OVERVIEW

COOPERATION PROJECTS

Initial Overview of the WASA Research Programme

SPONSORED BY THE
Federal Ministry of Education and Research

WATER RESEARCH COMMISSION

DEPARTMENT OF WATER AND SANITATION

WATER SECURITY IN AFRICA – WASA

The Need for Action 4
The WASA Research Programme 6
The Governing Board. 8

COOPERATION PROJECTS

3 Thematic Fields – 7 Collaborative Research Projects. 10

Sustainable Water Resources Management

SeeKaquA: Semi-Airborne Electromagnetic Exploration of Kalahari's Aquifers, Africa 12

WaMiSAR: Sustainable and Climate Adapted Water Management in Mining in the Southern African Region 16

Water Infrastructure and Water Technology

MAMDIWAS: Making Mining-Influenced Water a Driver for Change to Improve Water Security in South Africa 20

NEU-Water: Nature Engineered Urban Design for Water Recycling and Reuse 24

WaReNam: Multi-Scale Water Reuse Strategy for Namibia: Technology, Governance and Capacity Development 28

Hydrological Forecasts and Management of Hydrological Extremes

Co-HYDIM-SA: Co-Design of a Hydrometeorological Information System for Sustainable Water Resources Management in Southern Africa 32

WaRisCo: Water Risks and Resilience in Urban-Rural Areas in Southern Africa – Co-Production of Hydro-Climate Services for an Adaptive and Sustainable Disaster Risk Management 36

NETWORKING AND TRANSFER PROJECT

WASANet: The Networking and Transfer Project for the WASA Programme 40

Legal notice 44

Water Security in Africa – WASA

Gariep dam on the Orange River in South Africa, the largest dam in South Africa · Source: AdobeStock/Rudi

THE NEED FOR ACTION

The access to water is not only a human right and part of the United Nations (UN) Sustainable Development Goals (SDG 6 – Clean Water and Sanitation), but also key for improving living conditions in Africa and a driver for developing resilient and sustainable economies across the continent. However, especially Sub-Saharan Africa is suffering from worsening water scarcity and a severe deterioration in water quality, as stated in the UN World Water Development Report 2024. The major challenges for the African water sector are population growth and associated urban sprawl, growing water demands from the emerging and growing industrial and agricultural sectors, underdeveloped water infrastructure and technologies (supply and treatment), competing interests of water users, a lack of strategic investments in innovative » p. 6

SDG 6 – Clean Water and Sanitation · Source: UN

"Water is a key resource for the wellbeing and economic prosperity of societies in Europe as well as Africa. Given the current and the ever increasing multiple pressures on water resources due to global change, smart and innovative solutions for water management are more needed than ever."

Dr. Rainer Müssner is deputy head of division Resources, Circular Economy; Geosciences at the German Federal Ministry of Education and Research (BMBF). In this function, he is also the responsible programme officer for WASA and represents Germany in the Governing Board.

Federal Ministry of Education and Research

» *German Federal Ministry of Education and Research (BMBF), member of the WASA governing board*

"We cannot dispute the global and complex nature of the water security; however, we can facilitate joint learning across borders, support generation of credible scientific knowledge and sustainable solutions to address the pressing local and transboundary water challenges through strategic partnerships like WASA."

Dr. Mamohloding Tlhagale is the Head of Partnerships and Business Development at the Water Research Commission of South Africa, with over 20 years' experience of managing science, technology and innovation partnerships. She is an advocate of community, youth and women empowerment, and creating enabling environment to support the creation, uptake and transfer scientific knowledge and innovation products to improve livelihoods of ordinary citizens.

» *Water Research Commission of South Africa, member of the WASA governing board*

technologies and an underdeveloped water governance. With progressing climate change leading to an increase in temperature and likely altered rainfall patterns, Africa's water managers expect even greater difficulties in ensuring safe and sustainable access to clean water for a diverse user community in the future.

Hence, major investments in the water sector are needed as underlined by the African Union's (AU) Agenda 2063 as well as the AU's Science, Technology and Innovation Strategy for Africa 2024 (STISA 2024). They are essential to increase resilience by developing and implementing innovative water technologies, adapted water infrastructures and anticipatory and inclusive water management strategies. Sustainable research and industry collaborations and partnerships at national and international level are crucial to address the above-mentioned challenges.

The Water Security in Africa (WASA) programme is an initiative to make significant contributions to achieving the Sustainable Development Goals of the UN 2030 Agenda, deliver the Nationally Determined Contributions (NDCs) and implement national or regional adaptation plans and strategies.

THE WASA RESEARCH PROGRAMME

WASA contributes to increased water security in Africa by developing innovative water technologies and improved water management practices. The research aims to improve water supply and wastewater management for the benefit of people and environment in the face of climate change.

The research programme was jointly developed by African and German experts from science and practice, including the African Ministers' Council on Water (AMCOW) and ministries from Angola, Botswana, Namibia, Zambia and South Africa.

The guiding principles behind the WASA programme are to enable joint action by African and German partners from the very start of the project, to adopt a synergistic and integrated approach involving different ministries and political representatives as well as the pursuit of a long-term implementation strategy. This is also reflected in the funding structure of the programme: The German Federal Ministry of Education and Research (BMBF) provides a large part of the funding. South African researchers receive top-up funding by the Water Research Commission (WRC). In addition, the WASA programme receives numerous in-kind contributions from African and German research partners and stakeholders.

WASA is part of the German Governments research initiative 'Research for Sustainability (FONA)' and contributes to the Federal Government's 'Future Research and Innovation Strategy'. The programme also supports the BMBF's Africa Strategy to strengthen cooperation with African partners in tackling global challenges, establishing long-term and high-quality research infrastructures, strengthening regional and continental collaboration, developing innovation potential and new markets and enhancing Germany's profile as a key partner for Africa in the fields of education and research.

The goal of the WASA research programme is to provide solutions for the water sector that are easy to implement in practice, transferable to other regions or users, and inclusive for all water user communities in order to support decision making at the operational and regulatory level.

Three thematic fields were identified as overarching topics for the WASA projects:

- Sustainable water resources management,
- Water infrastructure and water technology, and
- Hydrological forecasts and management of hydrological extremes.

"My role on the Technical Committee of Experts, advising the Cabinet Committee on Water Supply Security, has provided me with a comprehensive understanding of Namibia's water challenges, enabling me to develop effective short- and long-term solutions for the nation's water security. The WASA Programme provides some of those solutions for Namibia."

Maria Amakali leads the Namibia Water Resources Management Directorate within the Ministry of Agriculture, Water, and Land Reform. She oversees the regulation, planning, and development of the water sector, ensuring equitable access to resources. As a key policy advisor, Maria focuses on sustainable water management and development for all.

REPUBLIC OF NAMIBIA

» *Ministry of Agriculture, Water, and Land Reform, Namibia, member of the WASA governing board*

Besides the development and implementation of innovative solutions for Africa's water sector, WASA includes capacity-building activities and vocational training, particularly on the promotion of young researchers through doctoral sandwich programmes and summer schools. The initiative also seeks to build strong collaborations with similar initiatives such as the SASSCAL Graduate Studies Programme (SGSP) and WaterNet, a capacity building network of water-related university and institutional members based in Southern and East Africa.

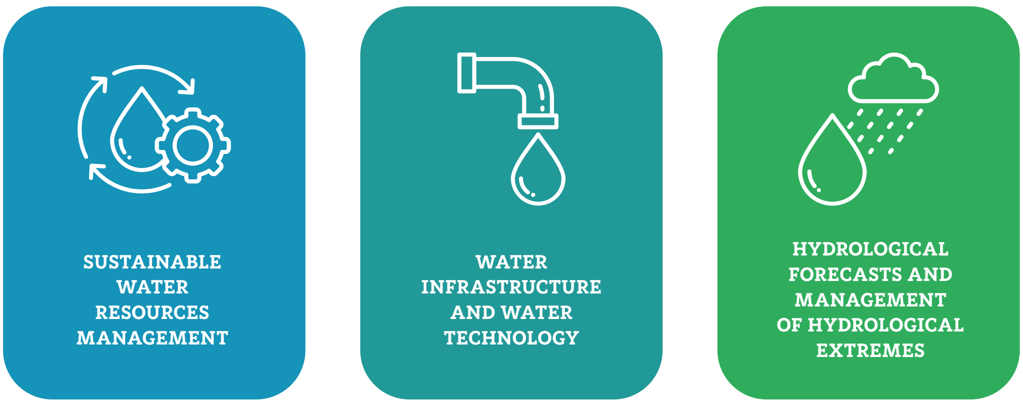
In addition, the seven selected research projects identify synergies together with active stakeholders in the sector including continental, regional and national water authorities, water operators, the private sector, other research programmes, international organisations, associations like the African Water and Sanitation Association (AfWASA) and the public.

To provide scientific and organisational support for the WASA programme, the separate networking and transfer project WASANet is funded.

THE GOVERNING BOARD

The implementation of WASA is guided by a Governing Board consisting of representatives from ministries, governmental organisations responsible for water management and research, and funding organisations of the countries where the respective research and implementation projects are conducted. The continental level is represented by AMCOW.

The Governing Board's primary objective is to provide strategic advice for the programme, projects and activities, ensuring that the respective research is aligned with local, regional and continental needs and policy priorities in water management in Africa and Germany, and to promote the successful execution of the WASA research programme's goals and objectives.



"Water security cannot be achieved through a single action but rather through integration of tools and strategies. WASA should therefore continuously seek to find intelligent and sustainable solutions to emerging issues that threaten water security in Africa."

Kelly Luzibo Gaboiphiwe is a water resources manager at the Department of Water and Sanitation, Botswana which is responsible for water resources planning development and management. In his current portfolio he oversees management water resources information systems for Botswana. That is, real time monitoring systems and instrumentation through facilitation of storage, retrievals and manipulation of water resources data for decision support. Kelly further brings to the board experience and expertise in groundwater management, water resources allocation and regulation. He has previously been involved in the management and implementation of water security projects.

REPUBLIC OF BOTSWANA
DEPARTMENT OF WATER AND SANITATION

» *Department of Water and Sanitation, Botswana, member of the WASA governing board*

Joanna Fatch leads the African Ministers' Council on Water (AMCOW) Water Resources Management function. In the framework of the Water Resources Priority Action Plan, which provides a comprehensive framework for managing Africa's water resources, her work support implementation of the Strengthening Water Governance Systems and Management Structures in Africa programme aimed at promoting and facilitating investment-orientated transboundary management and governance of Africa's water resources with a strategic focus to revitalise water governance systems; and strengthen vertical and horizontal linkages in the institutional processes and structures that form the basis for water management planning and decision making in Africa.

