Innovative water infrastructure management to increase water security for people, economy and agriculture in Southern Africa

ECWASA

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1 Executive Summary

The Eastern Cape (EC) region of South Africa faces recurrent water scarcity and prolonged droughts, intensified by climate change and human factors. Key challenges include increasing water scarcity, energy shortages, and declining water infrastructure due to inadequate investment and skills gaps. Ensuring safe and sufficient drinking water and reliable sanitation, particularly in marginalized areas, is a critical concern, while water supply disruptions during droughts also affect industry. Inadequate wastewater treatment facilities further pollute surface waters, posing risks to ecosystems and public health.

The ECWASA interdisciplinary research project aims to identify research and development needs to improve regional water infrastructure management and enhance water security in the Eastern Cape region. The objectives of the initial phase of the project included stakeholder engagement, international and scientific exchange, joint implementation of preliminary studies and co-design of a research proposal for a subsequent implementation phase. Various meetings, workshops, site visits and a final conference were held to gather insights and foster collaboration.

To address the diverse challenges in the Eastern Cape region, two pilot areas, Buffalo City Metropolitan Municipality (BCMM) and Kouga Local Municipality (KLM), were selected for the development of the joint preliminary studies. These areas have experienced or are facing water scarcity with varying socio-economic impacts.

A study on **Water Governance and Monitoring** identified significant challenges in water infrastructure governance that affect economic development in these areas. These challenges included budgeting and financing, maintenance and non-revenue water, capacity development, and climate-resilient governance and planning. Recommendations included developing short- and long-term strategies for infrastructure improvement, integrating climate change considerations into water infrastructure planning, learning from past water crises, and strengthening cooperation among water management departments.

A **Water Reuse and Resource Recovery** Study identified significant potential for direct and indirect potable reuse in both pilot regions. Specific options were identified in BCMM, such as non-potable water reuse for industrial purposes and direct potable water reuse. In KLM, the potential for water reuse in irrigation using domestic wastewater was explored and further highlighted in a study on Grassland Production and **Water Efficiency in Agriculture**.

A study on **Water and Sanitation in Marginalized Areas** aimed to assess the provision of water and sanitation services in informal settlements and townships. The main challenges identified were equitable access and affordability, particularly for low-income households who bear a disproportionate financial burden due to intermittent water supply. The study recommends exploring equitable water supply and financing systems that incentivize

investment in water infrastructure while discouraging wasteful consumption. In addition, the study suggests exploring alternative sanitation systems that prioritize health and social safety while promoting the recycling of sewage sludge for biogas and fertilizer production.

Finally, a study was conducted on the status quo of **Digitization and Asset Management** in the municipal water sector. The assessment found that several software solutions are already in use, but that a lack of connectivity between applications and siloed data stores leads to increased workload and untapped data and analytics potential. To address these challenges, the study highlights the importance of improved integration and automation of data management processes in the municipal water sector to increase efficiency.

In the initial phase of the project, specific research and development needs were identified in collaboration with local stakeholders and specified in joint preliminary studies. The project, and in particular the final conference, brought together stakeholders from politics, agriculture, industry and administration for an open discourse on the status quo of water security in the region. The consensus of the conference was the common understanding of the need for coordinated solution strategies, to which the ECWASA project can contribute as co-initiator and scientific counterpart.

2 Introduction and Objectives

South Africa, and the Eastern Cape in particular, frequently experiences water scarcity and droughts, which have become more severe and prolonged over the past ten years due to climatic changes and anthropogenic factors. While the water and wastewater infrastructure in the country is generally better compared to other countries in Southern Africa, the challenges it faces are substantial nonetheless. These challenges include water scarcity due to increasing water demand and growing pressure on natural water resources, frequent energy shortages as a result of political mismanagement and sabotage (in March 2023 this was about 9 hours per day), and a decline in water infrastructure due to inadequate investments and skills shortages in managing and operating institutions.

Some of the key issues facing South Africa today are ensuring a safe and sufficient supply of drinking water and reliable sanitation, particularly in marginalized areas. During droughts, water supply disruptions have an additional impact on industry and the economy, leading to higher production costs and a loss of attractiveness of South Africa as a well-established and safe manufacturing and production location. The generally poor performance of municipal and industrial wastewater treatment plants also leads to the contamination of surface waters with pathogens, nutrients and persistent organic pollutants, with negative impacts on ecosystems and public health.

Given this context, the main objective for the initial phase of the interdisciplinary collaborative research project ECWASA and its associated partners was to identify the specific research and development needs to sustainably improve regional water infrastructure management and, as a result, increase water security for people, economy and agriculture in the EC region.

