussions, signaling strong policy alignment toward climate adaptation and sustainable water management.

The UWR approach has driven transformative change by advancing priority urban resilience projects from planning to implementation through the SUNCASA program. By restoring the Dechatu catchment and advancing NBS, the project has delivered measurable benefits for climate resilience and community well-being. In 2024–2025 alone, SUNCASA engaged and trained 434 community members and stakeholders, created 7,432 green jobs (including both permanent positions and some temporary jobs generated during the implementation period), restored 605 hectares of degraded watershed, and planted over 880,000 trees (IISD 2026). These interventions have been implemented with the goal of reducing flash flood risks, mitigating UHI effects, and improving groundwater recharge, while enhancing ecosystem services. Strategic tree planting along flood-prone areas has strengthened resilience and created multifunctional green spaces as a risk-reduction mechanism, reducing erosion and exposure to recurrent flooding for farmers and informal workers operating near the river. These actions, originally identified as priorities in the Dire Dawa Action Plan, demonstrate how integrated green infrastructure can be established or built to safeguard livelihoods, enhance the resilience of vulnerable communities, and promote urban sustainability.

Policy alignment is evident in the city's emerging resilience strategy, a policy document which advocates for integrated GGI and inclusive governance. NBS strategic frameworks and design guidelines developed through the UWR approach are now informing city-level resilience work through detailed guidance and methodology on site selection and appropriate NBS design. Multi-level governance has strengthened coordination among municipal authorities, regional actors, and local communities, as demonstrated through SUNCASA project implementation, helping to ensure that resilience measures are locally relevant, inclusive, and sustainable.

Dire Dawa is leveraging its water resilience profile and action plan to attract funding for landscape restoration

and integrated water management projects. These efforts aim to improve water security, and build adaptive capacity across vulnerable neighborhoods, including by scaling NBS interventions.

Kigali

The UWR approach is believed to have had a positive influence on the city by shifting officials' mindsets on the importance of prioritizing green infrastructure as a core component of urban resilience, moving beyond isolated tree-planting efforts and traditional infrastructure approaches. In doing so, it has helped establish a new direction for urban resilience planning that integrates green infrastructure and resilience in a more holistic manner (Pers. comm. 2025b). Following the completion of the Kigali City Water Resilience Profile and Action Plan, this shift has continued to evolve, with the city incorporating water resilience into its broader resilience roadmap, a policy document which mainstreams climate change across sectors, including water management and urban planning.

This influence is evident in the current city development strategy, which derives its entire climate resilience priorities from the City Resilience Roadmap. By placing resilience at the heart of the city's agenda, the strategy adopts a more holistic vision of resilience than previous development strategies (Pers. comm. 2025b). Post-plan developments include the 2025 National Urbanization Policy, which provides a roadmap for smart urban development with enhanced focus on climate-resilient infrastructure and water systems.

On the policy side, a sector strategic plan (a five-year implementation framework) was developed, introducing for the first time ever a strong outcome dedicated to mainstreaming NBS and the environment into the urbanization sector. This is important from a planning and budgeting perspective to fast-track climate risk reduction in the cities of Rwanda, opening doors for innovative thinking to incorporate green and not just gray infrastructure. This led to the establishment of the first ever Urban NBS and Environment mainstreaming thematic working group in the Ministry of Infrastructure, which is co-chaired by WRI, to guide the government of Rwanda on a stronger path to green development. This thematic working group

is a government platform for partner engagements where all stakeholders in the NBS space are brought together to share priorities and ensure complementarity and alignment while avoiding duplication.

The UWR approach helped the city embrace a nature-focus mindset that does not solely rely on hard infrastructure, and planted NBS as a top priority for tackling different climate-related issues, especially flood reduction and urban heat mitigation. Insights from the UWR approach contributed to the city's buy-in for Kigali's wetlands rehabilitation initiative, a priority action identified in the Kigali action plan, and the design and implementation of SUNCASA to restore critical upstream areas to reduce flooding, landslides, and erosion that all have impacts on the city's water treatment. Following the completion of the action plan, the wetlands rehabilitation project launched in 2024 across five major sites (covering 491 ha) had progressed to 67 percent completion as of September 2025. Full inauguration is expected by the end of 2026, with the project focusing on ecological restoration, flood risk reduction, and the transformation of degraded areas into recreational green spaces that enhance water quality and urban biodiversity (IGIHE 2025).

Similarly, the SUNCASA project, initiated post-plan, has made significant strides in Kigali by restoring micro-catchments in the lower Nyabarongo River watershed. In 2024 alone, it achieved 60 percent of its agroforestry target by planting trees on 820 ha out of 1,262 planned, reducing downstream flood risks and improving water security through nature-based interventions like reforestation and soil stabilization (IISD 2026). Both of these initiatives reflect a strong shift towards an integrated development approach combining green and gray infrastructure.

The Kigali City Water Resilience Profile and Action Plan has opened up doors to new investments and is being used to mobilize funding in landscape restoration and any project that advocates for integrated solutions, the protection of water resources, and strengthening of local communities. One example of the approach's impact was that it strengthened the case for developing a proposal to the Swedish Embassy in Kigali to scale projects to other districts. Moreover, since it was identified as a key priority in the Kigali Action Plan, additional funding has been secured, including a US\$39.1 million project from the Green Climate Fund (GCF) for building climate resilience in the upstream part of the Nyabarongo River through forest and landscape restoration, focusing on water catchment management and community involvement in erosion control and water protection. Furthermore, a \$9 million grant from the World Bank and the Global Environment Facility (GEF) supports integrated landscape management in the Nyungwe-Ruhango corridor, restoring ecosystems to boost water resilience and reduce flood vulnerabilities

KEY TAKEAWAY

Kigali's SUNCASA project planted trees across 820 hectares in 2024 alone—60 percent of its agroforestry target—to reduce flood risk and stabilize soil.

in Kigali's upstream areas. These investments align with broader efforts like the Intego initiative by the Rwanda Green Fund, which channels resources into wetland rehabilitation, biodiversity conservation, and climate-resilient water infrastructure, benefiting over 220,000 residents through enhanced water management and community empowerment.

Musanze

The process of the UWR approach helped initiate the city's stormwater master plan. Following the completion of Musanze's Water Resilience Profile and Action Plan, the stormwater management plan, identified among the key priorities, was immediately taken up by the partner organization Enabel who delivered a high-level concept. This led to the development of a comprehensive stormwater master plan through the Volcanoes Community Resilience Project funded by the World Bank. The master plan includes key strategic recommendations such as integrating GGI and prioritizing NBS-based interventions. This has been rolled out to improve water access, mitigate soil erosion from runoff, and support domestic needs during dry spells, further integrating stormwater strategies with community level adaptations.

A wetland in Musanze was proposed within the validated project pipeline to become an ecotourist park as an output of the conversations that took place when stakeholders convened to develop the Musanze Action Plan during the UWR approach. Since the proposal's emergence from the stakeholder workshops in 2022, the Mukungwa wetland project has advanced significantly, with the Musanze District Land Use and Development Master Plan approved in July 2025 incorporating the establishment of the Mukungwa Urban Ecotourism Park to boost tourism through features like canopy walkways while restoring the wetland's ecological functions. Developments after 2022 emphasize integrating the park with NBS for flood adaptation, water quality improvement via natural filtration, and biodiversity enhancement, aligning with broader catchment management under the Mukungwa Catchment Management Plan (2020–2024) and supporting community engagement through environmental education and protection against encroachment. Ongoing discussions involve coordination with partners like REMA and donors to secure funding for implementation, with plans to digitize the master plan for better stakeholder access and integrated urban planning that prioritizes wetland preservation as a key resilience asset.

Johannesburg

In Johannesburg, the UWR approach played a significant role in raising awareness on the importance of integrated river catchment management through a whole govern-

KEY TAKEAWAY

In July 2025, Musanze approved plans for the Mukungwa Urban Ecotourism Park, turning a 2022 stakeholder proposal into an official part of the city's land use master plan.

ment and whole society collaborative approach. As most of the rivers and wetlands in Johannesburg are polluted and critically endangered, through the UWR approach, the city explored opportunities for transforming its riverine management to support the adaptation of river corridors and other ecological infrastructure against flooding, droughts, and increasing temperatures due to climate change. Various departments whose mandates include or impact river catchments got together to develop the concept of transforming the city's riverine management. Since 2024, a Transformative Riverine Management Program and its accompanying business case have been developed through the partnership. By using a combination of cost-benefit analysis, designing key interventions and river systems modelling, the study demonstrated the substantial value of riverine management as an effective risk-reduction and cost avoidance strategy. This has not only helped integrate climate change resilience priorities within policy, but it has also mobilized political support, alternative funding, effective stakeholder engagement, and will lead to increasing the city's livability through the introduction of safe green corridors by the river.

During the 2025 financial year, an allocation of \$3 million was set aside by the City of Johannesburg for river catchment rehabilitation. The development of the transformative riverine management program has enabled the city's finance leaders to appreciate the benefits of riverine management including reduced damage costs from infrastructure and livelihood damage.

Through the UWR approach, the City of Johannesburg explored securing alternative water sources to create less reliance on surface water. Groundwater is a strategic bulk water resource for agriculture, mining, and domestic use, and previous studies show that there is great potential for further groundwater development to diversify water supply. However, groundwater use is not sufficiently monitored, while significant risks of pollution and over-extraction threaten the long-term sustainability of the aquifers. Compounding these challenges, Johannesburg's dolomitic geology is prone to sinkhole formation as a result of excessive groundwater extraction.