Every drop counts
AMCOW
Count every drop
AFRICAN MINISTERS' COUNCIL ON WATER

» *African Ministers' Council on Water (AMCOW), member of the WASA governing board*

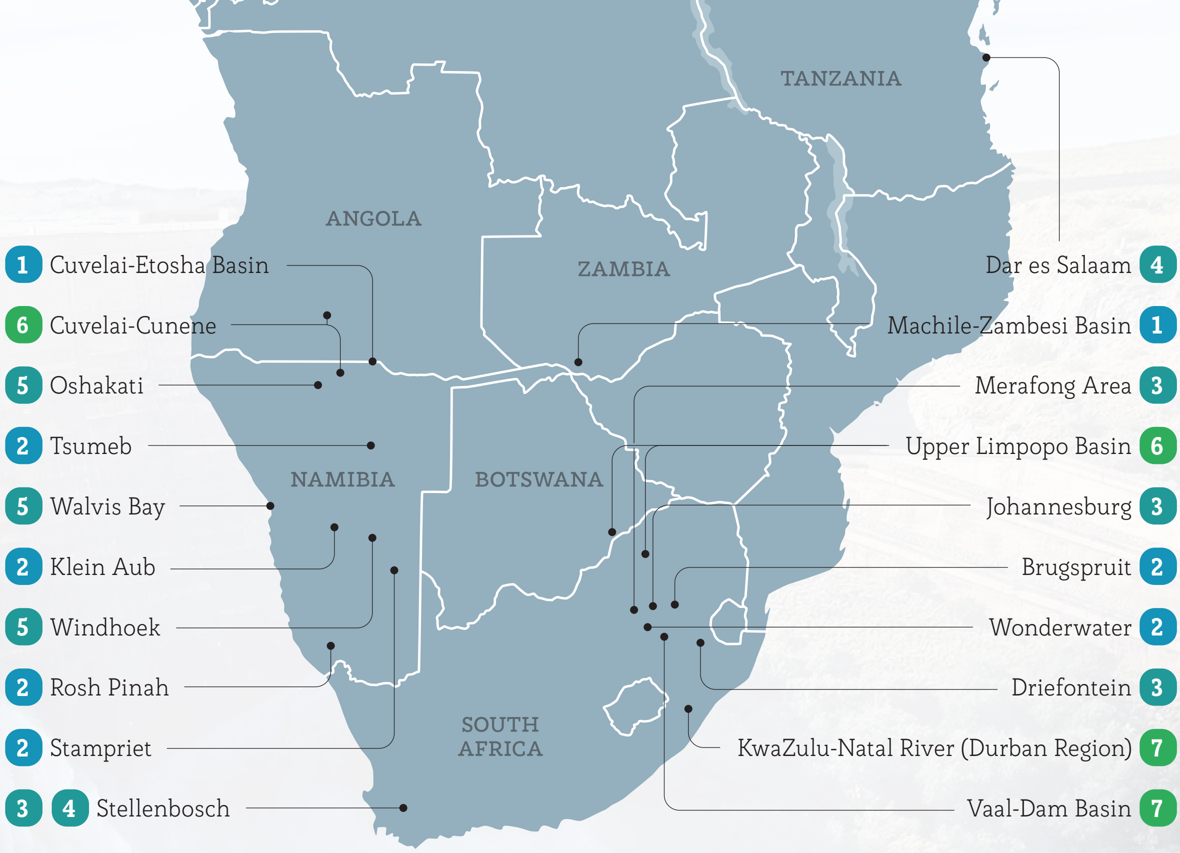
Cooperation Projects

Gariep dam overflowing · Source: Adobe Stock/dpreezg

3 THEMATIC FIELDS – 7 COLLABORATIVE RESEARCH PROJECTS

Following a transparent and inclusive selection process engaging international experts from the water sector and considering the strategic priorities of all partner ministries, seven collaborative research projects were jointly selected. In addition, a networking and transfer project was started.

Overall, more than 90 partner institutions collaborate in the projects. They represent the different stakeholders from research, academia, politics, practice and industry in Germany and Southern Africa who join their efforts in achieving Water Security in the Region.



Map of Southern Africa showing the geographical locations of the pilot sites and regions targeted of the collaborative research projects, Source: WASANet/AdobeStock

Thematic field 1:
Sustainable water resources management

SeeKaquA 1
Semi-Airborne Electromagnetic Exploration of Kalahari's Aquifers, Africa

WaMiSAR 2
Sustainable and Climate Adapted Water Management in Mining in the Southern African Region

Thematic field 2:
Water infrastructure and water technology

MAMDIWAS 3
Making Mining-Influenced Water a Driver for Change to Improve Water Security in South Africa

NEU-Water 4
Nature Engineered Urban Design for Water Recycling and Reuse

WaReNam 5
Multi-Scale Water Reuse Strategy for Namibia: Technology, Governance and Capacity Development

Thematic field 3:
Hydrological forecasts and management of hydrological extremes

Co-HYDIM-SA 6
Co-Design of a Hydrometeorological Information System for Sustainable Water Resources Management in Southern Africa

WaRisCo 7
Water Risks and Resilience in Urban-Rural Areas in Southern Africa – Co-Production of Hydro-Climate Services for an Adaptive and Sustainable Disaster Risk Management

Networking and Transfer

WASANet
The Networking and Transfer Project for the WASA Programme

SeeKaquA

Semi-Airborne Electromagnetic Exploration of Kalahari's Aquifers, Africa

CONSORTIUM SPEAKER IN GERMANY
Dr. Raphael Rochlitz,
Department S2 –
Electromagnetics,
LIAG-Institute
for Applied Geophysics

CONSORTIUM SPEAKER IN AFRICA
James Sauramba,
Executive Director,
SADC Groundwater
Management Institute

WEBSITE
www.leibniz-liag.de/en/research/projects/seekaqua

GEOGRAPHICAL LOCATIONS
- Namibia: Cuvelai-Etosha Basin
- Zambia: Machile-Zambesi Basin

ABSTRACT

Arid regions in Southern Africa, which currently depend on surface water resources, experience severe challenges to supply clean water in times of continuously growing water demands and climate change. The SeeKaquA project aims at exploring two different deep aquifer systems in Southern Africa to make these water resources available for sustainable water management. For this purpose, we consider the environmental friendly semi-airborne electromagnetic (SAEM) method with unique capabilities to provide large-scale 3D models of the electrical conductivity in the subsurface to enhance the hydrogeological understanding at two demonstration sites, the Cuvelai-Etosha Basin (CEB) in Namibia and the Machile-Zambesi Basin (MZB) in Zambia. Groundwater sampling from existing boreholes will further support the interpretation of the geophysical measurements. Integrating all collected data with existing geological, hydrochemical and borehole information in hydrogeological modelling will provide recommendations for drilling locations and an estimate of the potential value of groundwater in the pilot regions that can contribute to a sustainable water management plan.

IMPACT

Our project can improve the water supply in the Southern African region while contributing also to climate resilience with the potential exploitation of deep groundwater instead of surface water resources.
A sustainable knowledge and technology transfer of the SAEM method in combination with the hydrogeological analysis is a major goal of SeeKaquA. We aim to achieve it by working together in an international consortium of research institutions in Africa and Germany and the geophysical exploration company terratec with local branch offices in Namibia and Germany. The close cooperation of academic and industrial partners as well as local stakeholders as associated partners aims to enable not only the first successful demonstration of applying the SAEM method for groundwater exploration during the project phase, but also independent exploration activities in the long term. The applied workflows to identify deep groundwater resources and to recommend suitable drilling locations have a high potential to be transferred to other regions in Southern Africa and worldwide.

"The SeeKaquA project strives to improve exploration techniques for deep groundwater in the Kalahari Basin, which spreads through the Central Southern African region for sustainable water supply."

Dr. Josefina Hamutoko

FOCAL POINTS OF THE PROJECT

- First application of the SAEM method supporting hydrogeological interpretation of deep aquifer systems
- Improvement of SAEM measurement system to be modular with state-of-the-art components
- Enhancement of processing and inversion software with focus on groundwater applications and modern open-source implementation to provide accessibility worldwide
- Hydrogeological modelling including 3D resistivity information to recommend suitable drilling locations
- Recommendations for use of deep groundwater resources as part of a sustainable groundwater management
- Knowledge and technology transfer to local stakeholders such as companies, universities, and authorities for long-term exploitation of the developed workflows

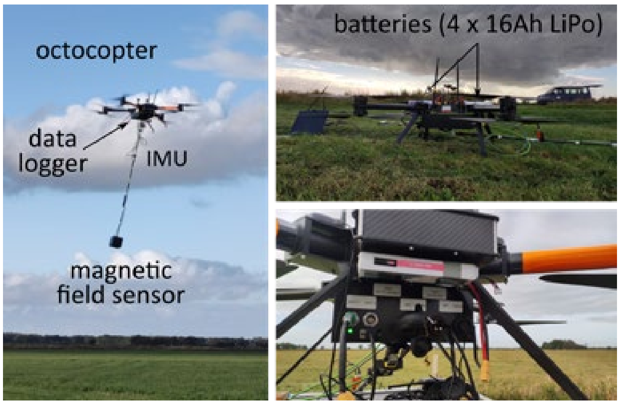
WORK PACKAGES

WP 1: Cuvelai-Etosha Basin demonstration site (Namibia)

» *Lead partners: LIAG, terratec, BGR, UNAM*

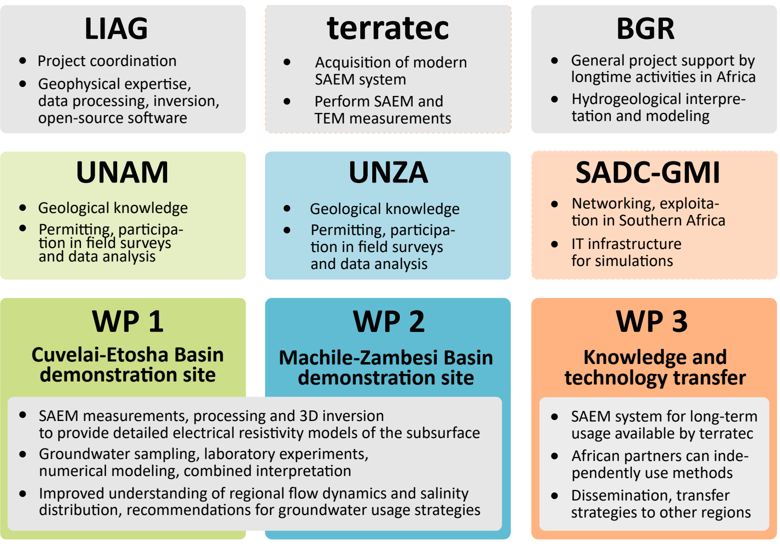
We will perform the first field campaign lasting three weeks at the CEB demonstration site in the second project year. We are confident to cover multiple square kilometres with SAEM data to provide a detailed 3D resistivity model after processing and inversion of the obtained raw data. This model

Map showing the two proposed study areas: the Cubango Megafan (CMF) in the Cuvelai-Etosha Basin and the Machile catchment in the Upper Zambezi Basin · Source: BGR



UAV-based receiver system including octocopter, magnetic field senor, data logger and inertial measurement unit (IMU) for semi-airborne electromagnetic exploration · Source: LIAG

can enhance our understanding of the current salinity distribution within the KOH-II aquifer and provides valuable insights into the hydrogeomorphological features frequently observed in alluvial depositional environments. To complement the geophysical and other existing information, we will collect additional hydrogeological information in the field as part of groundwater sampling and monitoring campaigns. Laboratory experiments including batch tests, column experiments and sand tanks will further support the understanding of geochemical processes in the subsurface. The ultimate goal is to have a hydrogeological model of the local site available to develop recommendations for managing the regional water supply in the upcoming years.



Project Structure: Overview of partners in SeeKaquA with key contributions (top) and work packages (WP) with important project goals (bottom) · Source: LIAG

WP 2: Machile-Zambezi Basin demonstration site (Zambia)

» *Lead partners: LIAG, terratec, BGR, UNZA*

The second field campaign at the MZB demonstration site is scheduled in the third project year. The workflows are comparable to WP 1, though there are less hydrogeological information and no borehole data available at this demonstration site. Therefore, the primary focus here is to explore poorly known freshwater resources in the deeper subsurface based on the obtained 3D resistivity models. This site is particularly suited to show that the modern SAEM exploration method with dense data coverage can provide subsurface models which are detailed enough to identify optimum drilling locations for potential groundwater exploitation.