The following subtasks should achieve the main objective:

- International exchange, technical involvement of relevant stakeholders and implementation of stakeholder workshops.
- A comprehensive co-design of the work packages leads to targeted outcomes for the subsequent implementation phase.
- Conduct studies on topics related to the main phase tasks. This includes data collection and identification of other relevant stakeholders. This is to assess the feasibility of the tasks, define work packages and create a constructive working environment between the project partners.
- Design a strategy for local capacity building and communication for the implementation phase.

3 Chosen Approach

In order to cover the structural diversity of the EC in the development of adapted solutions, two pilot areas were selected, which are characterised by water scarcity, but whose challenges are different in socio-economic terms. At the same time, the same research approach was applied to the two pilot areas in parallel, consisting of three pillars:

1. **Stakeholder identification and participation** through bilateral meetings and workshops.
2. **International and scientific exchange** in the framework of a kick-off event, numerous on- and offline working meetings as well as field visits
3. **Definition and elaboration of joint preliminary studies** on R&D topics for the main phase

Finally, a **final conference** was held with all participating project partners from both pilot areas and other actors from politics, science, business and administration. The status quo of the water supply and treatment situation was discussed from different perspectives and the results of the initial project were presented and discussed. The findings from the initial phase and the final conference were incorporated into the concept for the main phase and submitted to the German Ministry of Education and Research (BMBF) as well as the Water Research Commission (WRC) of South Africa to apply for funding.

4 Most relevant scientific and technical results

The pilot areas studied during the initial phase of the project were Buffalo City Metropolitan Municipality (BCMM) and Kouga Local Municipality (KLM). Both pilot areas have experienced water scarcity in the recent past or are currently experiencing water scarcity with different impacts on the local economy and population (Buffalo City Metropolitan Municipality 2022; Kouga Local Municipality 2023). The BCMM region with its metropolitan area is an important industrial location of the EC, which is particularly characterised by the automotive industry and corresponding suppliers. KLM's economy, on the other hand, is agricultural dominated (fruit and vegetable growing, dairy production and livestock farming) with an additional focus on tourism in the coastal regions.

Figure 1: Location and impressions of the water supply situation in BCMM and KLM.

The water supply of both pilot areas is mainly based on surface water, although in KLM treated groundwater is increasingly fed into the local network. Increased groundwater use in BCMM is more likely to be seen in private households of structured residential areas, usually with the aim of independence from the public drinking water supply and on private farms in the wider region.

As part of the first pillar of the approach, relevant stakeholders in the pilot areas were identified through online and literature research and informed about the planned project and the main project objectives through personal visits of the project coordinator. During these visits, the framework of the project initiation was reviewed and adapted according to the conditions and requirements on site. Following the fact-finding mission by the project coordinator, an online meeting of the project consortium was held to present the new findings and to agree on the next steps of the project.

In April 2022, a visit of the German project consortium to South Africa was conducted. During the visit, kick-off meetings with the South African partners of local administration and selected industrial stakeholders as well as fact-finding visits at both pilot areas were carried out.

In BCMM, the wastewater treatment facility East Bank, the Umzonyana water treatment work, the Creek pump station as well as the main water reservoir of BCMM, the Bridle Drift Dam, were visited. Additionally, the Mercedes Benz SA manufacturing plant in East London was visited with a special focus on the water supply and treatment facilities of the plant. A smaller part of the group also visited public sanitation and water supply stations in a marginalised area of BCMM. In KLM, the wastewater treatment plant and reticulation system in Kruisfontein as well as groundwater treatment works and boreholes in Humansdorp were visited. Impressions of the water infrastructure facilities visited in BCMM are illustrated in Figure 2 and KLM in Figure 3 respectively.

Figure 2: Impressions of the water infrastructure facilities visited in BCMM. (a) Raw water before treatment to drinking water. (b) Reservoir. (c) Surface aeration of wastewater at East Bank Wastewater Treatment Plant. (d) Participants exchange information about the visited plants.