KEY TAKEAWAY

Johannesburg is rolling out a citywide borehole monitoring network to track groundwater levels and quality in real time, addressing risks from over-extraction and sinkhole formation.

Through the UWR approach, the city worked with WRI to develop and prioritize a groundwater monitoring program and knowledge/data systems to ensure that the water is protected and sustainably used as a critical resource for long-term resilience. The city prioritized raising external funds for the implementation of the program while funding the initial monitoring program in 2025. Working with WRI, the City of Johannesburg is engaging external funders on raising investments for their groundwater program. The project will install a comprehensive borehole monitoring network system to ensure sustainable management of groundwater resources. The borehole monitoring network will provide real-time monitoring of water levels and quality of groundwater in the aquifers across the city, to inform a sound groundwater management framework. This framework will also include, amongst other activities, running a managed aquifer recharge system, enabling decentralized groundwater schemes, and regulation of proliferation of private boreholes in order to ensure sustainable water security.

Gqeberha

In 2022, NMBM experienced a severe drought, with rainfall levels among the lowest in recorded history (NMBM 2022). During the rollout of the UWR approach, Gqeberha, the greater NMBM, and surrounding regions were experiencing a severe drought and water supply crisis due to below average rainfall, exacerbated by climate change, alongside growing water demand and infrastructure capacity limitations. The main water supply dams had been declining since November 2015 and as of December

KEY TAKEAWAY

Gqeberha's proposed NRW performance-based contract could pay for itself in under two years, with a projected \$2.5 million net present value and a 16 percent cut in water losses.

2022 local dam levels were sitting at 10 percent available water for use and extraction. Through the UWR approach, Gqeberha became open to exploring multiple avenues to address NRW, estimated at 47 percent with real physical losses of 32 percent (94 million liters per day). Despite interventions by NMBM, NRW has been over 40 percent for 8 of the past 10 years (Castalia and WRI 2022). The administration of Gqeberha worked with WRI to develop a pre-feasibility analysis of NRW performance-based contracts (PBCs) to address sustainable financing for urban water resilience. A PBC is a results-oriented contract method that focuses on the outputs, quality, or outcomes achieved by the contractor, and ties at least a portion of the contractor's payment, contract extensions, or contract renewals to the achievement of specific, measurable results. PBCs have historically been more effective at reducing NRW than municipality- or utility-led NRW reduction efforts (Kingdom et al. 2018; Barclay 2021). The initial financial analysis indicated that the NRW PBC project had a payback period of 22 months and a net present value of \$2.5 million (Castalia and WRI 2022). The project was expected to make a significant contribution to sustainable water extraction, reducing system input volumes by an estimated 16 percent. Combined with moderate demand management programs to reduce water demand by 3 percent, NMBM will achieve a sustainable level of daily extraction. Through the Development Bank of Southern Africa's Water Partnerships Office, a full analysis for implementing NRW PBCs was undertaken.

Overall, Gqeberha, through NMBM, is strengthening its climate resilience through targeted strategies which integrated learnings from the UWR approach. As part of stakeholder engagement efforts, the approach worked closely with different teams championing these initiatives to advance and implement key actions. For example, reinforced strategies include the Climate Change and Green Economy Action Plan which focuses on water, energy, and sustainable urban development. The Integrated Development Plan supports this with measures for water conservation, disaster management, and renewable energy. Guided by the Eastern Cape Provincial Climate Change Strategy, these efforts help the NMBM adapt to water scarcity, extreme weather, and biodiversity loss, fostering collaboration and progress in climate resilience.

Common enabling factors

Enabling factors identified in three or more cities, highlighting common elements across different contexts that contributed to the successful roll-out of the UWR approach, include:

- Strong involvement and political will of city government officials to participate and take a lead on urban water resilience issues.
- Willingness of stakeholders to engage and exchange across sectors and disciplines.



- Existing laws, regulations, and reforms that define the roles and responsibilities of municipalities in the water sector.

Political will and local leadership at the city level were demonstrated through mayoral commitment and willingness to advance water resilience as a priority issue, resulting in an open and collaborative administrative environment. In Musanze and Kigali, for example, political leadership was quick to support the UWR approach and to place water at the front and center of design and urban policymaking (Pers. comm. 2025c). In Musanze, the acting Vice Mayor of Economic Affairs consistently participated in the discussions and encouraged other stakeholders to attend and contribute to the process. In Dire Dawa, the administration was already aware of the city's groundwater depletion challenges, creating a strong foundation for commitment and collaboration. This existing understanding of the importance of urban water resilience for the city's residents helped foster a proactive and coordinated response from the administration (Pers. comm. 2025d).

Bringing together a variety of stakeholders from the public and private sectors, as well as from civil society and academia, allowed for many different perspectives and encouraged people to think beyond their silos and sectors. In Johannesburg, the diversity of perspectives helped create novel and useful interventions (Pers. comm. 2025e). For example, during the assessment workshop, stakeholders assigned low scores to the internal governance indicators, signifying inefficiencies arising from overlapping and unclear mandates. When all participants reconvened for the visioning workshop, it was important to reveal this diversity of perspectives at the table. They agreed to an action: "To improve strategic alignment of relevant departments within the City of Johannesburg to build a collaborative approach to improved urban water resilience". This commitment demonstrates the importance of enacting behavioral change and shifting the city's organizational culture to a collaborative one (City of Johannesburg 2022).

The same enabling factor was found in Addis Ababa where the workshops provided an opportunity to facilitate an exchange of diverse ideas across stakeholders to develop the final action plan (Pers. comm. 2025a). This was evidenced through the development and commitment to the action: "Assess and strengthen existing platforms and networks for political collaboration and dialogue around water resilience". Participants emphasized the need to raise awareness, strengthen cross-sectoral communication, and enhance leadership capacity at different levels of governance (Adane et al. 2021).

Important national institutional reforms over the past decades have played a key role in setting out defined roles and responsibilities for the water sector in most of the six cities. Even when these are not always enforced, they serve as an example, reference, or foundation to build upon, and can serve as policy safeguards to protect vulnerable populations. The existence of favorable plans and programs in Rwanda is one example. Water is incorporated into all land use planning and development processes through consultation with public institutions mandated to manage water, ensuring that access to clean, safe, and reliable water is considered a core development priority (Arup et al. 2022). Similarly, South Africa's Constitution affirms that "Everyone has the right to have access to sufficient food and water ... (and) the state must take reasonable legislative and other measures, within its available resources, to achieve the progressive realisation of each of these rights" (Republic of South Africa 1996). The Water Services Act of 1997 also speaks to people's rights of access to basic water supply and basic sanitation, tasking the government with ensuring that both water supply and sanitation services are provided in a manner that is efficient, equitable, and sustainable (Republic of South Africa 1997). These national policies provided a strong foundation for engaging city officials in discussions on water quality and access for people living in Johannesburg and Gqeberha, as access to water is a constitutionally protected right in South Africa.

Insights and lessons from applying the UWR approach

This section highlights common themes across the six pilot cities, including shared priorities, implementation challenges, and lessons learned from implementing the UWR approach.



Priorities across the six African cities

As part of the methodology from Arup's CWRA, each city identified a set of urban water resilience vision statements with corresponding plans for action. These were developed during the visioning workshops and the result was a City Water Resilience Profile and Action Plan. Across these action plans, four thematic priorities are consistently reflected in the vision statements and corresponding actions across all six cities including strong cross-sectoral stakeholder engagement and coordination; adequate climate and water risk resilience planning; robust data for data-driven decision-making; and improved and resilient water infrastructure and management.

Additional priorities with high visibility directly mentioned in at least five of the cities' written vision statements and actions include NBS and ecosystem protection; sustainable finance and investments; streamlined regulation and enforcement for sustainable water resource management; and sustainable sanitation services. Finally, priorities explicitly mentioned in at least four of the cities' plans include capacity building for efficient and sustainable water resource management; inclusive and equitable access to safe water; reliable and resilient water infrastructure; and educational or cultural trainings to better protect water resources. Figure 13 showcases which priorities are mentioned in which city plans with the corresponding vision number.

FIGURE 13 | Common themes that emerged across the pilot cities' UWR visions and corresponding actions

■ Strong presence (mentioned in 3+ visions) ■ Moderate presence (mentioned in two visions) ■ Limited presence (mentioned in one vision)

	ADDIS ABABA	DIRE DAWA	KIGALI	MUSANZE	JOHANNESBURG	GQEBERHA
Strong cross-sectoral stakeholder coordination	V4, V5	V1, V2	V1, V2, V4, V5, V6	V1, V2	V2, V3, V4, V5, V6, V9	V1, V6
Climate and risk resilience planning	V4, V5, V6	V1, V5	V4, V8	V2, V4	V2, V3, V5, V8	V1, V2, V4
Build reliable and resilient water infrastructure	V7, V9	V3	V7		V1, V7	
NBS and/or ecosystem protection	V1, V9	V5	V9	V7		V2, V3, V7
Robust data for data-driven decision-making	V2, V6, V7, V8	V7	V1	V4	V1, V3, V4	V4
Inclusive and equitable access to safe water	V2, V8	V2		V6		V7
Educational and cultural trainings to better protect water resources	V3			V1	V7	V8
Capacity building for efficient and sustainable water resource management	V1, V3, V5, V7, V9	V6, V1	V2, V3, V6	V3		
Sustainable finance and investments		V3	V10	V5	V5, V9	V5
Regulation and enforcement for sustainable water resource management		V4	V2, V6	V2	V8	V7
Stormwater management	V9	V5	V8, V9	V6	V7	V8
Decentralized or community-driven water resilience activities	V2, V3		V5		V6	
Sustainable sanitation services	V8	V8	V9	V5		V6

Notes: Corresponding visions for each city are denoted with the letter "V" and a number, e.g., V1 for Vision 1. Darker blue tones in this heat map indicate more frequent mentions across multiple visions for that city, while lighter tones indicate fewer mentions. Blank boxes mean that theme was not explicitly mentioned in the city's vision or its actions (not necessarily that it is not a city priority documented later or elsewhere in a different manner). Topics or themes emerged organically at the moment of tracking mentions by each city; themes mentioned the most frequently are showcased in the heat map.