WP 3: Knowledge and technology transfer

» *Lead partners: LIAG, BGR, SADC-GMI*

In the first months of the project, LIAG and terratec assemble a new modular SAEM measurement system for the usage in SeeKaquA and beyond. SADC-GMI acquires and installs a workstation with support from LIAG. It allows the African partners to perform resource-demanding simulations including geophysical as well as hydrogeological modelling, processing, and inversion. During the second half of the first year, we invite the African partners for an initial training workshop in Germany and organise a practical training and initial operation of the new measurement system in Namibia. During the measurement campaigns at the demonstration sites and the subsequent data analysis, we aim to transfer enough knowledge by on-the-job-training to allow independent usage of the applied methods by the African partners after the project phase. The outcomes of our activities and the potential to apply our exploration strategy in other regions will be presented to a broad audience of interested local stakeholders at a final workshop held in Southern Africa. In this way, knowledge and technology transfer is promoted throughout the entire project.

"The focus of the project is on the transfer of knowledge and technology. We believe that this can increase the development of groundwater in southern Africa beyond the scope of this project."

Dr. Roland Bäumle

PARTNERS & CONTACT INFORMATION

Core partners	Role in the project, Key contributions
LIAG-Institute for Applied Geophysics Dr. Raphael Rochlitz, raphael.rochlitz@leibniz-liag.de	Project coordination, geophysical data analysis
Federal Institute for Geosciences and Natural Resources (BGR) Dr. Roland Bäumle, roland.bauemle@bgr.de	Hydrogeological interpretation and modelling
terratec Geophysical Services Germany (TG) Klaus Brauch, brauch@terratec-geoservices.com	Geophysical exploration, data acquisition
terratec Geophysical Services Namibia (TN) David-John Adams, adamsd@terratec-geoservices.net	Geophysical exploration, data acquisition
University of Namibia (UNAM) Dr. Josefina Hamutoko, jhamutoko@unam.na	Groundwater research, CEB demonstration site
University of Zambia (UNZA) Dr. Kawawa Banda, kawawa.banda@unza.zm	Groundwater research, MZB demonstration site
SADC – Groundwater Management Institute (SADC-GMI) James Sauramba, jamess@sadc-gmi.org	Networking, IT infrastructure

Associated partners	Key contributions
Ministry of Water Development and Sanitation (MWDS)	Permissions, existing data
Ministry of Agriculture, Water & Land Reform (MAWLR)	Permissions, existing data
Water Resources Management Authority (WARMA)	Networking, dissemination
Cuvelai Watercourse Commission (CUVECOM)	Networking, dissemination

WaMiSAR

Sustainable and Climate Adapted Water Management in Mining in the Southern African Region

CONSORTIUM SPEAKER IN GERMANY
Prof. Dr. Stefan Norra, Institute of Environmental Sciences and Geography, Chair for Soil Sciences and Geoecology, University of Potsdam

CONSORTIUM SPEAKER IN AFRICA
- Namibia: Dr. Martin Schneider, Desert Research Foundation of Namibia
- South Africa: Charl Harding, Impact Catalyst

WEBSITE
www.wamisar.info

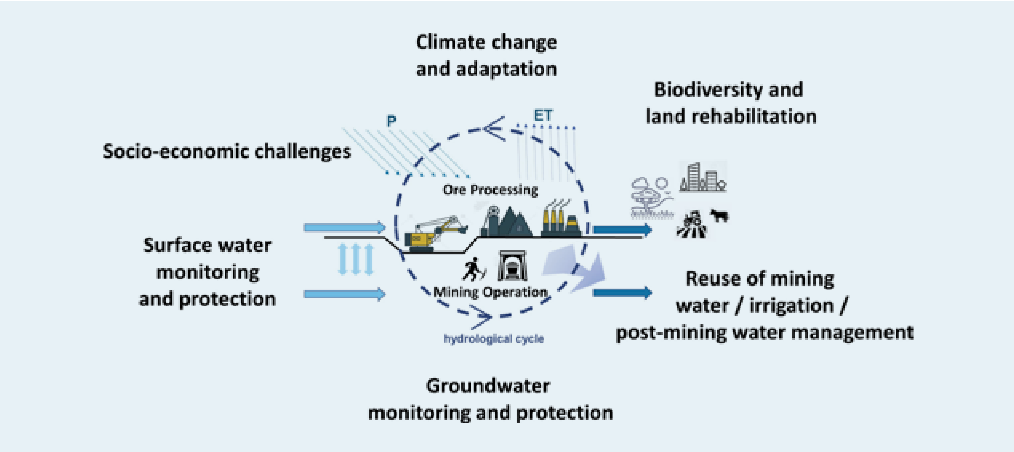
GEOGRAPHICAL LOCATIONS
- Namibia: Tsumeb, Klein Aub, Stampriet and Rosh Pinah
- South Africa: Wonderwater and Brugspruit

ABSTRACT

The sustainable and climate-adapted management of water resources is critical throughout the lifecycle of mining activities. WaMiSAR develops solutions for the sustainable and climate-adapted management of water resources from the beginning to the end of mining activities.
The project focuses on key areas such as establishing hydrological and hydrogeological baseline studies under the conditions of only limited data available, implementing automated monitoring and modelling of water availability in the unsaturated zones of mine residue deposits. WaMiSAR also develops revegetation strategies that support agricultural uses such as biomass and crops or promote biodiversity and ecosystem services through the irrigation with mine water, as well as remediation measures for polluted surface and groundwater, including automated groundwater monitoring. Finally, local socio-economic conditions and community involvement will be considered in the development of the strategies.

IMPACT

The project aims to advance water reuse strategies, improve environmental protection and promote biodiversity. We expect a benefit for local communities, policymakers, mining industry professionals, environmental engineers, governments, NGOs, and mining companies by providing actionable insights and technologies for sustainable and climate-adapted water management. The mining sector in Namibia and South Africa will particularly benefit from the project results, with implications for greening and agricultural use of spoil heaps and mine water resource management. Ultimately, WaMiSAR aims to provide a holistic and modularly expandable toolbox that supports sustainable water management in various mining environments and can be tailored to specific challenges. The results are particularly applicable to these southern African countries, addressing regional water security and mining-related environmental challenges, but are applicable globally, including future uses in Germany. Furthermore, the education network of WaMiSAR involves students in the research activities based on the concept of research-based teaching.



Aspects of the integrated mine water management · Source: Prof. Dr. Stefan Norra, University of Potsdam

FOCAL POINTS OF THE PROJECT

WaMiSAR will address the challenges of water security and environmental protection, focussing on Namibia and South Africa, but with global relevance and will lead to the development of a comprehensive mine water management toolbox including:

- ecological oriented concepts to implement baseline studies for the use of water resources in mining;
- adapted remediation strategies for groundwater resources contaminated by mining activities;
- adapted filter measures for the use of mining water;
- sustainable use of water resources for stockpile recultivation and effective revegetation techniques;
- socio-economic assessment concepts for the sustainable use of mining water resources and the development of post-mining societies.

The implementation of the Mine Water Management Network (MiWaNet) will foster international cooperation and knowledge sharing, creating opportunities for economic growth and environmental sustainability.

"It is exciting that the project will address water issues on abandoned as well as active mines, and that it will include a focus on the challenge of water requirements for mine residue rehabilitation in the arid zone."

Prof. Theo Wassenaar

WORK PACKAGES

WP 0: General Project Management – Mine Water Management Network

» *Lead partner: KIT-AGW (contributors: University of Potsdam, DRFN)*

Coordination of WaMiSAR includes reporting, finance management, public relation and communication of the project results via the website and press conferences, organisation of meetings and the coordination and editing of the compendium for applied concepts for securing and improving water quality and the use of the available water resources in mining affected landscapes. Moreover, the organisation of the exchange platform MiWaNet and the education network MiWaEduNet activities are part of WP 0.

WP 1: Capacity Building Network

» *Lead partner: KIT-AGW (contributors: University of Potsdam, NUST, DRFN, Aquantec, Delta h)*

Capacity building activities are organised as a cross-cutting task and are linked via the Integrated Water Resources Management (IWRM) programme of Namibian University of Science and Technology (NUST) to all participating universities, organisations and companies

"Mine water is a water resource as well. Especially at dry climatic conditions, this resource is of high value and should be used. However, it must be ensured that no dangers arise from it due to potential contaminations."

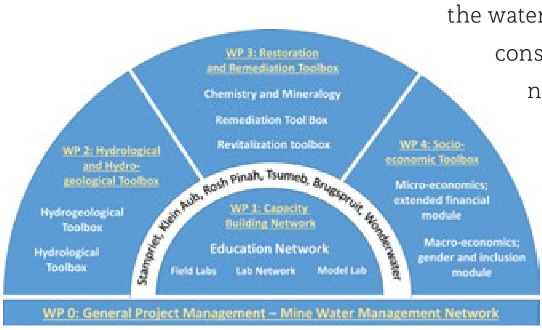
Prof. Dr. Stefan Norra

from the Southern Africa region and Germany. The consortium contributes with its know-how and extensive analytical facilities. Laboratory facilities as well as expertise in hydrogeological and hydrological modelling will be provided for the whole network within the Mine Water Laboratory Network (MiWaLabNet) and a virtual model lab (MiWaModNet). Thus, WaMiSAR offers the opportunity to exploit the joint synergies that can result from cooperation in the field of education and capacity building. In this context, doctoral theses will be written in the framework of the project.

WP 2: Hydrological and Hydrogeological Toolbox

» *Lead partner: Technische Hochschule Lübeck (contributors: University of Potsdam, Delta h, Hydroisotop, Aquantec, KIT-AGW, NUST, DRFN)*

WP 2 involves the development of a web-based hydrological information system that provides expected values and confidence intervals for natural groundwater conditions as well as hydrological and hydrogeological tools for modelling water resources at different scales and in different natural and technical environments. It encompasses methods to assess the natural state, baselines and background values of the water balance and water constituents, reconnaissance studies, tools for conceptual aquifer characterisation, water balance modelling tools and integrated simulation tools. The outcome will be a dashboard solution supporting water resources management in the context of mine projects.



Project structure: Working packages of WaMiSAR · Source: Prof. Dr. Stefan Norra, University of Potsdam

WP 3: Restoration and Remediation Toolbox

» *Lead partner: University of Potsdam (contributors: KIT-AGW, Hydroisotop, TZW, Sensatec, DRFN, NUST, Imapct Catalyst)*

WP 3 includes studies to characterise the mineralogy, chemistry and biochemistry of the stockpile materials and soils at the selected sites, as well as the chemical characterisation of the water resources. The work includes the investigation of the status of water resources in the study areas through geological/hydrogeological, geochemical and microbiological characterisation. This will lead to the identification of potential geochemical or biochemical processes affecting water and soil quality, as well as plant growth and contaminant uptake. Strategies for groundwater remediation (Brugspruit and Tsumeb), mine water treatment (Wonderwater, Tsumeb and Rosh Pinah) and revegetation (Rosh Pinah, Klein Aub, Tsumeb and Wonderwater) will be developed during the project.

WP 4: Socio-Economic Toolbox

» *Lead partner: IREM (contributors: Impact Catalyst)*

The socio-economic toolbox for the evaluation and support of the solutions researched and developed within WaMiSAR comprises two sub-projects, namely WP 4.1: The micro-economic evaluation to support decision-making and business planning with a digital financial model 'eFim' extended with micro-economic data (by IREM) and WP 4.2: The macro- and socio-economic evaluation with a focus on gender and inclusion 'GESI' (by Impact Catalyst).