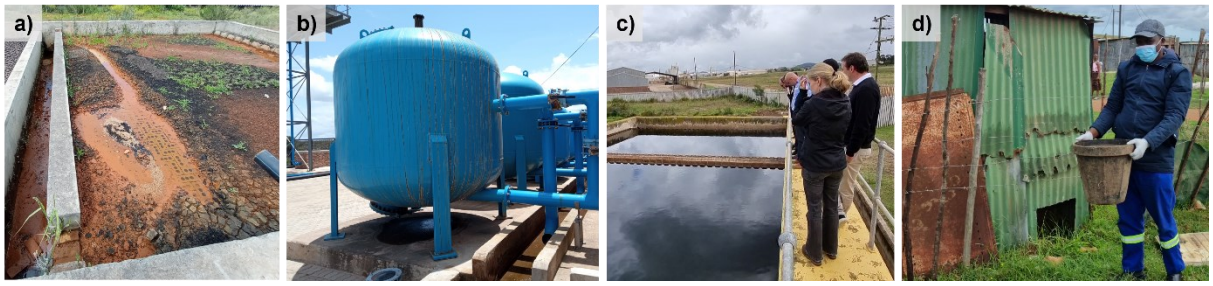


Figure 3: Impressions of the water infrastructure facilities visited in KLM. (a) Rinsing water discharge of a groundwater treatment plant. (b) Sand filter of a drinking water treatment plant. (c) Participants of the ECWASA project during a visit to a wastewater treatment plant. (d) Bucket collection in the framework of the sanitation system in marginalized areas.

Part of the kick-off events was a workshop with the South African partners to identify key water management issues that were to be jointly elaborated in the framework of preliminary studies during the initial phase. For this purpose, interdisciplinary South African-German working groups were formed for each the preliminary study.

In the framework of the initial phase, the following preliminary studies were jointly elaborated:

1. **Water Governance and Monitoring**
2. **Water Reuse** and Resource Recovery
3. Grassland production and **Water efficiency in agriculture**
4. **Water and Sanitation in Marginalized Areas**
5. **Asset Management and Digitization** within the municipal water sector.

The studies are available on request. In the following chapters, the main findings are presented.

4.1 Water Governance and Monitoring

The findings of the Water Governance and Monitoring study indicate that the challenges of water infrastructure governance failure have significant implications for economic development of the pilot areas. These challenges can be categorized into five main fields: budgeting and financing, maintenance and non-revenue water, capacity enhancement, socio-ecological complexities, and climate-resilient governance and planning. These challenges have a detrimental impact on water resources infrastructure throughout the areas, leading to decay and failure. The consequences of infrastructure governance failure extend to various aspects, including ecosystem health, human health, and the economy, with issues such as poor water quality, emerging contaminants, and public health risks arising from wastewater spillage.

To address these challenges, several recommendations are proposed. Firstly, the development of short- and long-term strategies to improve and refurbish existing water infrastructure, utilizing the latest technological advancements. This includes the implementation of telemetry systems for remote tracking of water leakages to enhance response time for repairs. Secondly, future water infrastructure projects and planning should be climate-sensitive, considering the projected impacts of climate change on water security. Lessons from other regions, such as Cape Town's experience with water crisis-induced drought, should be adapted and applied. Lastly, it is suggested to review and amend existing laws and frameworks governing water infrastructure management to enhance cooperation and integration among departments throughout the value chain.

4.2 Water Reuse and Resource Recovery

Within the framework of the **water reuse** study, large potentials for direct potable water reuse as well as indirect potable water reuse were identified for both pilot regions. In BCMM, various options for water reuse including reuse for industrial purposes were identified with two options attracting higher attention than others: 1. Non potable water reuse from East Bank Wastewater Treatment Works for industrial purposes including Mercedes Benz with an estimated yield of 2.294 million m^3/a; and 2. Direct potable water reuse from East Bank Wastewater Treatment Works to deliver reclaimed water (potable reuse standard) to the Umzonyana Reservoir with an estimated yield of 1.217 million m^3/a. In order to gain experience in the use of the water treatment technologies for water reuse purposes and to train local professionals to operate and maintain the plants, the study proposes the installation of pilot plants at the East Bank wastewater treatment facility to test the production of different water qualities from urban wastewater on site before implementing large-scale and cost-intensive water reuse projects.

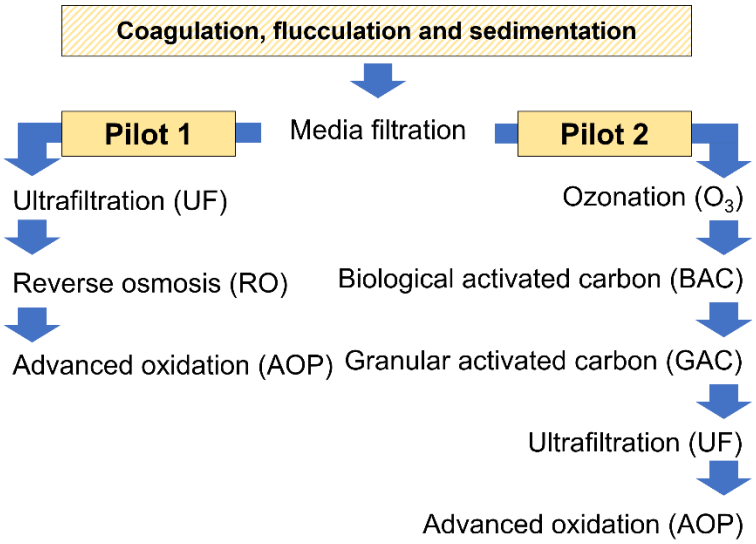


Figure 4: Proposed reuse pilot plant to be installed at the East Bank Wastewater Treatment Plant. The plant consists of two parallel treatment streams with a capacity of about 10 m^3/h.

