

News letter

September 2021



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BIO + DIVERSITY

Life

Variety

Background

Through funding from the JRS Biodiversity foundation, the SADC- Groundwater Management Institute, in collaboration with partners from the Aquatic Systems Research Group (ASRG) at the [University of Venda](#) and the [Institute for Groundwater Studies at the University of the Free State](#) are implementing the [Groundwater Dependant Ecosystems \(GDEs\) and Biodiversity project at the Khakhea/Bray Transboundary Aquifer \(TBA\)](#).

Project implementation commenced on 1st August 2020 and this newsletter which is the first since the launch of the project, provides the background and milestones of the project per component since its inception.

The Khakhea-Bray Transboundary Aquifer straddles the border between Botswana and South Africa, which is formed by the perennial Molopo River. Khahea/Bray Transboundary Aquifer is experiencing rapid increase in water abstraction for agriculture and domestic use, which threatens the sustainability of its Groundwater Dependent Ecosystems (GDEs).

The project aims to integrate GIS and remote sensing, hydrogeology, and ecology to generate data on the biodiversity of the Khakea/Bray TBA and develop a database linking groundwater information to ecological health. The project also aims to define the relationships between groundwater quality, groundwater levels, and biodiversity in this TBA and ultimately encourage joint management of this and other transboundary ecosystems in the SADC region. The research is the first of its kind in the SADC region to integrate GIS/Remote sensing, hydrogeology and aquatic ecology within a TBA, and it will serve as a pilot for other TBAs found within the SADC region.

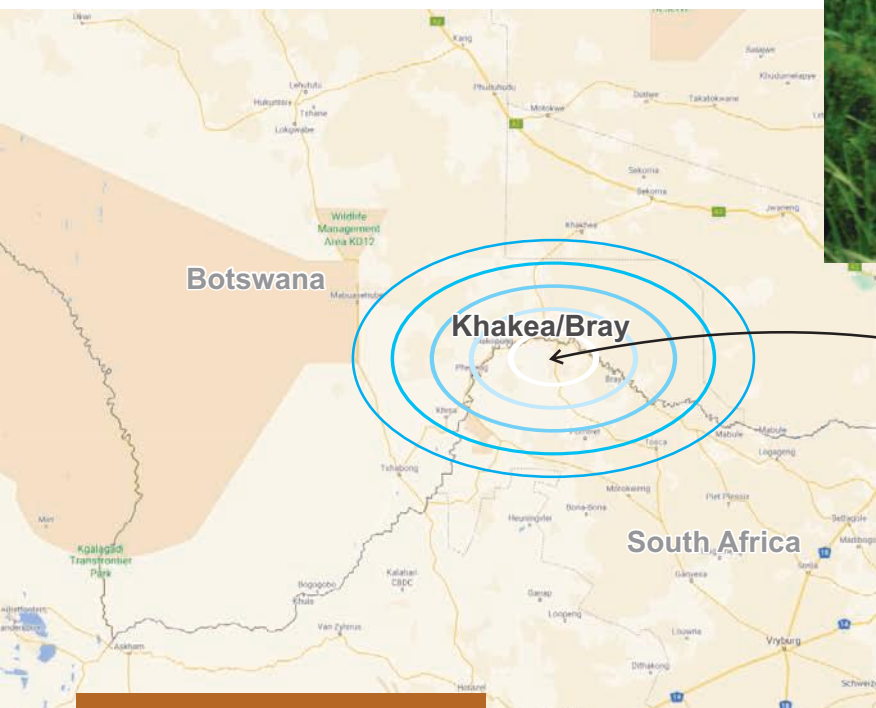
The brief scope of the project is to:

- perform a desktop delineation of the Khakhea/Bray TBA,
- assess the ecological conditions at the GDEs,
- collect ground and surface water biodiversity data at the identified GDEs,
- identify and explain the linkages between groundwater and surface water ecosystems i.e. wetlands (i.e. pans),
- identify hot spots where management interventions should be focused, and
- develop a Groundwater Dependent Ecosystems Atlas which is linked to a biodiversity database.