PARTNERS & CONTACT INFORMATION

Core partners	Role in the project, Key contributions
University of Potsdam, Institute of Environmental Sciences and Geography, Chair for Soil Sciences and Geoecology Prof. Dr. Stefan Norra, norra@uni-potsdam.de; MSc Rosa Sengl, rosa.sengl.1@uni-potsdam.de	Project coordination, remediation and revitalisation studies, groundwater quality monitoring
Karlsruhe Institute of Technology (KIT), Institute of Applied Geosciences (AGW), Chair of Geochemistry and Economic Geology PD Dr. Elisabeth Eiche, elisabeth.eiche@kit.edu Dr. Flavia Digiacomo, flavia.digiacomo@kit.edu	Project management, public relations, capacity building, networking, mine chemistry and mineralogy studies
Technische Hochschule Lübeck, Laboratory for Hydrology and Water Resources Management Prof. Dr. rer. nat. Dipl.-Hydr. Christoph Külls, christoph.kuells@th-luebeck.de Dimitrios Bassukas, dimitrios.bassukas@th-luebeck.de	Hydrological and hydrogeological studies
TZW: DVGW-Technologiezentrum Wasser (German Water Centre) Prof. Dr. Andreas Tiehm, andreas.tiehm@tzw.de Dr. Lara Stelmaszyk, lara.stelmaszyk@tzw.de	Micro- and molecular biological studies (mine water treatment toolbox)
Sensatec GmbH Dr. Stephan Hüttmann, s.huettmann@sensatec.de; Harry Ylikangas, harry@sensatecafrica.com	Implementation of mine water treatment measures
Hydroisotop GmbH Dr. Florian Eichinger, fe@hydroisotop.de Florian Blum, fb@hydroisotop.de	Hydrogeological/hydrogeochemical studies, isotopic and chemical analyses, mine water treatment
Aquantec GmbH Dr. Karl-Gerd Richter, richter@aquantec-gmbh.de Philipp Rinkel, rinkel@aquantec-gmbh.de	Hydrological, hydraulic and groundwater modelling, MiWaModNet
Delta h GmbH Dr. Katrin Brömme, kb@delta-h.de Prof. Dr. Kai Witthüser, kai@delta-h.co.za	Numerical modelling of groundwater flow and mass transport, MiWaModNet
IREM gGmbH Prof. Dr. mult. Karl-Ulrich Rudolph, Dr. Gabriele Walenzik, Alina Kalus mail@irem-research.de	Development of 'eFim' (extended financial model) as part of the socio-economic toolbox
Desert Research Foundation of Namibia (DRFN) Dr. Martin Schneider, martin.schneider@drfn.org.na	Project management in Namibia, co-organisation of MiWaLabNet, organisation of field work in Namibia
Namibia University of Science and Technology (NUST) Prof. Harmony Musiyarira, hmusiyarira@nust.na Prof. Theo Wassenaar, twassenaar@nust.na Rennie Munyayi, rmunyayi@nust.na	Implementation of mine water management practices, research on soil water balances and revegetation measures, organisation of MiWaEduNet
Impact Catalyst Charl Harding, charding@impactcatalyst.co.za Lena-Sophie Kuhr, lskuhr@impactcatalyst.co.za	Coordination of field work in South Africa, socio-economic evaluation
Rosh Pinah Zinc Corporation (Pty) Ltd, Rosh Pinah (Namibia) Dawid Saayman, dsaayman@rpzc.com.na	Rosh Pinah Zinc Corporation (Pty) Ltd speaker
Sinomine Tsumeb Smelter (Pty) Ltd, Tsumeb (Namibia) Vazembua Tijizoo, vazembua.tjizoo@sinomine.na	Sinomine Tsumeb Smelter (Pty) Ltd speaker

Associated partners	Key contributions
Botswana International University of Science and Technology (BIUST): Prof. Peter Eze	BIUST speaker
Sasol: Jacque Duplessis	Sasol speaker
Free State University: Prof. Paul Lourens	Free State University speaker

MAMDIWAS

Making Mining-Influenced Water a Driver for Change to Improve Water Security in South Africa

CONSORTIUM SPEAKER IN GERMANY
Prof. Dr.-Ing. Stefan Panglisch, University of Duisburg-Essen, Duisburg

CONSORTIUM SPEAKER IN AFRICA
Prof. Dr. Richard Moutloali, University of South Africa, Johannesburg

WEBSITE
www.uni-due.de/zwu/mamdiwas.php

GEOGRAPHICAL LOCATIONS
- Germany: Duisburg, Essen, Mülheim an der Ruhr, Wuppertal, Berlin and Schwalmtal
- South Africa: Johannesburg, Stellenbosch, Driefontein and Merafong area (Vaal River catchment)

ABSTRACT

MAMDIWAS addresses the environmental and financial challenges posed by untreated mining influenced water, including but not limited to acid mine drainage in South Africa. Through a holistic and collaborative approach involving local partners and stakeholders, the project focuses on technology development for water and material reuse, integrated water resources management, as well as co-production, governance, policy, and regulation. The goal is to create economic opportunities, promote sustainable water management, and contribute to the transition from a mining-based to a post-mining society. Through collaboration, capacity development, and the demonstration of innovative solutions, the project intends to inspire transformative change, increase water security, and contribute to the achievement of SDG 6 targets.

IMPACT

The outcomes of the project are expected to significantly benefit local communities, national government agencies and authorities, NGOs, and international networks. The project targets sustainable water management solutions with a primary focus on South Africa, though its methodologies and technologies have potential applications in other mining-intensive regions globally. The mining sector will particularly benefit from the economic opportunities created for mine water treatment, supporting a transition to post-mining societies. Emphasising application-oriented solutions, the project ensures practical benefits that promote future research and development. The results will create transfer potential for both German and South African companies, enhancing collaboration and innovation in sustainable water resource management and contributing to key SDG goals.

FOCAL POINTS OF THE PROJECT

- Technology Innovation: Creating innovative technologies for water treatment and resource recovery from mining influenced water.
- Integrated Water Resource Management: Implementing a comprehensive approach for sustainable water use and protection in mining areas.
- Co-Production and Governance: Encouraging collaboration among local partners, authorities, and communities for joint solution development and implementation.

Graphical depiction of the mine influenced water journey: from source, through environmental impact, conventional treatment, and advanced nanofiltration membrane treatment · Sources: Dr. Michael Eisinger

- Policy and Regulation: Developing guidelines and regulatory frameworks to support sustainable water management and legal implementation of new technologies.
- Economic Opportunities: Creating economic opportunities through mine water treatment and reuse and promoting investments in sustainable technologies.
- Post-Mining Transition: Supporting the shift from a mining-based economy to sustainable, environmentally friendly alternatives, aligned with key SDGs.

WORK PACKAGES

WP 1: Technological Innovations for active Mine Water Treatment

» *Lead partners: UDE/ZWU, UNISA*

The main objective of WP 1 is to develop cost-effective, energy-saving technologies for treating mining influenced water that reduce sludge and produce valuable by-products and reusable water. This involves enhancing the cascade concept, optimising acid mine drainage pre-treatment, and using new membrane-based technologies, such as capillary nanofiltration in closed cycle systems, combined with sludge precipitation.

"Through MAMDIWAS, we are not only improving water quality, but also empowering local communities. Together we are building a more sustainable future."

Prof. Dr. Richard Moutloali

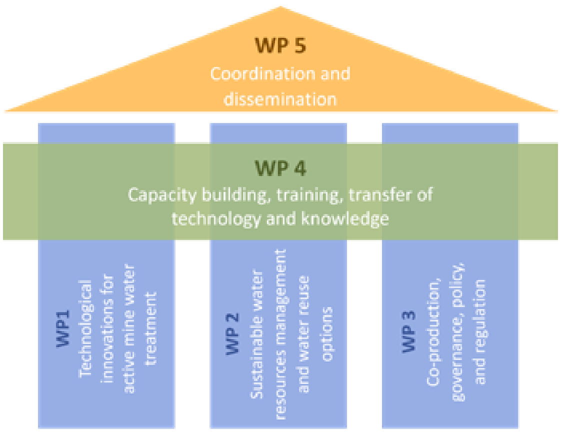
"MAMDIWAS transforms mine influenced water into a resource. Our technology creates clean water and new opportunities for South African communities and the environment."

Prof. Dr.-Ing. Stefan Panglisch

WP 2: Sustainable Water Resources Management and Water Reuse Options

» *Lead partners: IWW, SUN*

The main objectives of WP 2 are to implement an integrated water resources management approach for the Vaal River catchment, assess baseline water quality and quantity to identify water pollutants and their environmental impacts, and determine water reuse options (e.g., drinking, irrigation, hydroponics, industrial) and local community acceptance.



Project structure: Project organisation and work packages – capacity planning · Source: MAMDIWAS

WP 3: Co-Production, Governance, Policy, and Regulation

» *Lead partners: WI, UNISA*

The objective of WP 3 is to analyse the operating environment, conduct stakeholder mapping, develop recommendations for governance policy, and regulation and develop a post-mining development strategy that focuses on reclaimed water interventions for community enhancement.

WP 4: Capacity Building, Training, Transfer of Technology and Knowledge

» *Lead partners: UDE/ZWU*

WP 4 focuses on capacity building and technology transfer in South Africa, training academic and industrial professionals in water treatment and membrane technologies. It aims to meet local community needs, promote sustainable development, encourage entrepreneurship, and guide business setup. Key objectives include strengthening academia-industry networks for collaboration and knowledge exchange, developing a skilled workforce, and advancing membrane technology applications in South Africa.

WP 5: Coordination and Dissemination

» *Lead partners: UDE/ZWU*

WP 5 is designed to ensure the effective management, evaluation, and communication of MAMDIWAS. Its primary objective is to establish a robust monitoring and evaluation framework to track progress and outcomes, ensuring the effectiveness and efficiency of the demonstration activities.

PARTNERS & CONTACT INFORMATION

Core partners	Role in the project, Key contributions
University of Duisburg-Essen (UDE)/ Centre for Water and Environmental Research (ZWU) Prof. Dr.-Ing. Stefan Panglisch, stefan.panglisch@uni-due.de	WP 1–5: Project coordination, technological innovations for active mine water treatment, capacity building, training, transfer of technology and knowledge
IWW Institut für Wasserforschung gGmbH Dr. Tim aus der Beek, t.ausderbeek@iww-online.de	WP 1–3, 5: Studies on sustainable water resources management and reuse options
UN-Habitat Collaborating Center at Wuppertal Institute (WI) Prof. Dr. Oliver Lah, oliver.lah@tu-berlin.de	WP 2–4, 5: Research on co-production, governance, policy, and regulation
SIMA-tec GmbH Mark Enders, mark.enders@sima-tec.de	WP 1, 5: Planning, construction and commissioning of the pre-treatment demonstration plant
University of South Africa (UNISA) Prof. Dr. Richard Moutloali, moutlrm@unisa.ac.za	WP 1–5: Technological innovations for active mine water treatment and co-production
Stellenbosch University (SUN) Prof. Dr. Gideon Wolfaard, gmw@sun.ac.za	WP 2, 4, 5: Studies on sustainable water resources management and reuse options, co-production

Associated partners	Key contributions
UN-Habitat (UNH) Dr. André Dzikus	WP 2–4: Networking, co-production, knowledge exchange
RAG Aktiengesellschaft (RAG) Dr. Michael Drobniewski	WP 1, 4: Knowledge exchange, provide sites for pilot studies in a coal mine in Germany
Inge GmbH/Dupont (INGE) Martin Heijnen	WP 1: Membrane module provider, knowledge exchange
Sibanye-Stillwater Ltd (SI) Quinton Paulse	WP 1-5: Co-production, knowledge exchange, provide sites for pilot studies in a gold mine in South Africa
Sasol South Africa Ltd (SA) Enos Sitabule	WP 1, 4: Co-production, knowledge exchange
Roc Water Technologies (RT) Prof. Dr. Jannie Maree	WP 1, 4: Co-production, knowledge exchange
Johannesburg Water SOC Ltd (JW) Dr. Zakhele Khuzwayo	WP 2, 4: Co-production, knowledge exchange
iWater Pty Ltd (iWa) Prof. Dr. Esta van Heerden	WP 1, 4: Co-production, knowledge exchange
Eskom Holding SOC Ltd (Esk) Nandher Govender	WP 1-4: Co-production, knowledge exchange
Council of Science & Ind. Research (CSIR) Dr. Jeffrey Baloyi	WP 1, 4: Co-production, knowledge exchange
BNAqua Solutions (BNA) Boitumelo Nkatlo	WP 1 ,4: Co-production, knowledge exchange
Mintek (MT) Dr. Keneiloe Sikhwivhilu	WP 1, 4: Founding South African Membrane Society, co-production, knowledge exchange