Source: Authors 2026.

By highlighting the crosscutting themes across each city's vision statements, this provides evidence of what cities want to prioritize in terms of building their water resilience.

Cross-sectoral engagement and coordination

All six cities highly prioritized cross-sectoral stakeholder engagement and coordination, as reflected in multiple vision statements, to promote greater integration of water resource management. In addition to improved strategic collaboration between and within government agencies to better manage water resources from the national to the city level, cities desire better relationships and more open communication between the city and its communities, with relevant academic institutions, as well as with external stakeholders and the private sector. Kigali's action plan goes even further and speaks to collaboration with youth institutions and development partners to bridge skills and technical expertise gaps.

In the developed action plans, the pilot cities proposed different ways of promoting active and inclusive cross-sectoral stakeholder engagement: via the creation of water resilience coordination platforms or agencies, collaboration hubs, a community of practice or public fora, and peer-to-peer exchanges. Dire Dawa's action plan additionally proposed the establishment of legislation to ensure finances are available for stakeholder engagement, while Kigali suggested organizing annual urban water resilience exchanges, learning events, and strategic mentorship programs to bridge capacity gaps. Both Kigali and Musanze also suggested developing and operationalizing engagement frameworks to optimize water sector stakeholders' coordination. It is important for cities to recognize the potential engagement with the private sector as well. For example, Johannesburg

outlined a vision to establish appropriate public-private partnerships by engaging with large private sector water users to promote water stewardship and diversify revenue streams (Adane et al. 2021, 2023; Gcanga et al. 2022, 2023; Baloi et al. 2023; Ellis et al. 2022)

Adequate climate and water risk resilience planning

City stakeholders stressed the importance of embedding climate hazard and vulnerability assessments directly into development planning cycles, ensuring risk is a foundational input to water infrastructure and related decisions, rather than a parallel or reactive exercise. Mechanisms mentioned in cities' action plans to reinforce this risk and development planning align with other previously mentioned priorities such as integrated planning through cross-sector collaboration, inclusive governance, open communication channels, flexibility, and innovation. Johannesburg mentioned leveraging behavioral changes to improve collaboration, alongside developing effective communication channels in its planning approach; however, the documents provided no example of what was meant by "behavioral changes". Musanze highlighted digitizing the city's master plan so that it was accessible to all stakeholders, as well as developing neighborhood-level plans to enhance the master plan's implementation. Only Dire Dawa explicitly specified the planning horizon for resilience efforts, referring to the development of a 10-year resilience plan for the city-region. This was a gap in the other five cities in terms of their risk planning approaches.

Reliable and accessible data

Access to reliable, up-to-date and publicly available urban water resilience data is an important vision for all six cities. Actions centered on data include enhancing and improving the maintenance of existing information systems to better support decision-making, planning, implementation, and monitoring, as well as setting up a system or hub with personnel to manage cross-sectoral databases and properly disseminate information. There was a focus on real-time data collection and on developing more effective communication channels for timely dissemination to all stakeholders, including at-risk citizens.

Addis Ababa proposed establishing a new water resilience data center to provide open, centrally accessible data, alongside capacity building for relevant agencies to support coordination and data contributions. The plan also included developing research partnerships with local universities to conduct long-term water risk analyses and produce comprehensive community vulnerability maps. Both Addis Ababa and Gqeberha mentioned the need to develop a data baseline for the water sector in their cities.

While every city converged on the same priorities, the plans varied widely in how far they went toward defining concrete timelines, mechanisms, and metrics.

Improved and resilient water infrastructure and management

Building more resilient infrastructure was a priority in all six pilot cities' visions and was often reflected in actions spanning multiple thematic areas. Specifically, cities stressed the need for proactive maintenance and securing sustainable financing for water-related infrastructure, and for developing guidelines and standards to integrate climate risks into infrastructure planning and retrofiting. Addis Ababa and Dire Dawa both explicitly mentioned the need to establish smart data systems to assess and monitor water loss, including leakage. In addition, nearly all cities highlighted NBS or GGI in relation to building resilience to promote sustainable water use and to better respond to stormwater and flood-related challenges.

Common challenges

Five main challenges emerged in nearly all of the cities in the study:

- Inadequate government coordination around water issues.
- Insufficient awareness and dissemination of knowledge beyond expert groups.
- Technical capacity gaps.
- Scattered or unavailable data needed for decision-making.
- Insufficient finance and financing mechanisms.

Coordination around water resilience is often fragmented and siloed between and within institutions, and particularly when moving from the national to the city level. Lack of coordination between governing bodies and stakeholders can limit meaningful engagement for building water resilience and further present institutional and structural delays, as well as overlapping mandates. In Kigali, coordination exists at the national level between the public sector's water agencies, water utilities and organizations, yet weakens at the city level. Additionally, at times city priorities and city planning may interfere with national priorities (Arup et al. 2022).

In Dire Dawa, the Awash Basin Authority is limited by its mandate in its ability to coordinate, engage with stakeholders, and ensure the implementation of integrated water resource management (Kebede et al. n.d.-b). Instead, it is limited to the collection of fees for the use of water from large-scale farms and working on flood protection activities in the main Awash River (Hailu et al. 2018). Moreover, although water resources in Dire Dawa are shared across different regions, political leaders are not coordinating effectively, partly due to unclear mandates (Kebede et al. n.d.-b).

Insufficient finance to improve local and basin-level water resilience emerged as a challenge during the stakeholder conversations following the UWR approach validation workshops, as well as in interviews conducted as part of Reos Partners' third-party evaluation of the UWR approach. In their visions, cities also prioritized raising and managing sustainable financial resources for water and sanitation infrastructure management; for example, through improved bill collection and water tariffs (as is the case for Dire Dawa and Addis Ababa), or by attracting new private capital investments for new plans by highlighting economic returns (as mentioned in Kigali's tenth vision). In the Reos report synthesis, stakeholders noted that "a large part of getting finance right is not just accessing more funds, it is about changing the mindsets of funders and cities", with cities needing to view themselves as businesses with funding pipelines and more work needed to highlight how technology could be leveraged for urban water resilience (Reos Partners 2021).

Lessons learned

Implementation of the UWR approach across the six pilot cities has yielded a rich array of insights and lessons derived from multi-stakeholder workshops, resilience assessments, action planning, and evaluations of city-specific interventions. These lessons, informed by interviews with project partners, technical experts, and the collective experience of WRI staff involved in the roll out of the approach, under-



score the complexities of building water resilience in rapidly urbanizing African contexts. While each city's unique hydrological, socioeconomic, and governance landscape shaped its experiences, overarching themes emerged that highlight systemic barriers and opportunities for adaptive management. Despite contextual variations, the UWR approach revealed common challenges and imperatives that transcended individual cities. These themes consistently echoed in stakeholder discussions and framework assessments, stressing the need for systemic shifts to address root causes of water vulnerabilities such as flooding, scarcity, pollution, and infrastructure failures. Eight key lessons centered on similar themes resonated across cities:

- **Integrated and watershed-level planning is difficult to execute yet necessary to effectively tackle the root causes of issues.** Executing comprehensive, cross-sectoral planning proved challenging due to institutional silos, fragmented mandates, and resource constraints, yet it is deemed essential for tackling interconnected urban issues like upstream catchment degradation, urban sprawl, and climate-induced shocks. Existing literature on water management also supports the need for integration and move away from fragmentation (Nieuwenhuis et al. 2021; Grigg 2024; Zhang and Chui 2025). In Addis Ababa, for instance, workshop discussions identified that coordination gaps between federal, regional, and city levels on various issues, which could include monitoring, regulation, or enforcement, hindered basin-wide management, which was said to have led to pollution from untreated industrial waste and siltation in reservoirs.

Similarly, in Johannesburg, reliance on inter-basin transfers from distant sources amplified vulnerabilities to external disruptions, underscoring the need for adaptive, multi-level strategies that integrate water with urban development, energy, and waste systems. Across cities, low City Water Resilience Framework scores in integrated planning (e.g., 2.0 [low] in Kigali) highlighted how top-down approaches often overlook local interdependencies such as stormwater management in Musanze's volcanic terrain or flood-prone informal settlements in Dire Dawa. This further underscored the importance of strong local leadership and locally driven decision-making processes, as municipal actors were often best positioned to identify context-specific risks, coordinate across sectors, and translate broad resilience objectives into actionable interventions. Holistic planning, when pursued, enabled synergies, as seen in Gqeberha's alignment of drought mitigation with economic development in industrial zones, demonstrating that addressing root causes requires embedding resilience into master plans and policies to prevent reactive, piecemeal responses.

