Water and Cooperation within the Zambezi River Basin (WACOZA)

National University of Science and Technology, Zimbabwe (NUST, ZIM)

Inception Report

December 2017

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1.0 PROJECTOVERVIEW

1.1 Background

This project contributes to the case study project entitled “Water and Cooperation within the Zambezi River Basin (ZRB)” for Southern Africa Centres of Excellence (CoEs) in the framework of AU/NEPAD ACEWATER2 project. The transboundary basin presents many opportunities for scientific activities from a perspective of Water-Energy-Food-Ecosystem (WEFE) nexus. Review of existing literature on the basin reveal that topics such as hydrology, hydropower production and dams operations, at regional scale (i.e. river basin or relevant tributaries), or even at local scale (as is the case for groundwater hydrology, or at major artificial basins for eco-hydrology assessment) have been explored.

Based on ZAMCOM strategies and envisaged actions, further areas of investigation and scientific analysis that NUST, ZIM as one of the CoEs could develop include: i) Groundwater hydrology in Zimbabwe ii) Aquifers contamination and vulnerability to contamination for key aquifers, at Zimbabwe scale. This is in line with the general objective of the project: To Assess WEFE interdependencies by developing and testing a Spatial Decision Support System on Water Cooperation, across the Zambezi River Basin.

1.2 Groundwater hydrology and quality

NUST, ZIM belongs to a group of four other institutions (namely University of Western Cape, South Africa; University of Zambia, Zambia and Joint Research Centre) tasked with investigating groundwater hydrology and quality. The objectives of the scientific activities for the group are as highlighted in section 1.2.1.

1.2.1 General Objectives

1. To understand baseline conditions on groundwater by gathering and processing data and by-products (i.e. piezometric heads, hydro-geological properties, wells productivity, geochemistry, isotopes dating);
2. To perform groundwater assessments and estimation of abstractions/depletion based on existing local case studies, in order to provide guidelines on best practices, including methods and tools (e.g. modelling).

In 1.2.2 specific objectives relating to the contribution of NUST, ZIM are stated.

1.2.2 Specific Objectives

1. To provide a multi-scale groundwater hydrology baseline database at ZRB and Zimbabwe level, based on literature review, available data sources and existing country/regional scale studies of major relevance to WEFE nexus;
2. To provide baseline conditions database on groundwater hydrology and water demand vs. availability for few shared regional case studies, by gathering and processing data and by-products and to perform groundwater assessment;
3. To perform vulnerability assessment to contamination of selected aquifers across the ZRB on the Zimbabwean side of the river basin.

1.3 Conceptual Framework

The main deliverable of the scientific activities related to groundwater hydrology is to produce a report on the groundwater hydrology at the Zimbabwe scale guided by literature review,

characterization at ZRB scale, and sample case studies of relevance for groundwater availability and vulnerability to contamination. The report and database produced shall be utilised in multi-scale integration of data for large scale assessment and mapping for ZRB under the leadership of University of Zambia and University of Western Cape. In the context of the water, energy, food and ecosystem (WEFE) nexus, the following thematic areas were identified as key in the scientific activities for the NUST ZIM team; Groundwater Resource Assessment and Groundwater Hydrology, Groundwater Quality and Vulnerability and Water Use Patterns in the basin. The conceptual framework presented in figure 1.1 shows the linkages between the thematic areas.