NEU-Water

Nature Engineered Urban Design for Water Recycling and Reuse

CONSORTIUM SPEAKER IN GERMANY
Prof. Dr.-Ing. Wolfgang Dickhaut, Environmentally Sound Urban- and Infrastructure Planning, HafenCity University Hamburg

CONSORTIUM SPEAKER IN AFRICA
A/Prof. Kevin Winter, Future Water Institute, University of Cape Town, South Africa

WEBSITE
www.hcu-hamburg.de/research/forschungsgruppen/reap/neu-water

GEOGRAPHICAL LOCATIONS
- South Africa: Franschhoek, Stellenbosch Municipality
- Tanzania: Dar es Salaam

ABSTRACT

NEU-Water aims to develop solutions and processes that promote the reuse of stormwater and greywater as part of water-sensitive urban development. The project seeks to address these issues while working in a dense, low-income urban context with limited access to water infrastructure and represents many of the challenges in Southern African countries. The project demonstrates concepts for mixed stormwater and greywater recycling in Franschhoek, South Africa and stormwater management in Dar es Salaam, Tanzania. As a consortium including universities, water utilities and technical experts, the project addresses both technical and institutional challenges in mainstreaming the application of decentralised and nature-based solutions for stormwater and greywater recycling in Southern Africa.

IMPACT

The project aims to develop concepts for integrating greywater and stormwater recycling within dense, informal low-income urban communities. The research activities planned in the project follow a holistic approach by focusing on technical concepts for greywater treatment, monitoring water quality for reuse, implementing operation and maintenance measures for system sustainability, and engaging in participatory planning. The demonstration and capacity-building activities are planned in Franschhoek, South Africa and Dar es Salaam, Tanzania. The project's key stakeholders include residents, local water utilities, municipal administrations and community-based organizations in both locations. The project's outcomes could be replicated across the region by addressing water quality and quantity issues to enhance water security.

"In NEU-Water, the recycling & reuse of greywater and stormwater is not just about saving water, it is a pathway to building resilient and sustainable communities."

Ajith Edathoot

Water Hub, NEU-Water project site · Source: A/Prof. Kevin Winter, UCT

FOCAL POINTS OF THE PROJECT

- Capacity building for adaptation and integration of water-sensitive urban design measures in the southern African context
- Peer learning between utilities on institutional adoption of sustainable stormwater and greywater management practices
- Demonstration of decentralised nature-based solutions for stormwater and greywater recycling
- Performance assessment of biofiltration treatment systems to remove typical pollutants (including pharmaceuticals) from greywater originating from informal and low-income settlements
- Development of appropriate operation and management models for decentralised stormwater and greywater management systems

WORK PACKAGES

WP 1: Capacity Building

» *Lead partners: HCU, HSE*

WP 1 aims to develop an enabling environment to adopt the concept of water reuse. The key activities include: 1) the development of decision support tools on applying the NEU-Water approach in stormwater and greywater recycling systems, and 2) peer learning through a water operator partnership between Hamburg and Stellenbosch.

WP 2: Demonstration of NEU-Water Concept

» *Lead partners: UCT, HCU*

WP 2 comprises implementation activities at 3 demonstration sites: 1) Monitoring of greywater pollution in the Stiebeuel river and performance assessment of biofilter systems in removing the pollutants (Water Hub,

"The Water Hub at Franschhoek is a living laboratory, testing nature-based solutions (NbS) by treating contaminated water from an informal settlement and reusing this water to safely irrigate local food gardens."

Emily Nicklin, PhD Student, University of Cape Town

Franschhoek, South Africa), 2) demonstration of mixed greywater/stormwater treatment and reuse within the Langrug informal settlement (Franschhoek, South Africa), and 3) operation and management of decentralised stormwater management systems built in institutional settings (Dar es Salaam, Tanzania).

WP 3: Applied Research

» *Lead partners: HCU, UCT*

WP 3 focuses on research activities of technical systems and the enabling environment. The technical studies aim for a qualitative and quantitative assessment of the performance of implemented measures to treat contaminated water for its safe reuse and discharge, and to determine the level of risk and options for mitigating further risks. The institutional research will assess and validate how an enabling environment can be achieved through multi-stakeholder engagement in planning, implementation, operation, maintenance and management of the systems developed through the project in the context of South Africa and Tanzania.

WP 4: Project Management

» *Lead partner: HCU*

WP 4 encompasses communication, reporting, monitoring and control of the overall project activities.

Groendal/Langrug settlement at Franschhoek, proposed project implementation area · Source: Ajith Edathoot, HCU

HafenCity University Hamburg (HCU)
- Project Lead
- Coordination of capacity-building activities
- Research on institutional settings and operation & management of systems

University of Cape Town (UCT)
- Lead for field research and implementation
- Coordination of activities in South Africa
- Research on pollution monitoring and technical performance of implemented systems

Hamburger Stadtentwässerung AöR (HSE)
- Co-lead on capacity building activities
- Water utility partnership and exchange

Urban Waters Consulting GmbH (UWC)
- Engineering and monitoring of technical systems

Stellenbosch Municipality
- Support of project demonstrations at Franschhoek, South Africa
- Water utility partnership and exchange

Ardhi University
- Support on stormwater management system research at Dar es Salaam, Tanzania

Project structure

PARTNERS & CONTACT INFORMATION

Core partners	Role in the project, Key contributions
HafenCity University Hamburg (HCU), Environmentally Sound Urban- and Infrastructure Planning Prof. Dr.-Ing. Wolfgang Dickhaut, wolfgang.dickhaut@hcu-hamburg.de	Project coordination, capacity building and research on institutional systems
University of Cape Town (UCT), Future Water Institute A/Prof. Dr. Kirsty Carden, kirsty.carden@uct.ac.za	Field research, coordination of implementation activities
Hamburger Stadtentwässerung AöR (HSE) Dr. Franziska Meinzinger, franziska.meinzinger@hamburgwasser.de	Capacity building, water operator partnership
Urban Waters Consulting GmbH (UWC) Andreas Schmidt, schmidt@urb-waters.com	Engineering expert, monitoring and O&M of systems
Associated partners	**Key contributions**
Stellenbosch Municipality, Infrastructure Services Shane Chandaka	Facilitation of pilot demonstration at Franschhoek, water operator partnership
Ardhi University, School of Spatial Planning and Social Sciences, Tanzania Prof. Ally Namangaya	Research support at Dar es Salaam

WaReNam

Multi-Scale Water Reuse Strategy for Namibia: Technology, Governance and Capacity Development

CONSORTIUM SPEAKER IN GERMANY
Dr.-Ing. Martin Zimmermann, Head of the Research Unit 'Coupled Infrastructures', ISOE – Institute for Social-Ecological Research, Frankfurt/Germany

CONSORTIUM SPEAKER IN AFRICA
Maria Amakali, Director: Directorate of Water Resource Management, Ministry of Agriculture, Water and Land Reform, Windhoek/Namibia

WEBSITE
www.isoe.de/en/nc/research/projects/project/warenam-main-phase

GEOGRAPHICAL LOCATIONS
Namibia: Windhoek, Oshakati, Walvis Bay

ABSTRACT

WaReNam aims to address the urgent issue of water scarcity in Namibia and to support the Namibian Government in developing and operationalising a national water reuse strategy. This novel strategy could potentially increase water security and diversify existing water resources by effectively utilising municipal wastewater. The overarching research question guiding WaReNam is: "Can the integration of innovative technologies, adaptive governance and enhancement of capacity development provide a framework for the creation and implementation of a national water reuse strategy in Namibia?" This question arises from the co-design process conducted during the project's initial phase, involving key Namibian stakeholders. Utilising a pioneering transdisciplinary real-world laboratory approach, WaReNam encourages stakeholder involvement in solutions, promoting a practical and scalable strategy.

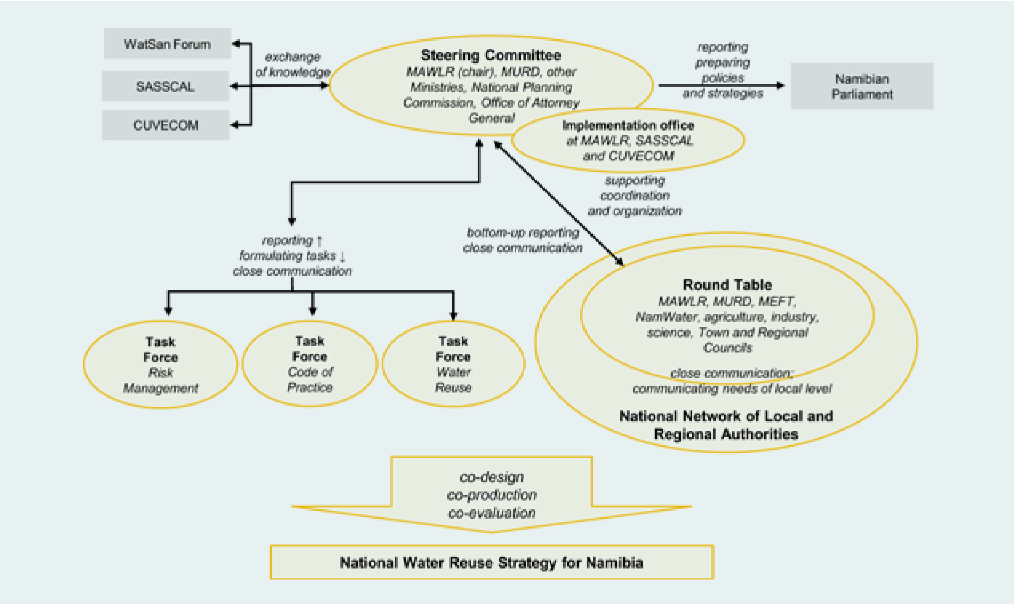
IMPACT

A key stakeholder in developing and implementing a national water reuse strategy is the Namibian Ministry of Agriculture, Water and Land Reform. The National Implementation Committee (NIC) will be established to develop and oversee the implementation of the national water reuse strategy. The NIC will feature a multi-level institutional structure to facilitate cross-sectoral and cross-level communication and cooperation.
An Upscaling Blueprint will provide local authorities with guidelines and training materials for planning new water reuse facilities and scaling up pilot plants. Additionally, the nationwide Network of Local and Regional Authorities (NLRA), consisting of town and regional councils, will integrate local perspectives into the strategy development. The primary applications of the planned reuse are in agriculture and industry. The potential replicability of the strategy in regions with similar water resource challenges aligns the project with SDG 6, making a significant contribution towards global water security.

FOCAL POINTS OF THE PROJECT

WaReNam focuses on three fundamental fronts: technology, governance, and capacity development.

- On the technological front, WaReNam will provide solutions for different water reuse scenarios that can be adopted and multiplied to other locations.



National Implementation Committee for Water Reuse · Source: ISOE

- WaReNam's governance objective is to co-produce effective governance structures and processes for developing a water reuse strategy together with the Namibian partners.
- Regarding capacity development, the goal is to develop a comprehensive and tailored capacity development approach for various stakeholder groups and personnel, ensuring the sustainable implementation of the water reuse strategy in Namibia across all levels.

