



EUROPEAN COMMISSION
JOINT RESEARCH CENTRE

**Zambia groundwater hydrology and aquifers contamination relevant to
WEFE Nexus analysis for the Zambezi River Basin.**

INCEPTION REPORT

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Abbreviations

ACE WATER	African Networks of Centers of Excellence on Water Sciences
DWRD	Department of Water Resources Development
IWRM&WEIP	Integrated Water Resources Management & Water Efficiency Implementation Plan
MEWD	Ministry of Energy and Water Development
MLGH	Ministry for Local Government and Housing
MMEWD	Ministry of Mining, Energy and Water Development (previous name of Ministry)
NAWSCO	National Water Supply and Sanitation Council
SANWATCE	Southern Africa Network of WATER Centres of Excellence
WARMA	Water Resource Management Authority
WEFE	Water-Energy-Food-Ecosystem
ZAMCOM	Zambezi Watercourse Commission
ZAMWIS	Zambezi Water Information System
ZEMA	Zambia Environmental Agency

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1. Introduction

1.2 Background

This work is defined within the project: “The African Networks of Centres of Excellence on Water Sciences PHASE II (ACE WATER 2)” that aims at fostering sustainable capacity development at scientific, technical and institutional level in the water sector. The project supports twenty (20) AU-NEPAD African Network of Centres of Excellence in Water Sciences and Technology (CoEs) organized in three regional networks, in conducting high-end scientific research on water and related sectors, in order to provide effective scientific and educational support to governments. The project is implemented in partnership between UNESCO, in charge of the human capacity development component, and the JRC that coordinates the scientific component and leads the project.

In the framework of the project scientific component, the SANWATCE (Southern Africa Network of WATER Centers of Excellence) identified the Zambezi River Basin as a case study area because highly representative of the Southern Africa River Basins: water management (quality and quantity), agriculture-food security and energy issues. The transboundary Zambezi River Basin (ZRB), the fourth wider one in Africa (after Nile, Niger and Congo) poses many challenges from a perspective of Water-Energy-Food-Ecosystem (WEFE) nexus, including, among others, hydropower, reservoir multipurpose optimization and release management, rain-fed and irrigated agriculture development, impact of land use and agricultural practices (including livestock and fisheries), role of ecosystem services (natural parks, wetlands), pressures on resources due to population increase and climate variability/change and extreme events risks (drought and flooding). This assignment is focused on a state of the art review of country groundwater hydrology and aquifer contamination for Zambia relevant to WEFE in the Zambezi Basin.

1.3 Objectives

As per the ToRs, the project is aimed at generating data on groundwater hydrology and aquifer pollution at country scale for Zambia to support WEFE nexus analysis in the Zambezi Basin.

The consultant will therefore specifically aim at the following:

- Identifying important aquifers in Zambia, both in terms of productivity and demand;
- Prioritizing the target areas in which these aquifers are situated according to their current and potential future use considering;
 - a) Urbanization and associated increasing demands and effects on both groundwater quantity and quality, with a particular focus on the impact of the lack of adequate sanitation and related health risks;

- b) Agricultural development and the potentially growing importance of groundwater as a source of irrigation water;
- c) Industrial growth, including mining activities, with potential impacts on groundwater quality;
- d) Potential conflicts between different user groups competing for water resources in relation WEFE nexus issues;
- e) Providing annexed raw data (geology/hydrogeology, aquifer types and productivity, piezometric heads and contamination data, groundwater use by sector) to support the wider ZRB assignment.

1.4 Project scope of the consultant

The project scope has been defined in the terms of reference of May, 2018 and is in principal aimed to address WEFE nexus interdependences and evaluates sustainable bridging-gap solutions within the ZRB. Based on state-of-the-art reviews and scientific analysis, a set of activities contributing to the development of the ZAMBEZI information system (named hereafter ZAMWIS) will be developed and implemented in regional scientific institutions and nationals. This system will provide a scientific baseline as well as scenarios and tools for decision making regarding water, energy and agricultural management within the river basin. This assignment will therefore provide a report on state-of-the-art (literature review, studies, available data/maps) in Zambia groundwater hydrology and aquifers contamination and annexed database of raw data and available base maps (i.e. geology/hydrogeology, aquifer types and productivity, piezometric heads and contamination data, groundwater use by sector), relevant to WEFE nexus analysis.

1.5 Study area

Figure 1.3: shows the location of the six catchments in Zambia. Zambezi River Basin covers the Zambezi, Kafue and Luangwa. This report however will attempt to cover the entire country but with a strong focus on the ZRB catchments for detailed analysis.



Figure. 1.3 : The six main river catchments of Zambia

Zambia needs to successfully diversify growth and consider issues of distributive justice and support to pro-poor sectors if the country is to make significant progress in achieving its poverty reduction goals. These aspirations are articulated in the country's 'Vision 2030' with the national development goal of reducing poverty and reaching middle income country status by 2030. The Government's strategy for inclusive growth and development is outlined in the National Development Plan. The Revised Sixth National Development Plan (R-SNDP) for the period of 2011–2015 is based on "*Sustained economic growth and poverty reduction*".

All of Zambia's water resources form part of two major international river basins, the Zambezi River basin and the Congo River basin. Competing sectoral water demands, coupled with significant water quality concerns and associated health risks, are imposing increasing constraints on economic growth and there is a need to optimize the economic allocation of water and explore alternative water development incentives in other parts of the country.

Zambia is involved in global, regional and river basin collaborations. Zambia has e.g. played an important role in development of the Southern African Development Community (SADC) Revised Protocol on Shared Water Courses (2000) and is engaged in the process of developing co-operative mechanisms with riparian states.