- **Frameworks can help break down silos and bring together different departments, but are not enough to overcome existing mandates and government systems.** In Johannesburg and Gqeberha, the CWRA framework and workshop-based methodology was brilliant at encouraging a holistic way of viewing challenges. It helped stakeholders link short-term decisions to long-term resilience outcomes, identify cross-sector synergies and facilitate unprecedented cross-departmental dialogue. However, colleagues and partners later reflected that the final product of a completed framework document was not enough to make real change in existing government systems. Additional follow-up is needed after the framework has been validated to ensure that this guidance document does not simply remain unused. As part of the approach moving forward, it is key to ensure the prioritized actions drafted within the city's action plan have received clear commitments from various departments to advocate for their integration within updated policies and mandates. Additionally, increased capacity building for city government officials after the framework's development is essential to ensure they have the tools and resources needed to advance urban water resilience from a renewed perspective and implement the identified action plan.

- **The UWR approach was especially helpful and valuable for secondary cities' planning and furthering commitments for implementation.** Generally, the three secondary cities in the study do not have access to the same level of resources in terms of tools, staffing, financing, and technical knowledge that are available to the country's capital and larger cities. These limitations are often reflected in other secondary cities worldwide, meaning they must operate with fewer resources than larger metropolitan areas (Roberts 2014; Marais et al. 2016). The CWRA methodology provided critical tools and resources for the participating secondary cities to guide and apply their urban water resilience planning (Arup et al. 2019). After the workshops as part of the CWRA process concluded, however, the Disaster Management, Housing, and Water teams in Musanze and Gqeberha did not plan any more meetings due to existing departmental structures which operate under different mandates that currently do not require them to hold each other accountable. This is why a sustainability function needs to be worked into the approach's methodology.

To ensure the broader approach's sustainability as a useful planning process for collective action, it is imperative to go a step beyond the workshop methodology and to attract additional funding to implement pilot projects that provide incentives for collaboration and ensure that a diverse group of



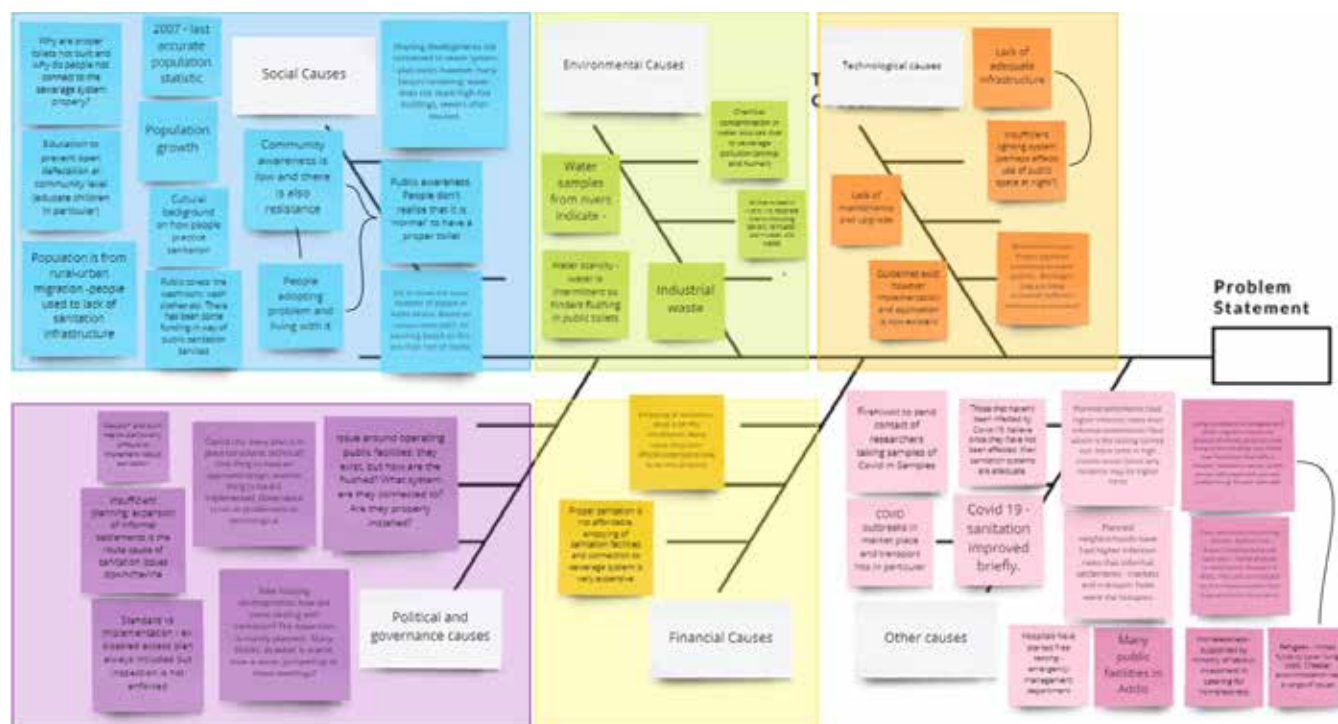
stakeholders work together and meet on a regular basis. This is a key pillar of the unified UWR approach, evidenced in Dire Dawa, where additional funding enabled the city and partners to stay involved in intersectional urban water resilience implementation and collaboration. In addition to securing further funding, collaboration should be embedded in updated departmental mandates, with clear responsibilities assigned to senior officials to ensure accountability and sustain coordination across city teams.

- **Diverse, continuous, and participatory stakeholder engagement enhances alignment and sustainability. It is also important to have a clear framework and the right tools for discussions.** Staff and partners involved in implementing the UWR approach stress that sustained involvement of varied actors—government agencies, civil society, academia, and private sector—fosters alignment, ownership, and long-term sustainability. In addition to these benefits, the urban planning literature shows that broad stakeholder participation can improve coordination and legitimacy (Martinez-Avila and Olander 2024; Reed 2008). However, in the UWR approach experience, initial exclusions (e.g., of vulnerable groups and community leaders) often limited effectiveness. Excluding community participation impedes effective water governance and can perpetuate inequalities in access to water and sanitation services (Tyhotyholo and Ncube 2023; Biancardi Aleu et al. 2022).
- In Musanze, weak local coordination and top-down decision-making initially sidelined civil society. However, the CWRA's assessment and visioning workshops revealed the potential of utilizing existing networks like Rwanda's national community workdays (dubbed "Umuganda") for maintenance

and awareness of urban water resilience projects through routine engagement of communities.

- Johannesburg's process engaged over 700 stakeholders, including members of historically marginalized communities in the city, to bridge inequalities rooted in historical legacies.
- Continuous engagement, as in Kigali's online sessions amid COVID-19 restrictions, built consensus and reduced duplicated efforts, illustrating how participatory processes enhance adaptive capacity and equitable outcomes, particularly for women, youth, and residents of informal settlements who bear disproportionate risks. The virtual methodology with sticky notes and other virtual fora created more of a level field for people who may not have spoken up in an in-person setting (Figure 14). It is important to recognize the benefits of following an approach with several types of participatory processes integrated throughout the timeline. Diverse approaches allow increased opportunities for engagement of various groups.
- Previous challenges highlighted in Dire Dawa, such as limited community input in the city's flood relocation efforts, are now being mitigated through increased collaborations with NGOs like the Red Cross, which are working with both the city and community members to identify contextual approaches to enhance early warnings systems (EWS) and address the specific needs of different communities.
- **Stakeholder engagement approaches must create spaces to both recognize a diversity of perspectives, including those that are often less dominant, and develop consensus-based solutions. An important lesson is to look at water challenges from several**

FIGURE 14 | Example of one of the virtual sticky note activities participants utilized during virtual visioning workshops to identify the root causes of each of the main UWR challenges in their city



Source: Arup, 2021.

perspectives. It is important for implementers of the approach to remember that challenges and problems are perceived differently by different stakeholders, and this can vary even from community to community in the same city. For example, along the same river one community may be more concerned about water pollution affecting the quality of their water source, while another community may worry more about the quantity of the water due to the prevalence of flash floods in their neighborhood. The nature of the main problems and priority concerns depend on which stakeholder group you are speaking to, whether it be neighborhood members, water supply companies, city water authority, or others. As described above, the UWR approach was useful as it brought different stakeholders to the table, yet it is also critical to talk to these groups separately because not everyone is vocal in a large group setting, and some voices may be more naturally dominant in the conversation. For this same reason, when developing solutions, it was best to talk with stakeholder groups separately in bilateral key stakeholder interviews before bringing the solutions and different groups all together at the same table. This lesson was pertinent in both Addis Ababa and Dire Dawa where the main urban water resilience problems were quite different, making agreements difficult.