In KLM, water reuse potentials have been identified especially in the use of domestic wastewater for treatment subsequent reuse for irrigation purposes. The wastewater treatment works in Humansdorp were identified as suitable pilot location due to the close proximity of water availability and agricultural demand. This scenario was further investigated in the Grassland production and Water efficiency in agriculture study.

4.3 Grassland production and Water efficiency in agriculture

The study showed, that the general water demand of the prevailing agricultural activities in the pilot areas is high, while water reuse techniques are still uncommon in daily practice. Thus, potential to increase water use efficiency in the agricultural sector is high with comparably good implementation perspectives due to the high extend of well-situated private enterprises in the sector and comparably low-quality requirements for irrigation water.

For both pilot areas, concepts to exemplarily increase the local water use efficiency were elaborated: Assuming a volume of 5 m^3/d of treated effluent of the wastewater treatment work of one of the main wastewater treatments works of KLM and taking an evapotranspiration of 3 mm/d into account, a total irrigation area of about 100 – 150 ha is expected to be realistic in the study. Moreover, the study suggests to combine conventional sewage treatment with soil filtration for groundwater recharge through overirrigation techniques to provide a water buffer for municipal supply in dry seasons. For the BCMM area, the potential of managing surface water for groundwater recharge and subsequent use for greenhouse cultivation was investigated. As protected vegetable production is an important economic sector and creates jobs, limited water availability during dry periods restricts the growth potential of the sector. A further challenge is the high herbicide concentration of the groundwater (especially “picloram”), that has to be reduced via e.g., ozonisation before usage. Picloram, while posing no negative impacts on humans and animals, exhibits a pronounced toxicity towards plants belonging to

the nightshade family, even at concentrations below 10 parts per billion. Consequently, the utilization of groundwater for irrigation purposes, particularly for tomato, pepper, and eggplant crops, which represent the primary vegetable cultivars in protected cultivation within the designated region, is restricted.

4.4 Water and Sanitation in Marginalized Areas

The study conducted on Water and Sanitation in Marginalized Areas aimed to assess the current state of safely managed water and sanitation services provided to informal settlements and townships in the selected pilot areas. The primary challenges identified are equitable access and affordability, particularly for low-income households (Beard und Mitlin 2021). Intermittent water supply resulting from burst pipes or water shedding not only poses health risks but also imposes additional financial burdens on households as they strive to compensate for the lack of water. Low-income households bear a disproportionate burden, experiencing greater financial losses compared to middle and high-income households (Burt et al. 2018). Theoretically, each family should have access to 6 m³ of water per month free of charge. Ideally, households in densely populated urban areas would be connected to a piped water supply system, which is considered the safest and most cost-effective water source. However, in most marginalized areas within the pilot regions, water is supplied through standpipes free of charge. This often leads to wasteful practices, such as open taps or illegal car washing, contributing to the high levels of non-revenue water, which averages around 41% in South Africa (Raletjena n.d.).

The study recommends exploring equitable water supply and financing systems that incentivize water suppliers through potential income generation. This approach aims to encourage investments in water supply infrastructure, improve water security, and discourage inefficient water usage. By addressing these issues, the study seeks to enhance the provision of water and sanitation services in marginalized areas, ensuring greater accessibility, affordability, and sustainability.

As about 40% of the water used in South African households serves for toilet flushing, an adaption in this sector promises great potential. In contrast to the widespread high-flush toilets, low-flush toilets, ventilated pit latrines, or the bucket system dominate in marginalised areas. Some residents even lack access to any toilet facilities. The widespread notion for high-flush toilets as general standard is viewed critically, since on the one hand the sewage infrastructure is not available or only available to a limited extent in many places, and on the other hand the further spread of this technology would lead to a further increase in water demand in private households. An exemplary analysis of the potential water savings for the BCMM region by replacing all high-flush toilets with low flush toilets, assuming 8.5 l water saving each utilization, showed that on average 18% of the annual water consumption could be saved. Given these

findings, the study recommends exploring alternative sanitation systems that prioritize health and social safety criteria, while also focusing on the recycling of sanitary materials for the production of biogas and/or fertilizer. Such systems would offer sustainable solutions by minimizing water usage and utilizing waste materials in beneficial ways.