2. Approach and Methodology

This assignment entails collection of data on the state-of-the-art (literature review, studies, available data/maps) in Zambia groundwater hydrology and aquifers contamination and annexed database of raw data and available base maps (i.e. geology/hydrogeology, aquifer types and productivity, piezometric heads and contamination data, groundwater use by sector), relevant to WEF nexus analysis. These outputs will also be delivered in close and effective cooperation with the University of the Western Cape, who are focusing on groundwater hydrology assessment at ZRB scale, and the NUST-Zimbabwe, in charge of the overall coordination of the Work Package on Groundwater Hydrology and Quality, as well as to produce Dissemination material for tailored training events. Products of this work will be delivered in form of inception reports (detailing job scope, objectives, scientific activities and overall workplan), scientific reports, presentations, databases (spatio-temporal data and maps). Activities in Zambia at country scale will provide relevant spatial coverages and evidences from regional case studies to be integrated in (and used for assessment/validation of outcomes of) the analysis at ZRB scale, implemented by University of Western Cape.

2.1 Assessment of existing data

Available data on drilling and test pumping will be obtained from different stakeholders such as the MLGH, DWA, ZEMA, NWASCO as well as from a number of drilling companies, NGOs and consulting firms operating in Zambia. This data will be interrogated to address the objectives. The scientific research outcomes will contribute to scientific capacity building activities to be delivered as workshops along the duration of the project. Trainings will address AU NEPAD SANWATCE, AMCOW experts, ZAMCOM and other African Basin authority's experts and related national authorities under the boundaries of the ACEWATER2 project budget. Within this framework, the Expert develops trainings contents and materials and engage himself to participate at the ACEWATER2 workshops, to be organized by JRC.

2.2 Project Administration

Milestones are as follows:

GW.M5 Inception Report, detailing the conceptual framework and table of contents of the final report, architecture of the database, data availability, issues, challenges and possible bottlenecks.

GW.M6 Report and database on Zambia groundwater hydrology characterization and aquifers contamination and annexed database of raw data and available base maps (i.e. geology/hydrogeology, aquifer types and productivity, piezometric heads and contamination data, groundwater use by sector), including related presentation and training material (due on 30.11.2018)

The expert will report to the JRC on the progress, problems encountered, etc. The deliverables should be sent to César Carmona Moreno, cesar.carmona-moreno@ec.europa.eu

2.3 Deliverables

All the project outcomes, both in terms of scientific reports, capacity building and training materials, DBs and calibrated models will be delivered to ZAMCOM as support of the SANWATCE, in the framework of the ACEWATER2 project. Synergies and cross-cooperation with ongoing research programs and projects will be pursued, also from the JRC within the WEF Nexus initiative.

2.4 Detailed Work Plan

This work plan is based on the activities indicated in the Terms of Reference. The workplan is outlined as follows in Fig. 2.4. The expert will deliver the final report by end of November and stipulated in the terms of reference. During the entire process of implementation, there will be consultations with UWC and JRC.

2.5 Proposed outline of the final report

The lay-out for the report will be as follows:

1. Introduction
 - 1.1 Background
 - 1.2 Project definition and objectives
 - 1.3 Project scope for the consultant
2. Aquifer identification and assessment based on drilling data
 - 2.1. Data source
 - 2.2. Data collection and quality
 - 2.3. Data coverage
3. Main aquifers related to catchments and hotspots
 - 3.1. Introduction
 - 3.2. Zambezi Catchment
 - 3.3. Kafue
 - 3.4. Luangwa
4. Ranking of aquifers based on Specific Capacity and Social economics
5. Threats to ground water quality
 - 5.1 Copper Mining and Processing
 - 5.2. Commercial Farming
 - 5.3 Population Density
 - 5.4 Ecosystems impacts on the Kafue (connection to Mining)
6. Groundwater data based on district information
7. Aquifer potential, development and protection
8. Hotspots

ANNEXES: Maps, Tables (Static water levels, depth of boreholes.....), terms of reference

Inception Report – Zambia groundwater hydrology and aquifer contamination

	May - June	July	August	September	October	November
Signing of contract and Discussions with Thematic Working Groups on groundwater	■					
Inception Report and data collection		■				
Data collection and analysis		■	■	■	■	
Preparation of Technical content and consultations with key stakeholders (UWC)				■	■	■
Submission of draft report and discussion with JRC						■
Stakeholder Workshop/discussions with UWC/EU		■	■	■	■	■
Revised Technical Report					■	■
Final submission						■

Figure 2.4: Workplan of the activities including final delivery of report.

3. Risks and Mitigation

Table 1, outline risk and mitigation action during implementation of this project. This will ensure quality delivery.

Table 1: Risks and mitigation action for this project

Risk	Mitigation action
Zambia does not have a national groundwater database where all the groundwater data has been collected and stored.	The expert is familiar with key stakeholders where this data may be sitting either in hard copies or digital and therefore will use his network
It is expected that some of the data may not be of good quality because it has been collected by drilling contractors without any training in geosciences but mere machinery knowledge.	The expert will perform some quality control checks as he is familiar with these challenges having worked in Zambia on water resources for over 10 years.
Data collected may not be relevant to the expectation of the project	The expert will consult with EU -JRC and UWC to ensure country scale data is relevant for the overall Zambezi Basin analysis
Time series data from monitoring network is limited and some part of the country are not covered.	<p>There has been some comprehensive studies done in the 90s of which, though old, will help to give the state of knowledge on these systems.</p> <p>The government through the Water Resources Management Authority has in the last three years commenced collection of data from mainly Lusaka. This data can be accessed through MOUs if required.</p>