- **Based on this experience, it is recommended that primary data collection include topics such as social norms, power dynamics, intersection vulnerability, and water insecurity.** Conducting these analyses will ensure that the results that come out of the UWR approach are grounded in the local realities of the communities. For example, the UWR approach prioritized and validated NBS implementation projects that were funded and taken up by the SUNCASA projects. However, before the projects were implemented, an additional step was incorporated. The planning, implementation, and monitoring of those NBS activities were rooted in an on-the-ground integrated climate, gender and social risk assessment that was conducted with local communities.
- **Developing robust monitoring of key hazards and accessible data-sharing systems emerged as a foundational requirement for evidence-based decision-making and investment. However, persistent gaps in tracking, data sharing, and data quality continue to hinder progress across all cities.** Data, particularly from the CCRs which used hazard scans and spatial mapping, as well as trend analysis of the city's water assets, helped spark useful discussions and highlight what cities could achieve. Clearly stated priorities and actions also helped make the case for city leadership to invest in urban water resilience. A related

lesson centered on data is finding a way for cities to welcome data and its use, without causing them to go on the defensive. Addressing these challenges through tools such as digital dashboards, shared data platforms, and geographic information system (GIS) mapping has improved forecasting and resource allocation. This highlights that robust, integrated data systems—including links to national portals—are vital for proactive resilience in the context of rapid urbanization and climate variability. Low UWR scores in data-related indicators (e.g., 2.0 for dissemination in Kigali, 1.5 in Johannesburg) reflected scattered, outdated information on water quality, hazards, and assets. These limitations complicated responses to shocks like flash floods in Dire Dawa or droughts in Gqeberha, where dams reached 14–18 percent capacity in 2022 (NMBM 2022). In Musanze, for example, lack of local hydrological data impeded enforcement of protections.

- **Beyond identifying main challenges and priorities, a lesson involving the UWR approach was to take the process one step further and identify, via stakeholder consensus, the most critical of these to use as engagement points to sustain action going forward.** Each city identified anywhere from 8–10 challenge statements and 6–10 vision statements utilizing the selected CWRA methodology. However, there was a lack of consensus on the most critical challenges and shared visions that needed to be addressed, as well as on the key priorities and actions required to sustain stakeholder engagement and maintain momentum. Addition of the final Validation Workshop was a step in the right direction to confirm city commitments and select the projects for a priority UWR approach project pipeline. This engaged key government authorities, acting as an entry point to promote long-term sustainability, and securing formal commitments to priority urban water resilience projects. It also aligned with donor priorities, helping to mobilize additional funding for the implementation of key actions.

Unique lessons

Beyond these common themes, each city's implementation of the UWR approach generated distinct insights shaped by its unique geography, demographics, and socio-political dynamics. These experiences often catalyzed innovative interventions, revealed previously untapped potentials and produced unique lessons specific to each city. In Kigali, a standout lesson was the transformative role of youth engagement, initially undervalued but pivotal in driving resilience outcomes. Younger participants, originally enlisted as volunteer note-takers in the approach's stakeholder workshops targeting government institutions, emerged as key experts, elaborating on officials' points and leading critical activities like mapping the SUNCASA project area to assess the potential of flood reduction via NBS. This catalyzed youth-led leadership, positioning them as respected experts by partners and city officials in the ongoing SUNCASA implementation work. It underscored the need to integrate local knowledge from diverse demographics, including youth (53 percent of Kigali's population), to strengthen the network of local partners, address data gaps, and foster innovative thinking and methodology. Additionally, discussions during the workshops revealed the importance of aligning Rwanda's national water utilities with Kigali's city priorities to enhance stormwater management efforts.

In Addis Ababa, particular lessons centered on recognizing and navigating transboundary tensions and industrial pressures in a fast-growing capital, given that the city hosts about 65 percent of the country's industries and more than 90 percent of them pollute rivers without enforced standards, exacerbating downstream impacts (Yohannes and Elias 2017). Unique insights included the value of involving informal cultural networks (e.g., Indigenous, voluntary community organizations for social protection dubbed *iddirs*) in community-led resilience workshops as a new approach to addressing urban water issues. According to Bekana et al. (2025), up to 40 percent of produced water is lost due to leaks, illegal connections, and other inefficiencies. This disconnect between NRW challenges and centralized budgeting highlights the need for innovative financing mechanisms such as water funds and cross-subsidization.

Each pilot city's unique geography, demographics, and social dynamics surfaced its own lesson—from the power of youth expertise and informal community networks to early-warning systems, gender-inclusive planning, and historic inequities shaping access today. Together, they confirm there's no one-size-fits-all solution: local context is what makes resilience work.

At the same time, topography-driven siltation resulting from upstream land-use changes underscores the importance of adopting a watershed-based approach to water management. COVID-19 adaptations such as redirecting industrial water to households, demonstrated adaptive equity, though tenure issues in informal settlements persist, requiring pro-poor innovations.

In the case of Dire Dawa, a semi-arid commercial corridor, lessons emphasized upstream-downstream interdependencies, where flash floods from highland runoff threaten industrial parks and informal settlements, deterring investments. Reflecting its arid context, historical flood events demonstrated that relocation measures alone are insufficient without community preparedness. In response, city teams negotiated effective collaborations with the Red Cross to provide 24-hour early warnings through siren systems. During the authors' site visits in 2025, local project partners described the benefits of the sirens providing a warning for community members who sell goods near the riverbank to pack up their materials and move to safety before the fast-moving water coming from upstream arrives. No additional information was collected regarding the frequency of warnings and the estimated damage avoided. Beginning with simple calculations would demonstrate the value of the system, and identify the people who benefit from it most, thereby building the case for replication. As time passes, documenting the events and avoided damage would add the power of evidence to the case.

Additionally, the SUNCASA project's first-year progress in Dire Dawa revealed the potential of NBS to support erosion control, groundwater recharge, and improved water quality. The project also generated valuable lessons on integrating gender equality and social inclusion (GESI), including the use of workshops to challenge gender norms and social biases that prevent women from effectively participating in NBS activities. Peer learning activities provided the space to address unique challenges and demonstrated that involvement and leadership from communities was key to further scaling.

In Musanze, the importance of leveraging local cultural networks for decentralized management was highlighted, where strong national coordination contrasted with local silos, leading to conflicts over water uses like agriculture versus urban supply. Unique lessons included the redundancy of multiple water sources buffering scarcity but exposing distribution vulnerabilities in growing urban areas, prompting recommendations for NBS hybrids like permeable paving and retention ponds to multifunctionally address floods, quality, and recharge. Lack of community involvement in the assessment and visioning workshop dialogues initially undermined ownership of the resulting water resilience action plan. However, follow-up activities that have integrated the existing practice of Umuganda and cell-level committees have begun to foster sustainability of

the UWR efforts, emphasizing inclusive communication to empower women, youth, and cooperatives. The process also revealed untapped potential for scaling circular technologies, including the integration of graywater systems into building regulations to help reduce water demand in a tourism-agriculture hub.

In Johannesburg, an economic hub that depends on water transferred from distant sources, key lessons focused on the importance of recognizing and addressing the enduring inequalities rooted in the Apartheid era. These inequities are particularly evident in informal settlements, where residents face amplified risks from aging infrastructure and pollution associated with acid mine drainage. Unique insights included private sector proactivity in emergencies outpacing government action. This prompted partnerships for alternatives like direct potable reuse, though regulations hinder adoption. Political volatility (e.g., frequent mayoral changes) was highlighted as a challenge as it disrupted plans, teaching the value of embedding resilience in strategies like the Water Security Strategy to ensure resilience priorities are maintained across these common political representative turnovers. Pilot projects in densely populated areas, such as litter traps along rivers, demonstrated multifunctional benefits for flood mitigation, improved water quality, enhanced livelihoods and strengthened community ownership. They also highlighted the importance of fostering cultural shifts toward water-sensitive design (Coetzee et al. 2025).

In Gqeberha, a prolonged drought that brought the city close to "Day Zero" underscored the vulnerabilities of hybrid water supply systems, where inter-basin transfers proved relatively resilient but local sources remained dependent on rainfall. Reflecting its role as an economic hub, water uncertainty delayed industrial investments in the Coega Special Economic Zone (SEZ), underscoring the economic imperative of building resilience. Infrastructure upgrades like pressure management and borehole development helped address water shortages. Meanwhile, the COVID-19 pandemic served as a stress test for resilience, exposing gaps in access to hygiene services in informal settlements. The city characterization and assessment phase revealed invasive alien plants as a localized threat that reduces water availability, prompting prioritization of biome-specific interventions. It also highlighted the need for more equitable service distribution in the context of persistent paradoxes in access to services.

In conclusion, these unique lessons from the UWR approach illustrate that while shared strategies provide a blueprint for resilience, incorporating local contexts maximizes impact within approaches. There is no "one-size-fits-all" solution to address water challenges given that each city across the continent has different capacities and needs. Future applications should prioritize scaling successful pilots, fostering pan-African knowledge exchange across the cohort, and securing sustainable financing to translate these insights into enduring urban water security.



Scaling the UWR approach



One of the central aims of WRI’s UWR in Africa Initiative was to scale the adoption, and investment in urban water-focused programs across the continent. The ambitious vision was to build sufficient visibility and knowledge to scale the unified UWR approach to 100 cities by 2032. Beyond the project pipeline and city-level outcomes described in the section on the pilot cities, WRI’s UWR in Africa initiative pursued this expansion and scaling within and beyond the six pilot cities through two complementary pathways:

- **Collective vision and partnership**, primarily through the 2030 Joint Agenda for Urban Water Resilience in Africa, the ACWA Platform, and development of a proposed blended finance instrument, the ACWA Fund.
- **Technical assistance for financing** delivered through the GGI Accelerator.