4.5 Asset Management and Digitization within the municipal water sector.

The preliminary study on Asset Management and Digitization aimed to evaluate the current state and possibilities of digital solutions within the municipal water sector in the selected pilot areas. The assessment revealed that predominantly standalone versions of digital solutions were in use, and in some instances, shared data storage solutions were identified. However, there was a lack of automated interfaces between different departments, resulting in increased workload for personnel involved in data management. Similarly, various applications used for data analysis were found to rely heavily on manual processes, resulting in significant workload for the personnel involved and being highly dependent on their capacity. These findings highlight the need for improved integration and automation of data management processes within the municipal water sector. Implementing digital solutions that streamline data sharing and automate interfaces between departments can help reduce workload and enhance overall efficiency in data analysis and management. Figure 5 illustrates different soft- and hardware solutions already in use in KLM.

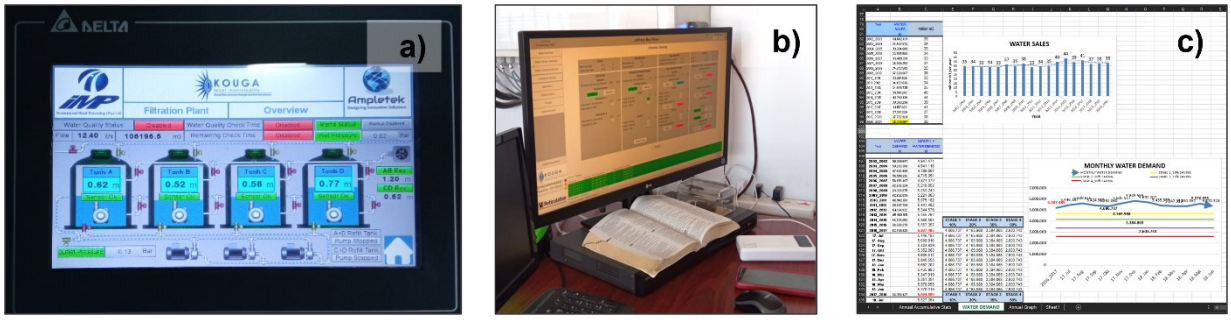


Figure 5: Digital-Solutions already in use in the local municipalities. Control units of water treatment plant (a) and (b) and digital database of water sales data and data and visual analysis in Excel (c).

Both municipalities encounter challenges related to incomplete or outdated base data, as well as difficulties in conducting comprehensive data research and implementing and operating (mobile) data loggers. In addition to constraints posed by personnel and financial resources, unreliable technology, inadequate energy supply, and incidents of vandalism and sabotage pose threats to the municipalities data management efforts. To address these challenges, the study recommends the establishment of additional units dedicated to the constant management and maintenance of the database. After digitizing and integrating existing data, it is crucial to map, research, or collect missing data and incorporate it into the database. Existing applications within different departments that have proven effective should be connected to the database, enabling direct data import into the modular system and ensuring

up-to-date information. Interfaces with external data storage, such as climate repositories or other large datasets, should also be considered.

To consolidate capacities and support decision-making processes, software applications should be developed to facilitate quick and current data analysis and reporting for various daily operational tasks. Given that the success of software implementation is often reliant on supporting training measures, a phased rollout with fixed release deadlines and long-term user support is recommended. Furthermore, the integration of new functions should be demand-driven and implemented in a similar manner. Figure 6 and Figure 7 exemplarily show digital tools already in use in the municipalities.