PROJECT STRUCTURE

The first three work packages Technology (WP 1), Governance (WP 2), and Capacity Development (WP 3) address different aspects of the three transformation process knowledge categories, which comprise system knowledge, orientation knowledge, and transformation knowledge. The last two work packages Financing Options and International Transfer (WP 4) and Dissemination and Project Management (WP 5) further contribute to transformation knowledge, providing strategic options for implementation and management of the water reuse strategy.

"I believe that the WaReNam project will provide innovative and strategic solutions to Namibia's water security, by appreciating wastewater as another important water source to be developed."

Maria Amakali

WORK PACKAGES

WP 1: Technology

» *Lead partner: Technische Universität Darmstadt*

WP 1 provides exemplary and transferable solutions for two different water reuse scenarios that can easily be adopted and multiplied to other locations. To develop flexible fit-for-purpose technologies, two pilot sites were identified during the Initial Phase of the project together with the Namibian partners: Walvis Bay and Oshakati.

WP 2: Multi-Level Adaptive Governance

» *Lead partner: ISOE*

WP 2 aims to co-produce effective governance structures and processes of the water reuse strategy together with Namibian partners. The suggested governance approach of a National Implementation Committee was co-designed by the project consortium and MAWLR. The National Implementation Committee (NIC) will be established for developing and overseeing the implementation of the national water reuse strategy.

WP 3: Capacity Development

» *Lead partner: Emschergenossenschaft*

WP 3 entails the development of a comprehensive and tailored capacity development approach for various stakeholder groups and personnel, ensuring the sustainable implementation of the reuse strategy across all levels. This approach is in response to the skill gaps in wastewater treatment identified during the initial phase, which highlighted the need for targeted education and training.

"By jointly creating a national water reuse strategy, we could harness a huge untapped potential and utilise about 37 % of Namibia's domestic wastewater outside of Windhoek."

Dr.-Ing. Martin Zimmermann

WP 4: Financing Options and International Transfer

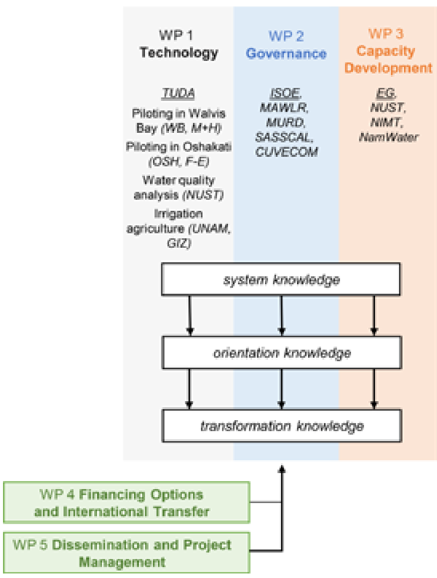
» *Lead partner: ISOE*

The primary objectives of WP 4 are to explore financing options for water reuse plants and facilitate the international transfer of the water reuse strategy. This WP seeks to identify viable financing mechanisms for water reuse projects and promote the water reuse strategy's adoption in other countries or regions.

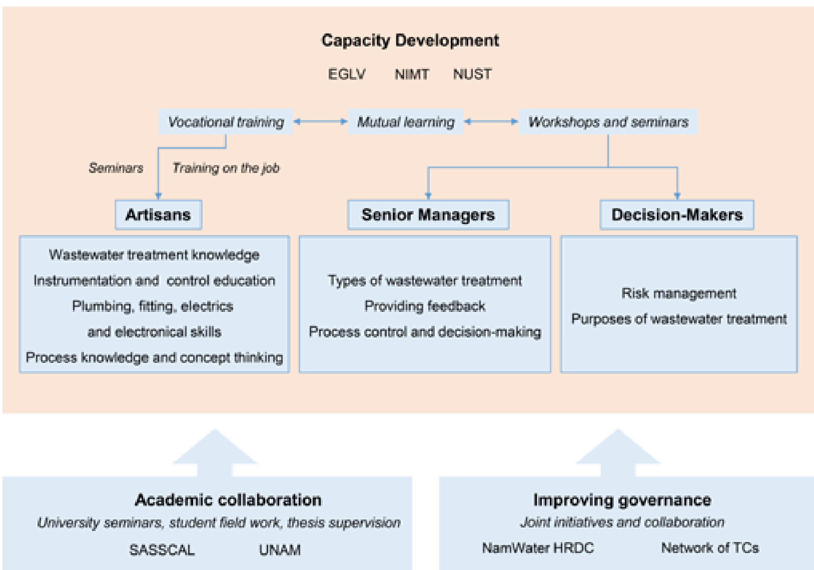
WP 5: Dissemination and Project Management

» *Lead partner: ISOE*

The primary goal of WP 5 is to ensure efficient project management and effective dissemination of results and knowledge to relevant stakeholders and institutions. WP 5 consists of Project Management and Coordination, Communication Strategy and Dissemination as well as Monitoring, Evaluation and Impact Assessment.



WaReNam Real-World Laboratory · Source: ISOE



WaReNam Capacity Development Approach · Source: ISOE

PARTNERS & CONTACT INFORMATION

Core partners	Role in the project, Key contributions
ISOE – Institute for Social-Ecological Research Dr.-Ing. Martin Zimmermann, zimmermann@isoe.de	Project coordination, governance, living labs
Technical University of Darmstadt Prof. Dr. Susanne Lackner, s.lackner@iwar.tu-darmstadt.de	Technology
Emschergenossenschaft Dr. Sven Lyko, lyko.sven@eglv.de	Capacity development
MANN + HUMMEL Water & Fluid Solutions GmbH Maximilian Werner, maximilian.werner2@mann-hummel.com	Piloting for Walvis Bay, membrane technology
FUCHS Enprotec GmbH Dr. Christian Henrich, christian.henrich@fuchswater.com	Oshakati demonstration plant
Ministry of Agriculture, Water and Land Reform Maria Amakali, maria.amakali@mawlr.gov.na	Governance
University of Namibia Prof. Dr. Komeine Nantanga, knantanga@unam.na	Irrigation agriculture, risk analysis
Namibian University of Science and Technology Prof. Dr. Habauka Kwaambwa, hkwaambwa@nust.na	Water quality
Southern African Science Service Centre for Climate Change and Adaptive Land Management Dr. Jane Olwoch, jane.olwoch@sasscal.org	Governance
Cuvelai Watercourse Commission Silvanus Uunona, silvanus.uunona@mawf.gov.na	Governance
Municipality of Walvis Bay John Esterhuizen, jesterhuizen@walvisbaycc.org.na	Case study
Oshakati Town Council Timoteus Namwandi, t.namwandi@oshtc.na	Pilot plant
Outapi Town Council Nashilongo Ananias, ananias.nashilongo@yahoo.com	Network of local and regional authorities

Associated partners	Key contributions
Ministry of Urban and Rural Development Nghidinua Daniel	Governance
Namibian Institute of Mining and Technology Ralph Bussel	Capacity development
Namibia Water Corporation Dr. Johannes Sirunda	Capacity development
Mecana AG Dr. Thomas Fundneider	Pile Cloth Media Filter
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) Tino Hess	Urban gardening

Co-HYDIM-SA

Co-Design of a Hydrometeorological Information System for Sustainable Water Resources Management in Southern Africa

CONSORTIUM SPEAKER IN GERMANY
Prof. Dr. Andreas H. Fink, Institute for Meteorology and Climate Research Tropospheric Research, Karlsruhe Institute of Technology

CONSORTIUM SPEAKER IN AFRICA
Prof. Dr. Gizaw Mengistu Tsidu, Earth & Environmental Sciences, Faculty of Sciences, Botswana International University of Science and Technology

GEOGRAPHICAL LOCATION
- Angola and Namibia: Cuvelai-Cunene transboundary catchment
- Botswana and South Africa: Notwane transboundary catchment in the Upper Limpopo basin

ABSTRACT

Co-HYDIM-SA responds to the explicit need for hydrometeorological early warning and information systems (EWIS) to optimise water resources management and thereby enhance water security in Southern Africa. This will be achieved through a transdisciplinary approach by combining scientific, academic and operational expertise in the fields of meteorology, hydrology, and risk assessment with the expertise of river basin authorities, water resource and dam managers. The innovative aspects are (a) to utilise the novel capabilities of sub-seasonal to seasonal hydrometeorological forecasting, (b) to improve the capability and details of seasonal forecasting, (c) to link hazard monitoring and forecasting to actual risk reduction, and (d) to provide a proof of concept for improved monitoring and early warning of hydro-climatic components in two transboundary catchments, the Cuvelai-Cunene and the Upper Limpopo.

IMPACT

In the Upper Limpopo basin, Co-HYDIM-SA will closely work together with the Water Utility Cooperation (WUC) that manages the Gaborone dam, a major water supply infrastructure for the city of Gaborone. With WUC, we will co-develop an Early Warning & Information systems (EWIS) with the aim of improving the dam management based on forecast of water inflow into the Gaborone reservoir for several weeks to months. In the Cuvelai-Cunene catchment in northern Namibia and southern Angola, the Cuvelai Basin Early Warning & Information System (CUVEWIS) will be co-developed with the Cuvelai Watercourse Commission (CUVECOM). It will contain hydro-meteorological information to improve monitoring and early warning of important hydro-climatic components in this cross-border catchment. Both EWIS and CUVEWIS will be implemented operationally in pilot versions at WUC and CUVECOM, respectively.

FOCAL POINTS OF THE PROJECT

Co-HYDIM-SA will develop new products for drought monitoring and utilise existing meteorological forecast for weeks to months ahead, calibrate them, and assess their skill. The rainfall products will serve as a basic input for hydrological models that will forecast e.g. river discharge, soil moisture, and terrestrial water storage. This hazard monitoring and forecasting will be linked to actual

The Calueque-Oshakati canal near Oshakati, northern Namibia. The water in the canal is pumped out from the Calueque dam at the Cunene river in southern Angola. It forms thus part of a transboundary water supply infrastructure providing water to northern regions of Namibia · Source: CR A. Fink, IMKTRO-KIT

The Gaborone dam in Botswana. The skyline of the city of Gaborone is seen in the background. The Gaborone Dam is a reservoir in the Notwane river catchment in Botswana, a headwater of the Limpopo river, with a capacity of 141,100,000 cubic meters. The dam is operated by the Water Utilities Corporation (WUC) and supplies the capital Gaborone with water · Source: CR A. Fink, IMKTRO-KIT

risk reduction. The overall aim is to provide a proof of concept for improved monitoring and early warning of key hydroclimatic components in two transboundary catchments, the Cuvelai-Cunene and the Upper Limpopo.

WORK PACKAGES

WP 1: Data Mining and Compilation

» *Lead partners: KIT-IMKTRO, UNAM*

The main goal of WP 1 is to significantly improve the availability of quality-controlled, hydrometeorological (observational, model-based) and socio-economic data for the study regions and to hand the data repository over to suitable organisations to secure its sustainability towards the end of the project.

WP 2: Hydrometeorological Monitoring and Forecasting at the Pan-Southern African Scale

» *Lead partners: KIT, BIUST*

The overall aim of WP 2 is to improve and operationalise regional hydro-meteorological monitoring and forecasting capabilities, amongst others for early warning of hydro-meteorological hazards at the regional scale, based on the needs of decision makers. In the field of rainfall monitoring and user-tailored sub-seasonal and seasonal forecasting, we will closely cooperate with world-leading partners.

“My motivation in this project is to adapt existing meteorological models to forecast extreme precipitation more accurately and provide early warnings for dam operators and water managers in the region.”