Collective vision and partnership

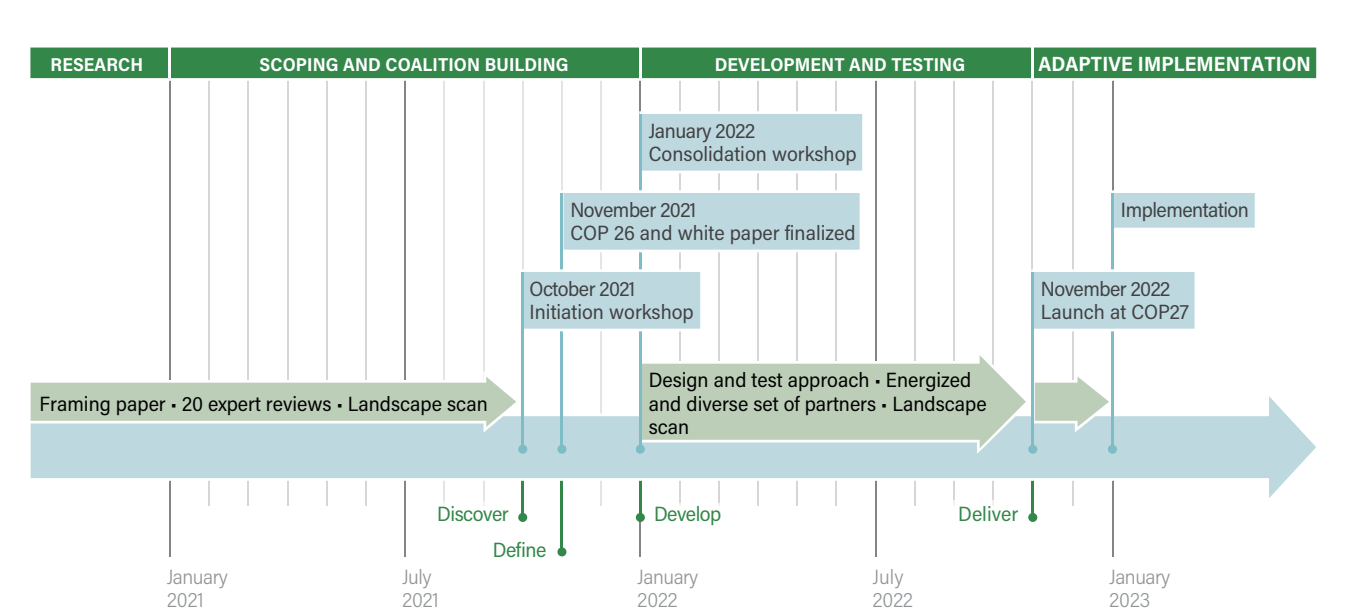
Between 2021 and 2023, WRI in collaboration with Reos Partners, with support from the German Federal Ministry for Economic Cooperation and Development (BMZ), conducted a series of broad stakeholder consultations among key actors shaping the enabling environment for urban water resilience (Figure 15). These dialogue interviews were conducted to delve more deeply into the four priority pathways for action identified in the 2021 Pathways Report. The engaged stakeholders across

the African water sector included national and regional governments, African research institutions, financial actors, and urban water experts. During the dialogues, stakeholders stressed the necessity and importance of developing a shared vision for water resilience in African cities, as well as a partnership platform as a pathway to scale (Reos Partners 2021).

Driven by stakeholder demand, in 2022 this coalition of actors co-developed and launched the 2030 Joint Agenda for Urban Water Resilience in Africa to articulate the principles and priorities for joint action. The Joint Agenda offered an opportunity to connect the dots across the many existing and emerging initiatives within a shared framework for ambitious, accountable, and coordinated action, ensuring impact at scale. A summary of nine strategic priorities of the Joint Agenda co-developed by the consortium of partners include:

- Prioritize the most vulnerable
- Plan for water
- Build capacities and capabilities
- Strengthen governance
- Enable collaboration and partnerships
- Build an inclusive urban blue and circular economy
- Leverage emerging technology
- Get finance right

FIGURE 15 | Process for developing the 2030 Joint Water Resilience Agenda for Africa



Source: World Resources Institute, 2022.

■ Create change at scale

This collaborative process led to the establishment of the ACWA Platform, a pan-African coalition committed to strengthening urban water resilience across African cities. As of 2025, the ACWA Platform had grown into a coalition of 25 organizations, founded on the principles of the Joint Agenda. All members of the ACWA Platform endorsed the Joint Agenda, which was key to building ownership, commitment, and action amongst the partners. The consortium also developed an architecture of governance that allowed for maturity over time.

There is need to connect cities with potential funding sources, including international development banks, private sector investments, and philanthropic organizations. To address this need, WRI in partnership with Castalia Advisors and Pegasys Global Consulting, developed a concept for a funding and financing instrument for the Platform, dubbed the ACWA Fund. The concept was developed against the backdrop of two key challenges to building water-resilient cities in Africa. First, less than 1 percent of climate investments are targeted at water services protection, and there is an estimated \$66 billion backlog in water and sanitation infrastructure investment in most of Africa (African Development Bank (AfDB) 2018, 2022). The Fund's concept has been proposed as a potential financing scheme for operationalization with the

aim of financing innovative urban water resilience solutions at scale, while addressing a unique opportunity to increase climate adaptation investment in Africa's water sector. The ACWA Fund requires seed funding for operationalization and has faced challenges in securing these initial funds, particularly in finding an anchor donor.

Technical assistance for financing delivered through the GGI Accelerator

The UWR approach in six African cities highlighted an untapped yet little understood opportunity to build water-resilient cities through the prioritization of NBS. However, it was also clear that the bulk of urban landscapes were degraded, limiting the power of a pure NBS approach. From multiple conversations with financial partners, it was highlighted that combining GGI elements can be an effective approach to securing financing for these initiatives and pilots in urban areas (Collins et al. 2025).

Against this background, WRI launched the GGI Accelerator leveraging funding from the Caterpillar Foundation, the Danish Development Agency (DANIDA), Global Affairs Canada, and past funding from the Department for Environment, Food and Rural Affairs (Defra) and AFD. The GGI Accelerator covers 11 cities in seven African

BOX 3 | Launch and members of the ACWA Platform

FIGURE B3-1 | Members of the ACWA Platform



Source: WRI.

The ACWA Platform secretariat is currently hosted by ICLEI-Africa. It is co-led with WRI Africa, WRI Ross Center for Sustainable Cities, the African Centre for Cities, Akiba Mashinani Trust, Arup, Cap-Net UNDP, CDP, City of Johannesburg, City of Kigali, EiABC, Future Water Institute at UCT, GSMA, Haramaya University, Musanze District, Practical Action, Resilient Cities Network, Rwanda Young Water Professionals, South African Cities Network, Stockholm International Water Institute, Water Integrity Network, Water Partnership Rwanda, WaterAid, Western Cape EDP, Zutari and Reos Partners.

countries (Kigali and Musanze in Rwanda, Addis Ababa and Dire Dawa in Ethiopia, Johannesburg and Gqeberha in South Africa, Nairobi in Kenya, Bukavu and Uvira in the Democratic Republic of Congo, Brazzaville in the Republic of Congo, and Kumasi in Ghana).

The GGI Accelerator provides technical assistance for this initial cohort of cities with support in the following areas:

policy guidance; project development and implementation; funding, finance and economic analysis; peer learning and capacity building; and communication and stakeholder engagement. The Accelerator's design was largely influenced by the findings of a landmark report published by WRI and the World Bank with contributions from AfDB in 2025 titled "Growing Resilience: Unlocking the

BOX 4 | Launch of the GGI Accelerator in Africa and launch of the Growing Resilience Report

FIGURE B4-1 | Launch of the GGI Accelerator in Nairobi, Kenya, in February 2024



Source: WRI.

By promoting the benefits of integrated green-gray solutions (over traditional gray infrastructure), the Accelerator's cities are being equipped with the capacity to unlock funding and work with local communities in the pilot cities. Greater political support and investments in GGI can address the infrastructure and climate challenges faced by many African cities. The GGI Accelerator provides dedicated resources, innovative approaches, and engagement with communities, governments, and investors to overcome NBS adoption challenges in African cities. It guides cities to become more livable and equitable.

In 2026, the GGI Accelerator is supporting the cities of Nairobi and Dire Dawa to develop Strategic NBS Frameworks, addressing key policy gaps identified by the municipalities. The Accelerator's efforts to support the cities with capacity and tools have led to, for instance, the city of Johannesburg setting aside a budget for NBS implementation. The city of Kumasi, on the other hand, has ring-fenced a portion of their municipal budgets for green-gray projects. In Addis Ababa and Nairobi, the Accelerator is supporting the development of a pipeline of bankable projects for riparian and watershed restoration.



KEY TAKEAWAY

The case for urban water resilience isn't just environmental—it's economic. With returns as high as 23 percent over 25 years, these investments can pay for themselves many times over, making water resilience one of the more compelling economic arguments cities have for climate adaptation, not just a public health or infrastructure one.

Potential of Nature-Based Solutions for Climate Resilience in Sub-Saharan Africa.”

The scaling of urban water resilience projects across partner organizations through the ACWA Platform can lead to significant quantitative outcomes. These projects could directly benefit people living in African cities by improving access to clean water and enhancing wastewater management systems.

In terms of indirect economic benefits, the implementation of urban water resilience strategies can stimulate local economies. Improved water management can enhance agricultural productivity, reduce health costs associated with waterborne diseases, and increase property values in areas with reliable water supply systems (World Bank n.d.). A study by Brandon et al. (2025) revealed that for every dollar invested in making cities more resilient, there is an average estimated economic rate of return of nearly 23 percent over a 25-year period. Similarly, adaptation investments in water supply and sanitation over the same time period come with an average estimated economic rate of return of 19 percent for every dollar invested, and investments in water resources and flood management result in average returns of 18 percent, further highlighting the importance of these initiatives, not only for environmental sustainability but also for economic growth.