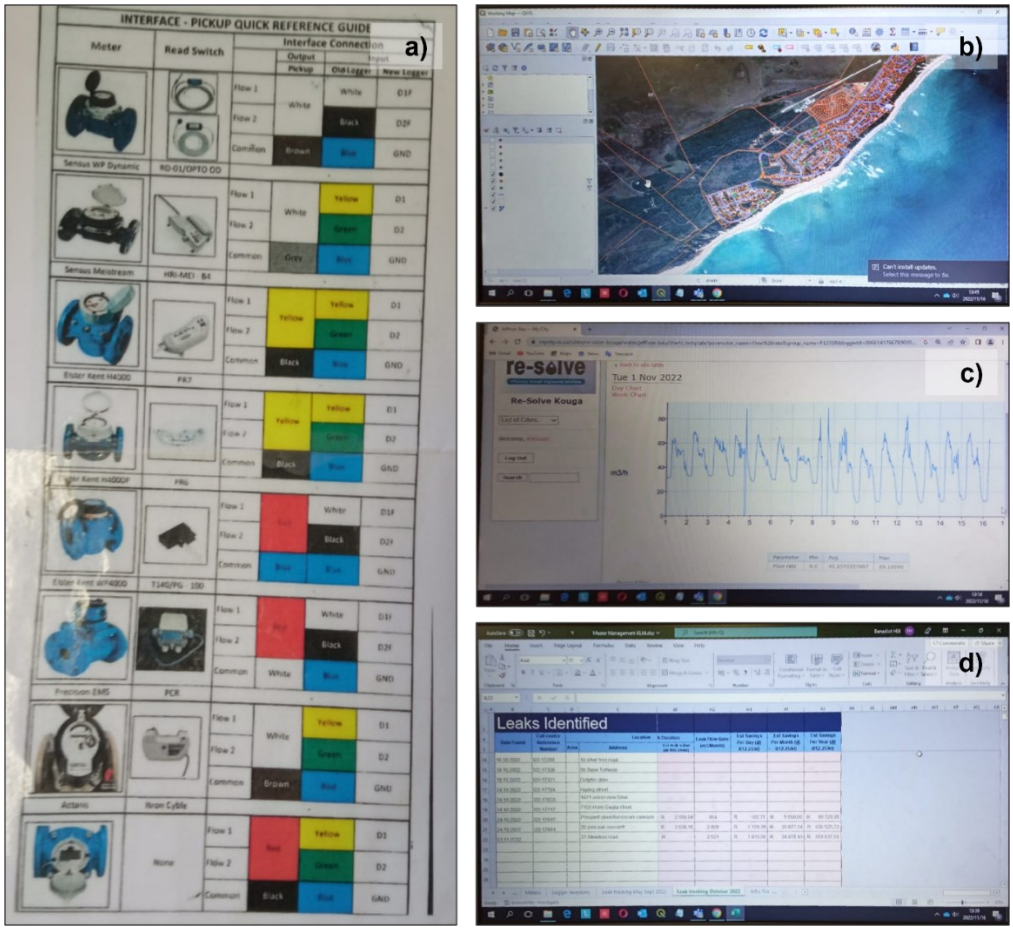


Figure 6: Flow-Meters (a) and different software solutions in use at the local municipalities as GIS-Software (b), Online data management and analysis solutions (c) as well as Microsoft Excel-Tools (d).

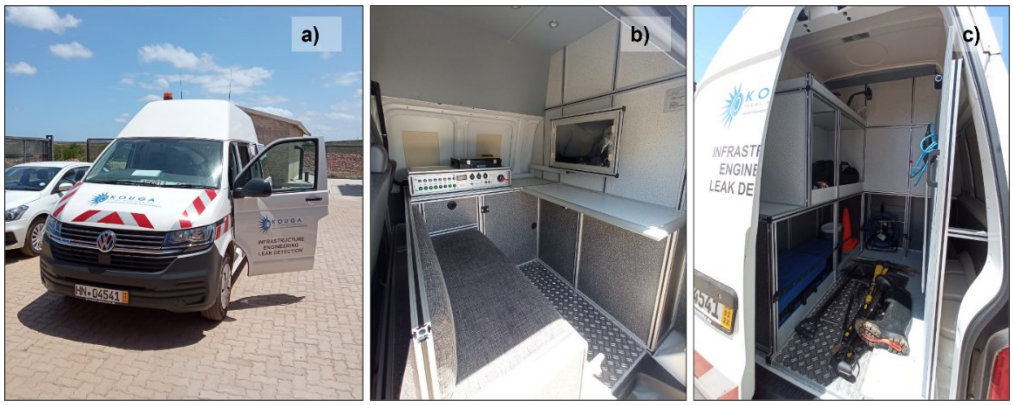


Figure 7: Leakage Detection Vehicle of KLM, financed by Federal Ministry for Economic Cooperation and Development, Germany (Climate cooperation with Ilsfeld), used by the Infrastructure Engineering Department since August 2022. Exterior perspective (a). Inside set up with technical devices (b). Storage for technical equipment (c).

4.6 Stakeholder involvement and research priorities

In February 2023 the findings of the preliminary studies were verified and discussed in a workshop with stakeholders of the South African water sector. The programme of the workshop called “Water-Workshop” can be found in the appendix. The following final conference called “ECWASA Springboard Conference” with about 70 participants from academia, politics, business, and administration served as a platform for various stakeholders to collectively address the specific challenges and present their respective strategies already implemented to face the limited availability of water. In the subsequent panel discussion, all participants underlined the importance of cross-sectoral strategies to effectively address the existing challenges. Recognizing the complex nature of safe and reliable water supply, the stakeholders emphasized the need to bridge gaps and foster collaboration among different sectors, including academia, government, industry, and public administration. The conclusion on the conference was the need of cross-sectoral strategies and expertise and resources available from each sector to ensure a holistic approach to problem-solving and increasing the water security for people, economy and agriculture at the EC. The agenda of the conference can be found in the appendix and Figure 8 shows impressions of the workshop and final conference.