Prof. Dr.
Gizaw Mengistu Tsidu

WP 3: Gaborone Dam Water Level Early Warning and Management System

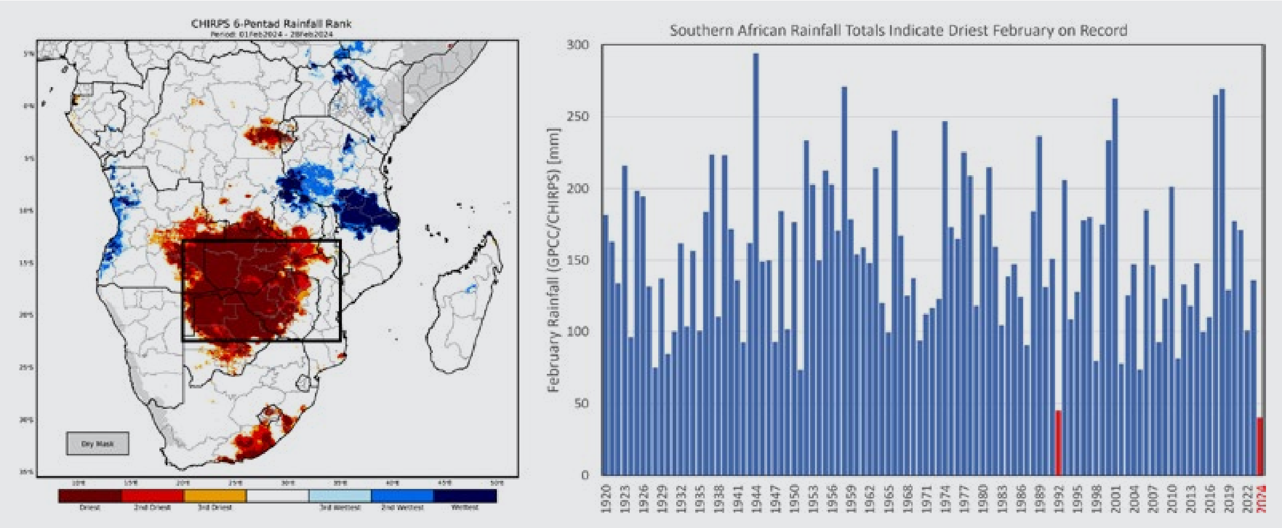
» *Lead partners: BIUST, KIT*

Addressing priorities of WUC and other water authorities, the EWIS system will include functionalities for monitoring droughts as wells as for (sub-)seasonal forecasting of droughts and wet spells. Hydrological models will be deployed to quantify the water inflow and outflow of the dam for the coming weeks and months. A prototype EWIS system will be implemented at WUC and tested in an operational setting in the second part of the project.

WP 4: CUVEWIS (Early Warning-supporting Hydrometeorological Information System for the Cuvelai)

» *Lead partners: ICWRGC/BfG (International), CUVECOM/GHABIC*

Addressing CUVECOM’s priorities, the CUVEWIS system will include functionalities for monitoring and (sub-) seasonal forecasting of droughts and wet spells, including a prototype warning



Severe drought of 2023/2024 in Southern Africa. Large areas of Southern Africa had their driest February 2024 on record. One potential factor of the dry 2023/2024 rainy season was El Niño. Co-HYDIM-SA will provide more robust rainfall forecasts for lead times from a few weeks to a few months to improve early warning of drought · Source: Climate, Hazard Center, https://blog.chc.ucsb.edu/?p=1375

component for both hazards based on a traffic light approach. To include water-related risks and vulnerabilities for the population, this will be complemented by a risk and vulnerability assessment in WP 5.

WP 5: Vulnerability and Risk Assessment

» *Lead partners: UoB, UNAM*

In the Cuvelai-Cunene and Limpopo River Basins, where 1.7 million and 18.8 million people reside respectively, a coherent vulnerability and risk approach is crucial, integrating collaborative modelling and stakeholder engagement to inform sustainable water-related risk reduction strategies amid the challenges posed by floods and droughts.

WP 6: Technical and Academic Capacity Building

» *Lead partners: ICWRGC/BfG, CUVECOM*

One goal of WP 6 is to organise and implement a capacity building workshop on the use/application of project related models and tools as well as broader topics related to integrated river basin management and data management. Another goal is to contribute actively to Southern African regional education programmes.

“My motivation is short-cutting the valorisation of recent improvements of rainfall forecasts out to a few months for improving water resource management in Southern Africa through working directly with water commissions and dam managers.”

Prof. Dr. Andreas H. Fink

WP 7: Technical and Academic Capacity Building (Project coordination and knowledge transfer)

» *Lead partners: KIT, BIUST*

WP 7 provides all required instruments to assure an efficient and effective project implementation and interaction with the WASA programme partners and beyond. It assures an effective scientific, administrative, financial and risk management and coordinates the interaction/feedback loops between partners and Co-HYDIM-SA stakeholders and associated partners. It also provides the link to the project management agency, the network and transfer project and other WASA projects.

PARTNERS & CONTACT INFORMATION

Core partners	Role in the project, Key contributions
Karlsruhe Institute for Technology (KIT) Prof. Dr. Andreas H. Fink, andreas.fink@kit.edu Prof. Dr. Harald Kunstmann, harald.kunstmann@kit.edu	Coordination, sub-seasonal and seasonal forecasting, high-resolution hydrological modelling
University of Bonn (UoB) Prof. Dr. Mariele Evers, mariele.evers@uni-bonn.de	Vulnerability and risk assessment of hydrological extremes
Goethe University Frankfurt Prof. Dr. Petra Döll, p.doell@em.uni-frankfurt.de	Monitoring and seasonal forecasting of water resources
International Centre for Water Resources and Global Change (ICWRGC) Dr. Luna Bharati, bharati@bafg.de	Hydrological and water balance modelling, capacity building
Alitiq GmbH Daniel Lassahn, daniel.lassahn@alitiq.com	Artificial intelligence-based correction of sub-seasonal hydro-meteorological forecasts
Deutscher Wetterdienst Elke Rustemeier, elke.rustemeier@dwd.de	Drought monitoring and forecasting
Botswana University of Science and Technology (BIUST) Prof. Dr. Gizaw Mengistu-Tsidu, mengistug@biust.ac.bw	Drought monitoring and hazard assessment, hydrological modelling
University of Namibia (UNAM) Dr. Martin Hipondoka, mhipondoka@unam.na	Remote sensing, flood hazard assessment
Cuvelai Watercourse Commission (CUVECOM) Silvanus Kweenda Uunona, suunona@cuvecom.org	Water resource management, water information and early warning systems
Stellenbosch University Dr. Andrew Watson, awatson@sun.ac.za	Hydrological modelling
Associated partners	**Key contributions**
Water Utilisation Cooperation (WUC) Raditsebe Raditsebe	Dam management, dam data
WATERNET Jean-Marie Kileshye Onema	Water resource management, capacity building
University of California – Santa Barbara Prof. Dr. Chris Funk	Satellite rainfall estimation, early warning
University of Leeds Prof. Dr. Doug Parker	Meteorological forecasting, forecast communication
University of Pretoria Prof. Dr. Willem Landmann	Seasonal forecasting
University of Zambia Dr. Kawawa Banda	Hydrological modelling, capacity building

WaRisCo

Water Risks and Resilience in Urban-Rural Areas in Southern Africa – Co-Production of Hydro-Climate Services for an Adaptive and Sustainable Disaster Risk Management

CONSORTIUM SPEAKER IN GERMANY
Dr. Sophie Biskop, Department of Geography (Geographic Information Science) – Friedrich Schiller University Jena

CONSORTIUM SPEAKER IN AFRICA
Prof. Dr. Francois Engelbrecht, Global Change Institute – University of the Witwatersrand, Johannesburg

WEBSITE
www.warisco.uni-jena.de

GEOGRAPHICAL LOCATIONS
- South Africa and Lesotho: Integrated Vaal River System
- South Africa: KwaZulu-Natal River System in the larger Durban region

ABSTRACT

Southern Africa is projected to become drastically warmer and likely also drier, but with more extreme rainfall events in the east. WaRisCo will explore two of the biggest risks that climate change poses to South Africa: 1) the risk of a day-zero drought in the Gauteng province – an event with potentially disastrous socio-economic and environmental impacts, and 2) the risk of mega-flooding in the Durban region – such floods may be catastrophic in terms of the number of human lives lost. WaRisCo will develop a comprehensive hydrological modelling system integrating km-scale regional climate data and explorative land-use scenarios, enabling a step-up in the projection of future drought and flood risk in South Africa. Working with key stakeholders, WaRisCo will focus on anticipatory Disaster Risk Reduction (DRR) and climate change adaptation strategies.

IMPACT

WaRisCo is the first project to directly explore the probability of occurrence of mega drought and flood disasters in South Africa's Gauteng and KwaZulu-Natal Provinces. Based on this scientific foundation, the research team will develop adaption options to these risks in co-design with key stakeholders in national and local government. Key national implementation stakeholders are the Department of Water and Sanitation and the National Disaster Management Centre, and at the local level, the City of Johannesburg and the South African Cities Network. A particular focus of the project will be the development of climate-smart DRR plans that cater for events unprecedented in the historical record. WaRisCo will offer wide benefits to several sectors, including industry, agriculture and water.

FOCAL POINTS OF THE PROJECT

- Integrated hydrological model development
- Generating climate change projections at cloud permitting scale
- Development of explorative land use/ management and cover (LUMCC) scenarios
- Projections and assessment of future hydro-climate hazards
- Co-design & co-development of Disaster Risk Reduction (DRR) and adaptation strategies
- Capacity development

WORK PACKAGES

WP 1: Integrated Hydrological Model Development

» *LEAD PARTNERS: FSU Jena, SYDRO, ARC*

WP 1 will combine hydrological modelling with regional climate projections (WP 2) and explorative LUMCC scenarios (WP 3) to develop i) drought-focused models for the Integrated Vaal River System including water transfers between dams and considering management decisions, and ii) flood-focused models for the flood-prone rivers in the Durban region. Three hydrological modelling platforms will be utilised for process-based simulation at river basin scales, namely JAMS/J2000, TALSIM and PITMAN.

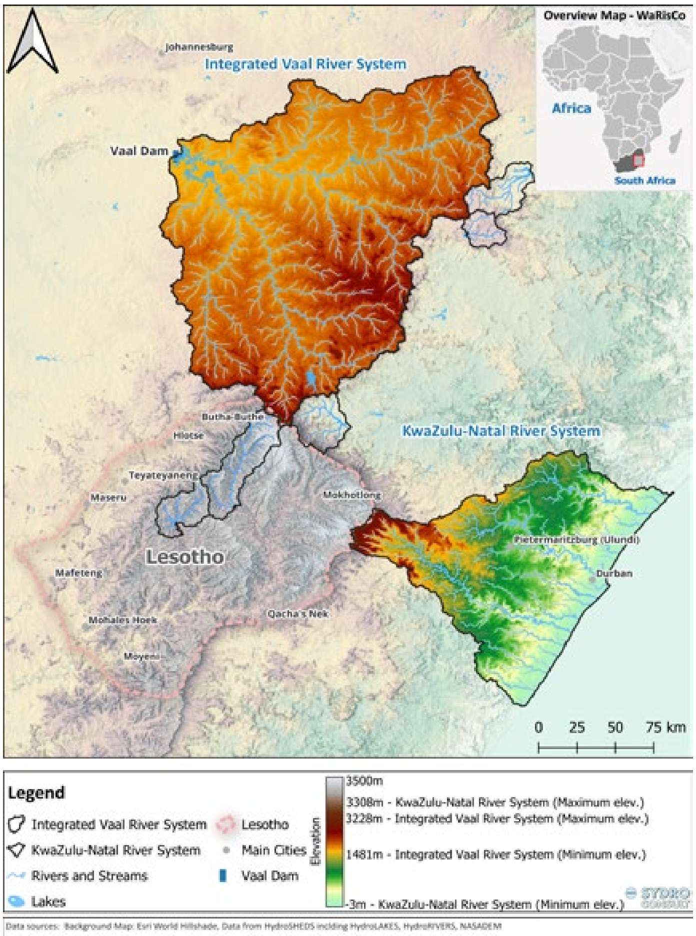
WP 2: Generating Climate Change Projections at Cloud Permitting Scale

» *LEAD PARTNERS: Hereon-GERICS, Wits-GCI*

WP 2 will generate a new set of climate change projections with a very high temporal and spatial resolution at the km-scale for the case study region. Two Regional Climate Models (RCMs), namely CCAM (Wits-GCI) and REMO-NH (Hereon-GERICS), will be used to generate climate projections at a spatial resolution as fine as 3 km. The novel RCM data will serve as input for the hydrological model system.