The UWR in Africa Initiative presents a powerful unified approach for scaling and expanding water resilience strategies across Africa. By shaping policies, identifying funding mechanisms, and fostering innovative thinking, cities can collectively enhance their water resilience. The potential quantitative impacts, such as the number of projects launched and beneficiaries served, underscore the importance of cross-building and monitoring this work further through cross-collaborative action in addressing the pressing water opportunities and through implementing NBS solutions and community-based diagnosis.





Recommendations

This section highlights the key recommendations emerging from the report. Although the recommendations are aimed at a variety of city stakeholders tackling urban water resilience issues in Africa, they are especially targeted at city and national officials, including policymakers, as well as international and local organizations, and water service providers. They are structured around the four elements outlined in the 2021 Pathways Report and the UWR approach, which were developed through research to support effective and well-defined project preparation:

- Risk informed land management and water-sensitive urban development.
- Prioritizing the most vulnerable.
- Enabling financial mechanisms to be in place for implementation.
- Aiming to create change at scale.

Additionally, the recommendations take into account the input and documentation from the robust stakeholder engagement conducted throughout the UWR approach in partnership with a third-party, Reos Partners, to further expand, deepen, and strengthen the recommendations for building African-led urban water resilience. It is important to acknowledge that this information is a concise compilation of five years of robust work in a pilot cohort of six cities with broader engagement through a coalition of UWR approach partners. The next phase would involve implementing an assessment to measure the impact and track progress against the initial baseline.

Water-sensitive urban development

Adopt integrated city-region and basin-level planning and management, and strengthen water authorities' ability to engage with other water stakeholders

The analysis of cities' priorities, discussions from the workshops, and the documented literature all emphasize the interconnectedness of urban, water, and climate issues. This stresses the need for an integrated water management planning approach that encompasses the entire basin, including upstream and downstream links. It also underscores the importance of cross-sectoral collaboration involving all sectors, from public to private and civil society, in planning and decision-making. National governments should unify

mandates, resources, and tools to promote cross-sectoral engagement, alignment and coordination on urban water resilience issues, thereby helping to close coordination gaps from the national to the local level, and between agencies. City departments should also work together to revisit and reform mandates that may be reinforcing fragmentation or limiting cross-departmental collaboration. This holistic planning will help address the root causes of urban water resilience issues and lead to more sustainable long-term actions. The stakeholder engagement during the UWR approach emphasized the importance of ensuring that this integrated water management takes a more inclusive and systemic approach (Reos Partners 2021).

Foster trust-based partnerships and diverse stakeholder engagement

The UWR approach demonstrated the importance of building partnerships and securing long-term commitments to strengthen collective efforts for water resilience, while clearly defining project roles and responsibilities. Strong partnerships allow for the opportunity to recognize different stakeholders' priorities and perspectives within planning, and to work together to arrive at a joint consensus. The UWR approach was successful because it set dedicated time aside at the beginning of the project to discuss each city's priorities and existing programs with the city agency, as well as to identify a specific point of contact within the city. This opened the opportunity for collaboration in ensuring the approach was appropriately rolled out and tailored to each city's context, understanding that the methodology could not be copied and pasted for each unique geography. It also built trust as each step of the approach was validated by the city, through the identified point of contact, with the aligned goal that the approach would be useful and lead to implementation and ownership of on-the-ground activities. The cohort of pilot cities recognized that the approach could be improved through greater engagement with and validation by the local communities who are most affected by climate-related risks. It is important to support and recognize leadership at the community level to co-create partnerships and knowledge grounded in the everyday realities of water challenges. Collaboration based on trust and full transparency between government officials, local communities, and international NGOs is key to successful implementation. In the dialogue interviews, partners shared that progress will only be made through collaborative, human-centered approaches that are sensitive to the needs and circumstances of vulnerable populations.



Develop better, accessible data and data systems to improve decision-making

Developing better, more accessible data and data systems is essential for strengthening project definition and decision-making around water resilience initiatives. Cities and stakeholders involved in data provision services should create reliable, high-resolution data on hydrology, climate projections, land use, topography, water demand, infrastructure performance, and social vulnerability. This includes flood-risk maps, groundwater levels, rainfall intensity curves, asset condition data from utilities, and neighborhood-level socioeconomic indicators that help identify who is most exposed to water-related risks. To the extent possible, these datasets should be integrated into a unified system with linked geospatial layers, engineering assessments, and financial models so planners can overlay data and see how different interventions interact across scales. With better data interoperability and visualization tools, cities can run scenario analyses to compare benefits, costs, cobenefits, and long-term resilience outcomes across projects. This improves the prioritization process by making trade-offs transparent and enabling evidence-based choices.

Track progress on urban water resilience metrics and outcomes to incentivize further action and investment

City officials should clearly define relevant urban water resilience baselines in their respective countries to monitor progress and make improvements towards collecting up-to-date data on enhancing water resilience.

Standardized metrics across each city would not only allow city officials and partners to identify the most at-risk populations now and in the future, but also to prioritize efforts and maximize the use of scarce public resources in hot spot areas. Efforts could be aligned with other city priorities such as smart meters to detect water usage and leaks which could help cities with water compliance and water conservation, respectively. Moreover, this tracking would close existing city data gaps and could shed light on which initiatives are working well, and why, and which could be used as rallying points to obtain future funding or expand initiatives.

Prioritize the most vulnerable

Build capabilities to leverage expertise on building equitable and resilient urban water systems

The research conducted as part of the UWR approach highlighted that greater investments in capacity for skills development within city structures are needed for meaningful and effective multi-stakeholder collaboration and community engagement. The authors recommended building capacities to plan, implement, and operationalize systemic, adaptive thinking into long-term strategies, policies, and investments specifically where the most vulnerable population groups live. When working with diverse groups, particular attention should be paid to anticipating and addressing uneven power dynamics. Applying an intentional social equity lens to urban water resilience activities ensures there is an equitable distribution of benefits in particularly vulnerable and underserved communities. Examples of how to do this include inviting diverse community groups to participate in planning and

decision-making, incorporating equitable and gender-responsive policies and strategies into existing urban water systems, and conducting social analysis and assessments to inform urban water resilience actions.

The SUNCASA project was key to understanding the importance of creating an enabling environment in communities and government to support equitably responsive urban NBS implementation through co-designing activities and training focused on capacity building and awareness raising. Through the piloting and implementation of this NBS project, it became evident that success stems from building strong local partnerships, not only with organizations focused on NBS and water management, but also with those that advance GESI (Balanean and Trivedi 2025).

Strengthen locally rooted, collaborative urban water governance

A broader recommendation to urban water resilience stakeholders is fundamentally shifting governance systems from siloed and fragmented approaches to an integrated, systemic and collaborative approach that is locally rooted and locally led. This will require concerted effort, commitment, and the effective use of tools and other resources to support institutional reform. Increased local political commitment and leadership is needed to shift towards new, innovative institutional practices for water management that are more decentralized and rooted in local contexts and systems. Similarly, political leadership should aim to develop, streamline, and align priorities, regulations, institutional mechanisms, and incentives to support inter-departmental, cross-sectoral, and multi-level coordination, collaboration, and co-production.

Enable financial mechanisms to be in place for implementation

City officials and financial organizations should prepare high-priority urban water resilience projects to ensure they are ready for financing and implementation

Support cities in translating their water action plans (developed using the UWR approach) into actionable priority projects by assisting in developing viable investment proposals and interventions, providing project preparation support, conducting feasibility studies, and delivering funding for critical projects. To catalyze investment, urban water resilience strategies must be translated into bankable projects that are ready for financing, enabling cities to connect with investors and

secure funding. A critical step identified in the stakeholder interviews is building consensus and momentum among diverse actors on priority city actions, and defining how each group will help move these forward through structured processes such as validation workshops and commitment letters. Having action plans and a long list of city priorities on their own may not lead to mobilization and implementation.

Bundle GGI elements as a funding approach, while facilitating access to financial resources and research on innovative financing

The implementation of the UWR approach has shown that city leaders should anticipate water-related disasters and develop resilient infrastructure and easily accessible financial structures to withstand them. By creating a shared funding pool combining conventional gray infrastructure with natural green infrastructure, cities can collaborate on large-scale water resilience projects that would be financially unfeasible individually. The resilience and cost-effectiveness of UWR projects can be enhanced when NBS are integrated with traditional built infrastructure (Marsters et al. 2025). Investing in “green plus gray” approaches can build greater resilience to a wider range of extreme conditions, both too much water and too little water, while at the same time boosting innovative thinking (van den Berg et al. 2021).

Aim to create change at scale

Shape policies and frameworks from the national to the local level, and vice versa

Scaling of the UWR approach can be particularly impactful in regions where cities are experiencing significant water stress. By shaping policies at local and national level in a way that they are connected and mutually strengthening, the UWR approach can help create a cohesive strategy that addresses the unique water challenges faced by cities in water-stressed regions. For instance, national governments can work with local government representatives to establish regulatory frameworks that support and empower local governments to implement innovative water management practices such as NBS for climate change adaptation. This involves developing policies that encourage sustainable water usage, promote the adoption of green infrastructure, and facilitate community engagement in water conservation efforts from the outset.