Figure 8: Impressions of the Water-Workshop (a) and ECWASA Springboard-Conference (b) & (c) in February 2023 in East London. (d) A Leak detection vehicle is presented to visitors of the conference in between the sessions.

Based on the knowledge gained through preliminary studies, field visits, stakeholder workshops as well as the final conference, the ECWASA consortium has set six priorities including demonstration and pilot plants, that shall be elaborated and implemented during the main phase of the ECWASA project.

These priorities are:

1. Technical solutions for **water reuse in agriculture and industries** to increase water efficiency in manufacturing and production processes
2. **Nature-based groundwater treatment solutions** to cost-efficiently reduce dependency on surface water resources
3. Innovative **stormwater harvesting and groundwater recharge** solutions to promote climate resilient urban planning and resource recovery
4. Decentralized **off-grid wastewater recycling** and faecal sludge solutions to ensure water and sanitation services in marginalized areas
5. **Data and asset management software solution** and capacity development to facilitate predictive maintenance operation in municipalities:
6. Building local capacity in municipalities through **education and training** measures as well as scientific exchange to support the training **of specialised professionals**.

The proposal for the ECWASA main phase has been submitted to BMBF and WRC in 2023 (Figure 9).

Figure 9: Graphical abstract of ECWASA main phase

5 Compliance with the project requirements

The project was largely completed according to the original work, time and budget planning. The only exception was milestone M4 “Research proposal for the main phase has been submitted”. Due to postponements and updates on the part of the WASA programme, a project outline for the main phase was submitted on time instead of a research proposal by 15 June 2023. All other work was carried out to the planned extent during the project period.

6 Numerical statement

The most significant items in the numerical statement are 0812 scientific personnel, 0835 contracting, 0843 other general administrative expenses, and 0846 mission expenses. Increased expenditures were required in line items 0812 and 0843 compared to the original budget. Mission expenses were more expensive than originally budgeted and increased staff coordination was required to prepare preliminary studies. Savings were achieved in 0843 and 0835 because not all of the planned missions were carried out by the cooperation partners as planned and it was possible to make increased use of local data. The awarding of contracts (0850) successfully supported the implementation of the local workshops and the data collection for the preparation of the preliminary studies.

7 Necessity and suitability of the work performed

The non-profit research institute FiW is a non-profit association and pursues exclusively and directly non-profit purposes. The association is financed exclusively by third-party funds. FiW is only entitled to basic funding from the state in the form of limited deficit financing, which must be substantiated in detail and may only be used for expenses that are not financed by projects. There is no further basic funding from federal or other sources. FiW has no funds of its own to finance the personnel and material expenses of its own projects and, in this case, of the Project. Consequently, the Project cannot be publicly funded by other funds, grants or contracts. FiW is not aware of any technical or economic risks.

For the sake of completeness, it should be noted that FiW receives funding from the State of North Rhine-Westphalia during the project period (2021-2023). This funding will only cover expenses that are not covered by the project funding. The funding is limited in amount and must be applied for and approved each year. The costs of the requested project will only be covered if there is no cost coverage and this can be proven.

The work carried out by the Institute for Tropical Agricultural Sciences at the University of Hohenheim was in line with the scope of the project description. The appropriateness was confirmed by the successful implementation of the project objectives.

The same applies to the other project partners whose project funding consisted solely of the provision of travel funds (position 0846).

8 Progress in the field of the project made during the implementation of the project by other initiatives

No relevant progress is known in this area.

Regular coordination regarding the planned work with the operator partnership between OOWV and BCMM has taken place and is also planned for the main phase of the project.

The German government started the Urban Water Catalyst Initiative, aiming “to support the sustainable transformation of reform-minded public urban water and sanitation utilities into climate resilient, well-performing and credit-worthy public companies”.

9 Publications

The following table lists all publications of the project results that have already been published and those that are scheduled to be published.

Tabelle 1: Successful and planned publications of the project results.