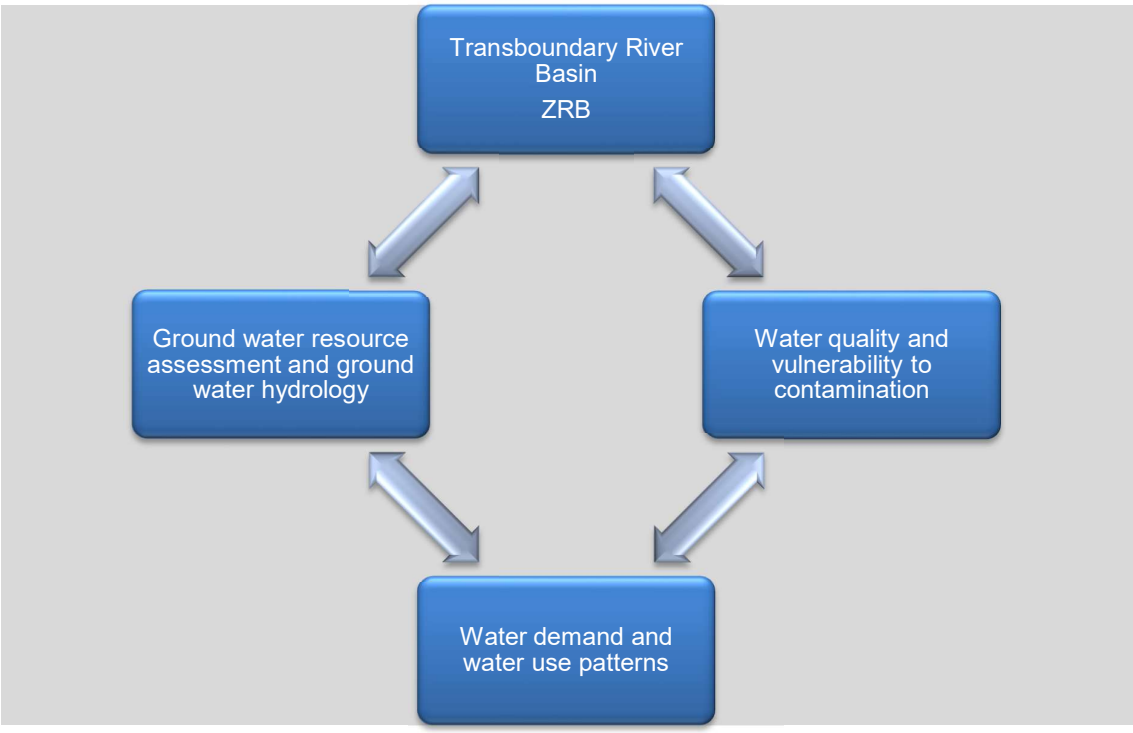

Fig 1.1 Conceptual Framework

Based on the conceptual framework presented in Fig 1.1, the NUST, ZIM team will collate data at country level that shall contribute to multi-scale groundwater databases for ZRB as coordinated by University of Zambia and University of Western Cape.

2.0 IMPLEMENTATION PLAN

2.1 The NUST, ZIM Project Team

The NUST, ZIM project is hosted in the Department of Civil and Water Engineering and the Chairperson of the department Dr Annatoria Chinyama is the team leader. The team comprises members from the departments of Environmental Science and Health, Applied Physics, Applied Biology & Biochemistry, Applied Chemistry and Forest Resources and Wildlife Management. A Research Officer from the Research and Innovation office was incorporated to assist in the coordination of the scientific activities. The details of the team members are as presented in Table 2.1.

Table 2.1 NUST, ZIM Project Team

Name	Area of Expertise	Contribution
Dr Annatoria Chinyama	Water Engineering	Team Leader
Dr Eugine Makaya	Water Engineering	Investigator (ground water hydrology)
Dr Paul Makoni	Hydrobiology	Research Coordinator
Dr Innocent Muchingami	Hydro geophysics	Investigator (ground water hydrology)
Dr Tendai Kativhu	Environmental Science	Investigator (water demand vs water availability and aquifer contamination)
Mr Constant Chuma	Hydro geophysics	Investigator (ground water hydrology and GIS mapping)
Mr Nicholas Ncube	Forest resources and ecosystems	Investigator (GIS mapping)
Mrs Sakhile Ndlovu	Hydrology	Investigator (ground water hydrology and GIS mapping)
Dr Champaklal Thakorlal Parekh	Chemistry	Investigator (Aquifer contamination)
MrJoshua Mbanga	Biology	Investigator (Aquifer contamination)

2.2 Planned Scientific Activities

The main deliverable for the scientific activities is to produce a report on the Groundwater hydrology at the Zimbabwe scale guided by literature review, characterization at ZRB scale, and sample case studies of relevance for groundwater availability and vulnerability to contamination and related databases. This report is due on 30 June 2019 at the end of the project. In order to achieve this deliverable the following planned activities presented in the logical framework shown in Table 2.2 will be undertaken from October 2017 to June 2019.

Table 2.2 Logical Framework for Planned Scientific Activities

Methods	Tools	Expected outcomes	Time frame	Anticipated Challenges	Proposed solutions
1. To provide a multi-scale groundwater hydrology baseline database at ZRB and Zimbabwe scale based on literature review, available data sources and existing country scale studies of major relevance to WEFE nexus.					
• Engage University of Zambia and University of Western Cape on agreed formats and data to be collated. • Reviewing existing hydro-geological manuscripts and technical reports on the ZRB • Engage Zambezi Commission (ZAMCOM) and Zimbabwe National Water Authority (ZINWA) on the extent of the available data	• Existing borehole logs and monitoring data for ZRB • Existing Technical reports for consultancy and funded projects within the ZRB	• Baseline report for Groundwater Hydrology in the ZRB • Baseline database for groundwater hydrology in the ZRB • Literature repository	12 months	Lack of borehole monitoring data Non availability of groundwater monitoring network for the water authority and groundwater users within the basin Not all aquifer units within the basin have been identified Delineation of the study areas	Identification and documentation of gaps at localised scale. Construct regional groundwater maps along the ZRB based on existing data
2. To provide baseline conditions database on groundwater hydrology and water demand vs. availability for few shared regional case studies, by gathering and processing data and by-products and to perform groundwater assessment.					
• Engage University of Zambia and University of Western Cape on agreed formats and data to be collated. • Identification of water sources in selected areas of the ZRB. • Characterisation of water consumption patterns in selected areas of the ZRB. • Quantifying the amount of water required for the different water users.	• Desktop survey of relevant reports and literature. • Questionnaires • Key Informant Interview (KII) guides • Checklist of baseline conditions	• Database of baseline data and mapson demand for water for different water users versus water availability and quality in the ZRB. • Report on the state-of-the-arton water demand by different water users against water availability and quality in the ZRB.	9 months	Non availability of data on water demand for various uses	Collection of indicative primary data