Conclusion



Implementing the UWR approach provided an opportunity to understand cities' gaps, challenges, priorities, and opportunities. It helped build relationships with relevant stakeholders, including government officials, and lay the foundation for investment, such as SUNCASA and the wetlands initiative. This work allowed cities and UWR partners to deepen knowledge and technical understanding of how urban water resilience challenges can be overcome, and frame an ambitious action agenda that has gained traction both in Africa and globally. This foundational work included testing strategic planning tools for risk-based planning in the water sector, implementing spatial analysis methodologies to assess climate-induced water risks, and developing and piloting a decision support framework for city-wide NBS planning for climate resilience. Although the UWR work was implemented in African cities, it is worth exploring its applicability for urban contexts in other regions and continents.

Cities are faced with a multitude of priorities and opportunities for engagement, both internal and external, while possessing finite resources. They are often pulled in different directions by different organizations and funders, at times with a project the cities didn't design themselves. In addition to cross-sectoral engagement and other benefits, the UWR approach provides an important shareable and accessible tool for officials to communicate the city's current priorities, and require that any new projects and initiatives align with them.



Appendices

Appendix A: Interview protocol used to guide conversations with UWR Approach city experts

Introduction

Hello, and thank you for agreeing to participate in this interview.

My name is _____, and I'm conducting research on urban water resilience in African cities. The purpose of this interview is to learn more about implementation of the UWR approach, especially to gather insights and lessons learned.

This interview will last approximately 45 minutes. Your participation is voluntary, and you may decline to answer any question or stop the interview at any time. We request that you respond in your professional capacity rather than in a personal capacity.

With your permission, I'd like to audio-record our conversation to ensure accuracy. The recording will be stored securely and, if you prefer, your identity will remain confidential.

Do you consent to participate and to have this interview recorded? Do you have any questions before we begin?

Interview questions (tailored for each interviewee)

1. Please briefly describe your experience and involvement with implementing the UWR approach. At what stage were you involved with the UWR work and what was your

respective role? (For example, were you part of the group of stakeholders involved in the early city assessment, or part of the pilot project preselection and pre/feasibility stage, or the ongoing city engagement?)

2. What are the biggest challenges to implementing the UWR approach?
3. What are the factors that helped with implementation?
4. What are some of the key lessons learned from implementing the UWR approach in this city?
5. How can African cities use the research, data, and stakeholder engagement process from the UWR approach to strategically plan, finance, and implement interventions to address water resilience challenges?
6. What are the enabling conditions, governance arrangements, and political, economic, and equity considerations?
7. What key decisions taken by the city can be attributed to the UWR approach? What is the city doing differently now as a result?
8. Tangible or concrete successes or outcomes from the UWR approach?
9. We are speaking with XYZ. Do you have any additional suggestions on who to interview about the experience implementing the UWR approach?
10. Is there anything else you would like to share with us?

Appendix B: City visions developed in the six pilot cities

TABLE B1 | City visions developed and validated in six cities as part of the UWR approach

ADDIS ABABA, ETHIOPIA	DIRE DAWA, ETHIOPIA	KIGALI, RWANDA	MUSANZE, RWANDA	JOHANNESBURG, SOUTH AFRICA	GQEBERHA, SOUTH AFRICA
Vision 1: Water-sensitive corporate organizations and businesses	Vision 1: Sustained soil and water conservation	Vision 1: Actionable, high quality, accessible data that are shared between stakeholders from public agencies, academic institutions, and the private sector to support management of water resources	Vision 1: Create stakeholders' awareness for improved water resource management	Vision 1: Robust and well-operated infrastructure through consistent proactive maintenance	Vision 1: Strong coordination that relates to planning, monitoring, and All-of-Society, Whole-of-Government response to climate-related disasters
Vision 2: Equitable access to safe and reliable water	Vision 2: Inclusive stakeholder engagement in IWRM decision-making	Vision 2: Well-developed and enforced guidelines and standards for the use of Kigali's water bodies and their buffer zones	Vision 2: Improve multi-level governance for robust and integrated water systems management	Vision 2: Collaborative and well-coordinated organizational culture between and within government agencies	Vision 2: A more integrated approach to dealing with the complexities of informality by adopting flexible, inclusive, and innovative approaches towards social development programs
Vision 3: Clean water courses	Vision 3: Sustainable financial resources for water resources management and infrastructure	Vision 3: Build capacity to advance Kigali's water resilience	Vision 3: Build technical capacity for improved financial planning in the water sector	Vision 3: Improved collaborative relationships between the City of Johannesburg and external stakeholders	Vision 3: Healthy catchments that can sustain natural capital, ecosystem services, and resilient livelihoods
Vision 4: Reliable and secured city-region water supply	Vision 4: Regulation and enforcement for sustainable water resource management	Vision 4: Innovative stakeholder engagement approaches for inclusive water resilience planning and implementation	Vision 4: Advance data management and use of technology platforms for effective water management	Vision 4: Well-run secure digital systems operating in real time to inform decision-making with reliable, well-maintained data collection and information systems	Vision 4: Diversified water supply sources for long-term water security planning that is resilient with redundancies
Vision 5: Comprehensive and participatory (structure) planning and implementation	Vision 5: Develop an integrated watershed management system to mitigate flood hazards, manage shocks, and improve early warning systems	Vision 5: Well-coordinated water governance, at the community level, towards water resilience	Vision 5: Accelerate investment in sustainable sanitation infrastructure for improved community and environmental health	Vision 5: A resilient, productive and livable city that can adapt to and thrive amid both acute shocks and chronic stresses	Vision 5: Robust budget prioritization system and strong decision-making processes supported by sustainable and diverse financial resources for short- and long-term resilience planning and projects
Vision 6: Access to reliable and up-to-date data to build water resilience	Vision 6: Improved quantity and quality of water supply, and a robust delivery system to meet existing and increasing demand	Vision 6: Ensure high quality water-related services	Vision 6: Enhance storm water management for improved water resilience	Vision 6: Equitable and just service provision reflective of collaborative relationships between the city and its communities	Vision 6: Strong institutional support within the Water and Sanitation Sub-directorate, and good collaboration and coordination between and within other directorates in the NMBM

ADDIS ABABA, ETHIOPIA	DIRE DAWA, ETHIOPIA	KIGALI, RWANDA	MUSANZE, RWANDA	JOHANNESBURG, SOUTH AFRICA	GQEBERHA, SOUTH AFRICA
Vision 7: Resilient infrastructure for Addis Ababa	Vision 7: Access to reliable and up-to-date data to build water resilience	Vision 7: Build resilient water-related infrastructure in the city of Kigali		Vision 7: A city made more resilient, livable and amenable by accessible and well-maintained blue green infrastructure	Vision 7: Clean urban riverine systems and settlements that promote human dignity, ecosystem services, and sustainable economic growth
Vision 8: City-wide inclusive, resilient, and sustainable sanitation	Vision 8 – Sustainable sanitation to protect water sources and community health	Vision 8 – Enhance resilience of key water-related plans		Vision 8 – Diversified water sources	Vision 8 – Well operated and maintained urban water, wastewater, sanitation, and stormwater infrastructure
Vision 9: Sustainable stormwater management		Vision 9: Flood resilient city with healthy water bodies		Vision 9 – Robust financial model supported by sustainable financial resources	
		Vision 10: Ensure sustainable water investments			

Abbreviations

ACWA	African Cities Water Adaptation	IISD	The International Institute for Sustainable Development
AFD	French Development Agency	IPCC	Intergovernmental Panel on Climate Change
AfDB	African Development Bank	IWRM	Integrated Water Resources Management
AVEGA-Agahozo	Association of Widows of the Genocide	NBS	nature-based solutions
BMZ	German Federal Ministry for Economic Cooperation and Development	NGO	nongovernmental organization
Cap-Net	International Capacity Development Network for Sustainable Water Management	NMBM	Nelson Mandela Bay Municipality
CCR	City Characterization Report	NRW	non-revenue water
CDP	Carbon Disclosure Project	OECD	Organization for Economic Co-operation and Development
COGTA	Cooperative Governance and Traditional Affairs, South Africa	PBC	performance-based contract
COVID	Coronavirus disease	PES	payment for ecosystem services
CSO	civil society organization	REMA	Rwanda Environment Management Authority
CWRA	City Water Resilience Approach	RYWP	Rwanda Young Water Professionals
DANIDA	Danish Development Agency	SACN	South African Cities Network
Defra	Department for Environment, Food and Rural Affairs, United Kingdom	SEZ	Special Economic Zone
DWS	Department of Water and Sanitation, South Africa	SUNCASA	Scaling Urban Nature-based Solutions for Climate Adaptation in Sub-Saharan Africa
EDP	Economic Development Partnership	SWAC	The Sahel and West Africa Club
EiABC	Ethiopian Institute of Architecture, Building Construction and City Development	UCT	University of Cape Town
EWS	early warning system	UHI	urban heat island
GCF	Green Climate Fund	UN DESA	United Nations Department of Economic and Social Affairs
GEF	Global Environment Facility	UN OCHA	United Nations Office for the Coordination of Humanitarian Affairs
GESI	gender equality and social inclusion	UN-Habitat	United Nations Human Settlements Program
GGI	green-gray infrastructure	UNDP	United Nations Development Program
GIS	geographic information system	UNEP	United Nations Environment Program
ICLEI	Local Governments for Sustainability	UWR approach	Urban Water Resilience approach
IDS	Integrated Development Strategy	WRI	World Resources Institute

Endnote

1. WRI conducted a landscape analysis to select a framework methodology for the UWR approach. The City Water Resilience Approach (CWRA) was selected for its systems-based approach to resilience. More information on the CWRA can be found at: <https://www.arup.com/en-us/insights/the-city-water-resilience-approach/>

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