"I am proud to lead this excellent African-German team of WaRisCo, which in co-design with key stakeholders will build resilience to mega-floods and multi-year droughts in a changing climate."

Dr. Sophie Biskop



Project area of interest: Integrated Vaal and KwaZulu-Natal River Systems · Source: M. Fraz Ismail

WP 3: Development of explorative LUMCC scenarios

» *LEAD PARTNERS: MLU-Hal, Wits-GCI*

WP 3 will model land use/management and cover changes (LUMCC) within the context of impacts on hydrological and local climate parameters through changes in evapotranspiration, percolation, runoff, soil-moisture, and subsequently streamflow. Detailed scenarios of future LUMCC in the Integrated Vaal and KwaZulu-Natal River Systems will be developed by implementing different model types relevant for different scales (local to regional).

“WaRisCo brings together state-of-the-art climate and hydrological modelling capabilities from Germany and South Africa, to project the likelihood of two of the biggest climate change risks South Africa may face in a warmer world: a ‘day-zero drought’ in Gauteng, and mega-flooding in KwaZulu-Natal.”

Prof. Dr. Francois Engelbrecht

WP 4: Projections and Assessment of Future Hydro-Climate Hazards

» *Lead partners: FSU Jena, SYDRO, Wits-GCI, Hereon-GERICS, ARC, MLU-Hal*

WP 4 will project changes in the frequency, duration and intensity of hydro-climate hazards, such as extreme floods and multi-year droughts, for different periods in the future, different levels of global warming and as a function of LUMCC. WP 4 will provide tangible outputs related to flood and drought risks that will be the basis for the disaster risk assessment across various sectors.

WP 5: Co-Design and Co-Development of DRR and Adaptation Strategies

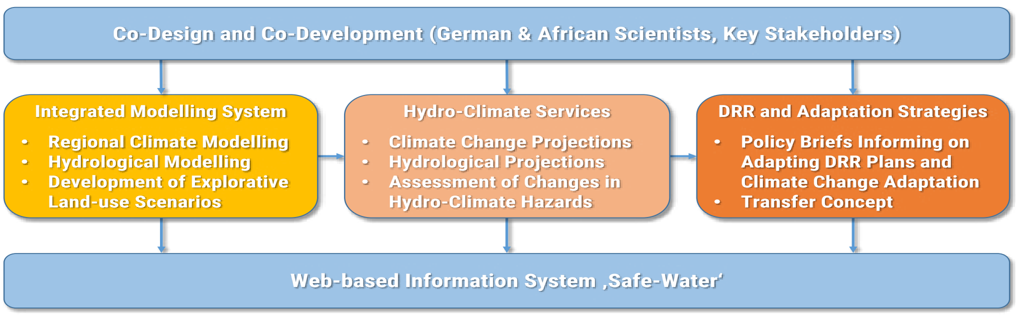
» *Lead partners: MA, FSU Jena, Hereon-GERICS, SYDRO, Wits-GCI, ARC, MLU-Hal, Implementation partners*

The research team will engage with key stakeholders towards the co-design of the research outputs for maximum uptake in DRR plans and long-term adaptation strategies, in both the Gauteng Province and Durban region. Moreover, we will co-develop a user-friendly web-based information system, named ‘Safe-Water’, and a transfer concept to ensure the transferability of this project to other hotspots of interest.

WP 6: Capacity Development

» *Lead partners: Wits-GCI, FSU Jena, Hereon-GERICS, SYDRO, MLU-Hal*

An important aspect of this project is the accompanying capacity building for young researchers, policy-makers and implementation partners throughout the duration of the project. The German and African partners will jointly support bi-national supervised masters and doctoral degrees through bilateral sandwich programmes offered by DAAD.
In addition, the project will provide tailor-made capacity building for policy makers and implementation partners to understand the complexity of hydro-climatic extremes.



Project structure: Key elements of the project ‘Water Risks and Resilience in Urban-Rural Areas in Southern Africa – Co-Production of Hydro-Climate Services for an Adaptive and Sustainable Disaster Risk Management (WaRisCo)’ · Source: Dr. Sophie Biskop

PARTNERS & CONTACT INFORMATION

Core partners	Role in the project, Key contributions
Friedrich Schiller University Jena, Department of Geography (FSU Jena) Dr. Sophie Biskop, sophie.biskop@uni-jena.de	Project coordination (German speaker), hydrological projections, web-based information system
University of the Witwatersrand, Johannesburg, Global Change Institute (Wits-GCI) Prof. Dr. Francois Engelbrecht, francois.engelbrecht@wits.ac.za	African speaker, climate change projections, stakeholder engagement
Helmholtz-Zentrum Hereon, Climate Service Center Germany (Hereon-GERICS) Dr. Torsten Weber, torsten.weber@hereon.de	Climate change projections, transfer concept
Martin Luther University Halle-Wittenberg, Institute for Geosciences and Geography (MLU-Hal) Prof. Dr. Christine Fürst, christine.fuerst@rektorat.uni-halle.de Deborah Schaudt, deborah.schaudt@geo.uni-halle.de	Explorative land use/management and cover scenarios
SYDRO Consult GmbH (SYDRO) Dr. Hubert Lohr, h.lohr@sydro.de Dr. Fraz Ismail, f.ismail@sydro.de	Hydrological projections
Motlole and Associates (MA) Dr. Chris Moseki, chrismoseki9@gmail.com	Stakeholder engagement
Agricultural Research Council (ARC) Dr. Johan Malherbe, johan@arc.agric.za	Hydrological projections

Associated partners	Key contributions
Department of Water and Sanitation (DWS)	Implementation partner: pathway for research uptake in National Water Strategy
National Disaster Management Centre (NDMC)	Implementation partner: pathway for research uptake in national and provincial DRR plans
South African Cities Network (SACN)	Implementation partner: pathway for research uptake in municipal governance
SASOL	Implementation partner: pathway for research uptake in industrial development plans
Department of Forestry, Fisheries and the Environment (DFFE)	Implementation partner: pathway for research uptake in National Adaptation Plan and climate change policies
City of Johannesburg (CoJ)	Implementation partner: pathway for research uptake in the CoJ DRR plan

Networking and Transfer Project

WASA contributes to water security in Southern Africa, and beyond · Source: AdobeStock/Stavros

WASANET: THE NETWORKING AND TRANSFER PROJECT FOR THE WASA PROGRAMME

WASANet is designed to develop and implement effective instruments and activities to foster exchange and identify synergies amongst the WASA projects and support their efforts to connect with the scientific community in water, climate and environmental research as well as decision makers in Sub-Sahara Africa, Germany, and beyond. By the integration of research and cross-cutting topics, networking, science communication as well as the active involvement of the public, private and industrial sectors, WASANet, together with the research projects, contributes to an effective synthesis and transfer of WASA-generated research data, methods and results to policy and decision makers in the countries addressed by the programme and beyond. Utilising WASANet's multifaceted scientific, academic, private sector and political network of actors in the water domain, the project further facilitates the science-policy dialogue and private sector engagement. This supports decision makers in the uptake of innovative and up-to-date water and forecast technologies to improve water security in Sub-Sahara Africa.

"The WASA programme is well established and has the recognition of academia, industry and policy makers. The main phase of the programme illustrates the continued long-term institutional commitment from various interest groups to high quality research and capacity building in Africa. The programme's networking and transfer project is a carefully conceptualised initiative to increase the impact and knowledge transfer of the research and capacity building activities. This project will ensure close collaboration and joint learning between the research teams."

Dr. Nico Elema

IMPACT

With its integrating approach, WASANet's main impact will be the strengthening of research integration and uptake in Sub-Saharan Africa and, thereby contributing to the Knowledge Economy by translating excellent research findings for decision makers. It will further serve to strengthen the link at the science-policy-industry interface by direct engagements and interaction. The desired impact, together with the WASA projects, can be summarised at three levels:

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Policy Impact:
With the generated knowledge, WASANet, in collaboration with WASA partners, will be enabled to provide the required, science-based information for policy decision making towards improved water management strategies and policies at local, national and regional level. Facilitated by WASANet, WASA will bridge the gap between science, private sector and policy.

Economic Impact:
WASA research findings, developed methods, products and services are expected to have significant direct and indirect economic impacts. WASANet will facilitate the transfer of knowledge on improved water technologies and optimisation of water management to improve infrastructures and generate additional income opportunities.

Societal Impact:
Through WASANet's communication strategy, the outcomes generated by WASA will increase the awareness of water security, as well as associated risks and opportunities for society and economy. Effective communication of science outputs to civil society will further support and inform stakeholders, climate adaptation options, and improve livelihoods and gender equality.

FOCAL POINTS OF THE PROJECT

A key component for the successful implementation of WASA is the effective support for funded projects and the funders in the integration, dissemination and utilisation of research results. This includes linking various stakeholder communities from the public, industry, and private sector to raise awareness and increase acceptance and upscaling of innovative WASA services and technologies by end-users in the African water sector. WASANet aims at supporting the WASA programme in both scientific integration and organisational tasks.

WASANet objectives are

- to raise awareness of the WASA programme and its research projects,
- to establish effective and sustainable cross-sector networks and knowledge transfer among them,
- to support decision makers in Africa's and Germany's water domains, and
- to promote the utilisation, integration and synthesis of results generated by the WASA research projects.

"WASANet provides a unique platform integrating research, industries and communities. The German water sector is committed to contributing to sustainable solutions to water and sanitation challenges. We strongly believe in fostering cooperation and partnership to benefit us All."

Marie-Louise Chagnaud

PARTNERS & CONTACT INFORMATION

Core partners	**Role in the project, Key contributions**
Institute for Meteorology and Climate Research Tropospheric Research (IMKTRO), Karlsruhe Institute of Technology (KIT) Dr. Jörg Helmschrot, joerg.helmschrot@kit.edu	German Speaker, project coordination, scientific integration
AUDA-NEPAD Southern African Network of Water Centres of Excellence (SANWATCE) Dr. Nico Elema, ne@sun.ac.za	African Speaker, policy engagement, academic capacity building
German Water Partnership e. V. (GWP) Marie-Louise Chagnaud, chagnaud@germanwaterpartnership.de	Industry engagement, science–policy dialogue
Stellenbosch University Water Institute (SUWI) Prof. Dr. Gideon Wolfaardt, gmw@sun.ac.za	Scientific integration, private sector engagement

Associated partners	**Key contributions**
African Ministers' Council on Water (AMCOW)	Science–policy dialogue at continental and regional levels
African Water and Sanitation Association (AfWASA)	Private sector engagement, network of practitioners
WATERNET	Regional academic and non-academic capacity building

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EDITORIAL
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WATER INFRASTRUCTURE AND WATER TECHNOLOGY

HYDROLOGICAL FORECASTS AND MANAGEMENT OF HYDROLOGICAL EXTREMES