Type	Title	Publisher/Fair/ Conference	Participants	Year	Status
Master thesis	Model-Based Analysis and Optimization of Water Supply in the Context of Climate Change in East London, South Africa	RWTH Aachen	Annalene-Charlotte Wedding, FiW	2022	completed
Master thesis	Analysis of the water supply regime in Kouga Local Municipality in South Africa and data-driven assessment of climate change impacts on the water sector	TH Cologne	Rony Majed, FiW	2022/2023	ongoing
Contribution	ECWASA – Innovative Water Infrastructure Management to Increase Water Security for People, Economy and Agriculture in Southern Africa	Proceedings WASA Stakeholder Information Event	ECWASA Consortium	2022	published
Presentation	ECWASA – Innovative Water Infrastructure Management to Increase Water Security for People, Economy and Agriculture in Southern Africa	WASA Stakeholder Information Event	FiW & IWR	2022	completed
Presentation	ECWASA – R&D Suggestions	ECWASA Springboard Conference	ECWASA Consortium	2022	completed
Presentation	Water Infrastructure Management and Water Security at the Eastern Cape Province in South Africa - ECWASA	Regionalforum Afrika, German Water Partnership e.V.	FiW	2022	completed
Presentation	Vocational Education and Training – Skilled work in Water and Waste Water Management – Cooperation between private and public sector within the ECWASA Project	Federal Institute for Vocational Education and Training (BIBB)	FiW	2022	completed

10 Literature

Beard, Victoria A.; Mitlin, Diana (2021): Water access in global South cities: The challenges of intermittency and affordability. In: World Development 147, S. 105625. DOI: 10.1016/j.worlddev.2021.105625.

Buffalo City Metropolitan Municipality (2022): Annual Report 20/21; available at: https://www.buffalocity.gov.za/folder.php?id=uAKr6oD6x (01.07.2023)

Burt, Zachary; Ercümen, Ayşe; Billava, Narayana; Ray, Isha (2018): From intermittent to continuous service: Costs, benefits, equity and sustainability of water system reforms in Hubli-Dharwad, India. In: World Development 109, S. 121–133. DOI: 10.1016/j.worlddev.2018.04.011.

Koga Local Municipality (2023): KOUGA Water Strategy, presentation at the ECWASA Springboard Conference, Cllr. Horatio Hendricks, East-London, 23.02.2023.

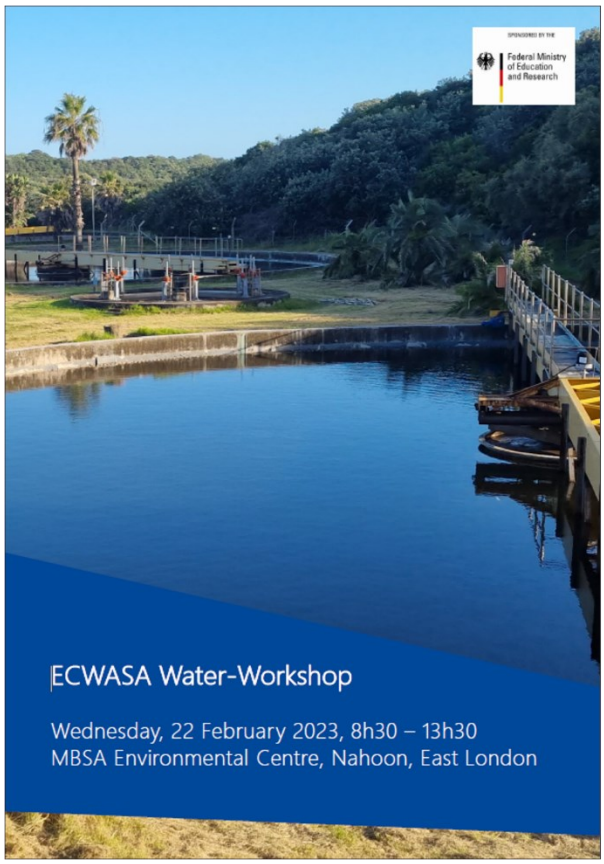
Muller, Mike (2008): FREE BASIC WATER: A sustainable instrument for a sustainable future in South Africa. In: Environment & Urbanization (Vol 20(1):), S. 67–87. DOI: 10.4324/9780203132937-25.

Raletjena, Moloko (n.d.): The ”No Drop Program” – Incentivizing and Facilitating Municipalities to Reduce Water Leaks. Hg. v. The 2030 Water Resources Group (2030 WRG). Online verfügbar unter https://www.2030wrg.org/southafrica-stories/, zuletzt geprüft am 15.06.2022

Rynk, Robert (2022): The Composting Handbook, Academic Press, https://doi.org/10.1016/B978-0-323-85602-7.00001-7.

Annex

Program Water Workshop, 22.02.2023 in East London.



Program ECWASA Springboard Conference, 23.02.2023 in East London.