• Mapping of water users profiles in relation to water availability and quality in the ZRB					
3. To perform vulnerability assessment to contamination of selected aquifers across the ZRB.					
• Engage University of Zambia and University of Western Cape on agreed formats and data to be collated. • Identification of contamination hotspots within the ZRB on the Zimbabwean scale. • Vulnerability assessment with an index and overlay method (the DRASTIC) method Inputs for DRASTIC method: i. Mapping of Depth to water table ii. Recharge maps iii. Mapping of Aquifer media	• Land use and land cover maps • Desktop survey of relevant literature • Site reconnaissance • Key informant interviews • Data from dip metres, piezometers, divers, historical data from monitoring wells • Precipitation data (daily time scale), Stream hydrographs, • Landcover / landuse maps, Satellite images to assess land use/land cover changes • Borehole logs from newly drilled borehole or historical records • Soil maps (remotely sensed)	• Report on State of the art aquifer vulnerability assessment. • Groundwater vulnerability map	9 months 18 months	Lack of relevant literature Unavailability of enough licences for ArcGIS No monitoring boreholes, or if available, poor data quality Lack of precipitation stations in areas of interest No borehole logs available Lack of maps at sufficient spatial resolution	Carry out a research study to cover information gap Migrate to open source software such as QGIS Identify and document areas for future monitoring networks for aquifers of interest Collaborate with NUST Namibia on Surface hydrology data needs Drill boreholes and verify subsurface geology Field verification of existing soil maps. Reconnaissance to map soil types

iv. Mapping **S**oil media				Non availability of maps at the required scale	Surveys to ascertain average slope
v. **T**opographical maps	• Surveyor general topographical maps			Equivalence of geophysical surveys.	Cable percussion drilling to study unsaturated zone
vi. Vadose zone **I**mpact	• Hand augers, geophysical surveys to determine unsaturated zone thickness,			Non suitability of hand augers for the required purpose or large vadose zone thickness unsuitable for simple hand augers Non availability of equipment for pumping test	
vii. Hydraulic **C**onductivity mapping	• Slug test, pumping test, simple in-situ test				

3.0 WORK PLAN

The work plan is presented in the Gantt chart below:

Year		2017			2018												2019					
Months		10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6
Activities	Setting up of the project team and assigning of roles																					
	Signing the contract																					
	Drafting and submitting the inception report																					
	Engagement of other CoEs (University of Zambia and University of Western Cape on agreed formats and data to be collated)																					
	Desk study of literature on ZRB and Zimbabwe groundwater hydrology																					
	Compilation of baseline data on ZRB and Zimbabwe groundwater hydrology																					
	Intermediate report on ZRB groundwater hydrology characterization in Zimbabwe																					
	Creation of a baseline database on ZRB and Zimbabwe groundwater hydrology																					
	Ground water availability assessment in ZRB and Zimbabwe																					
	Ground water use assessment in ZRB and Zimbabwe																					
	Conjunctive use of ground water and surface water assessment in ZRB and Zimbabwe																					
	Groundwater contamination assessment																					
	Ground water vulnerability to contamination assessment																					
	Desk top study of best practices of ground water hydrology and contamination assessment techniques and methods																					
	Consolidated database on groundwater hydrology and vulnerability to contamination (case studies)																					
	Compilation of final report																					

4.0 BUDGET

The cost of the project as in the contract will be €25 000.00 distributed as highlighted in Table 4.1

Table 4.1 Project cost breakdown

Milestone	Activity	Milestone Date	Amount
M1	Inception report	I month after project start date (15/12/2017)	€5 000.00
M2	Report and database on groundwater hydrology and contamination baseline in Zimbabwe	30/11/2018	€15 000.00
M3	Report and database on assessment of groundwater hydrology and vulnerability to contamination, Zimbabwe and key aquifer(s)	30/06/2019	€5 000.00
Total			**€25 000.00**