This project addresses two key issues identified within the groundwater field in the SADC region i.e., (i) conservation and sustainable development and (ii) biodiversity information and knowledge access.

Results from the study will help to support the Decision Support System to be developed for the TBA.

This project will serve as a critical input into the decision support system to be developed for the Transboundary Aquifer. According to CIWA's article Protecting Biodiversity Through Transboundary Solutions in Africa, biodiversity contributes significantly to national economies in Southern Africa.



Capacity Development:

An important component of the project is capacity building through post graduate research students at Masters and Doctoral levels.

Key Experts working under each of the project themes, namely Biodiversity, GIS/Remote Sensing and Hydrogeology led the recruitment of research students for the three themes. Seven students (4 MSc and 3 PhD) were recruited on the postgraduate programme as follows.

Short biographies of MSc and PhD Candidates working on the project:

GIS AND Remote Sensing Candidates:



Ms. Mangana B. Rampheri – PhD University of the Western Cape

Mangana B. Rampheri is a first year PhD candidate in Environmental and Water Sciences at the University of the Western Cape. Her research interest centres around the application of Geographic Information System (GIS) and Remote Sensing on Water Resources and Environmental Management.

Currently, her PhD research focuses on the application of GIS and Remote Sensing in the delineation of Groundwater independent water ecosystems in Khakea Bray Transboundary Aquifer System.



Mr. Kudzai Shaun Mpakairi – MSc University of the Western Cape

Kudzai Shaun Mpakairi graduated with a BSc Hons in Environmental Science from the University of Zimbabwe in 2018. To date, Kudzai has published several articles in SCOPUS indexed journals on climate change, ecology and natural resources management. Most of these articles

emphasize the use of GIS and Earth Observation techniques in climate change, ecology and natural resources management. For this particular project his research will focus on “Spatial characterization of dominant vegetation species clusters in the Khakea/Bray Transboundary Aquifer.

Biodiversity Candidates:



Ms. Chipo Perseverance Mungenge – PhD Rhodes University

Chipo Perseverance Mungenge holds a BSc. Hons in Biological Sciences (2013) and MSc in Tropical Resource Ecology (2015) from the University of Zimbabwe. She is currently pursuing her PhD with the Department of Zoology and Entomology at Rhodes University. Her research topic in the project is

“Do within-system processes shape plant, vertebrate and invertebrate diversity in the Groundwater Dependant ecosystems?”



Mr. Fannie Mfaniseni Masina – MSc University of Mpumalanga

Fannie Mfaniseni Masina is an MSc student at the University of Mpumalanga. He graduated with BSc Hons in Agriculture at the University of Mpumalanga. For his MSc studies under this project, Fannie is focusing on Assessing the influence of macrophytes diversity and structuring on macro-

invertebrate communities in Austral temporal ponds in the Khakea/Bray Dolomite Transboundary Aquifer.



Mr. Tafara Frank Bute – MSc Rhodes University

Tafara Frank Bute graduated with a 1st class BSc Hons in Applied Biosciences and Biotechnology at Midlands States University, Gweru, Zimbabwe in 2018. Tafara's involvement in the Groundwater Dependent Ecosystems and Biodiversity in the Khakea/Bray Transboundary Aquifer project

involves studying phytoplankton and microbial dynamics of the wetland ecosystems in the transboundary Aquifer of Khakea and Bray dolomite region. He is doing his MSc – Biodiversity at Rhodes University.

Geohydrology/Hydrogeology Candidates:



Mr. Brighton Munyai – PhD Candidate University of the Free State

Brighton Munyai is a Hydrogeologist with an MSc in Hydrogeology and his work experience encompasses groundwater resources development, mine hydrogeology, water use licensing and environmental hydrogeology. He is currently employed by the SADC Groundwater Management

Institute as the Senior Groundwater Specialist while pursuing his PhD in Geohydrology with the Institute for Groundwater Studies (IGS), University of the Free State. His involvement in the project involves the development of an integrated Hydrological Model to inform Management of Groundwater Dependant Ecosystems: The Case of Khakea/Bray Transboundary Aquifer.

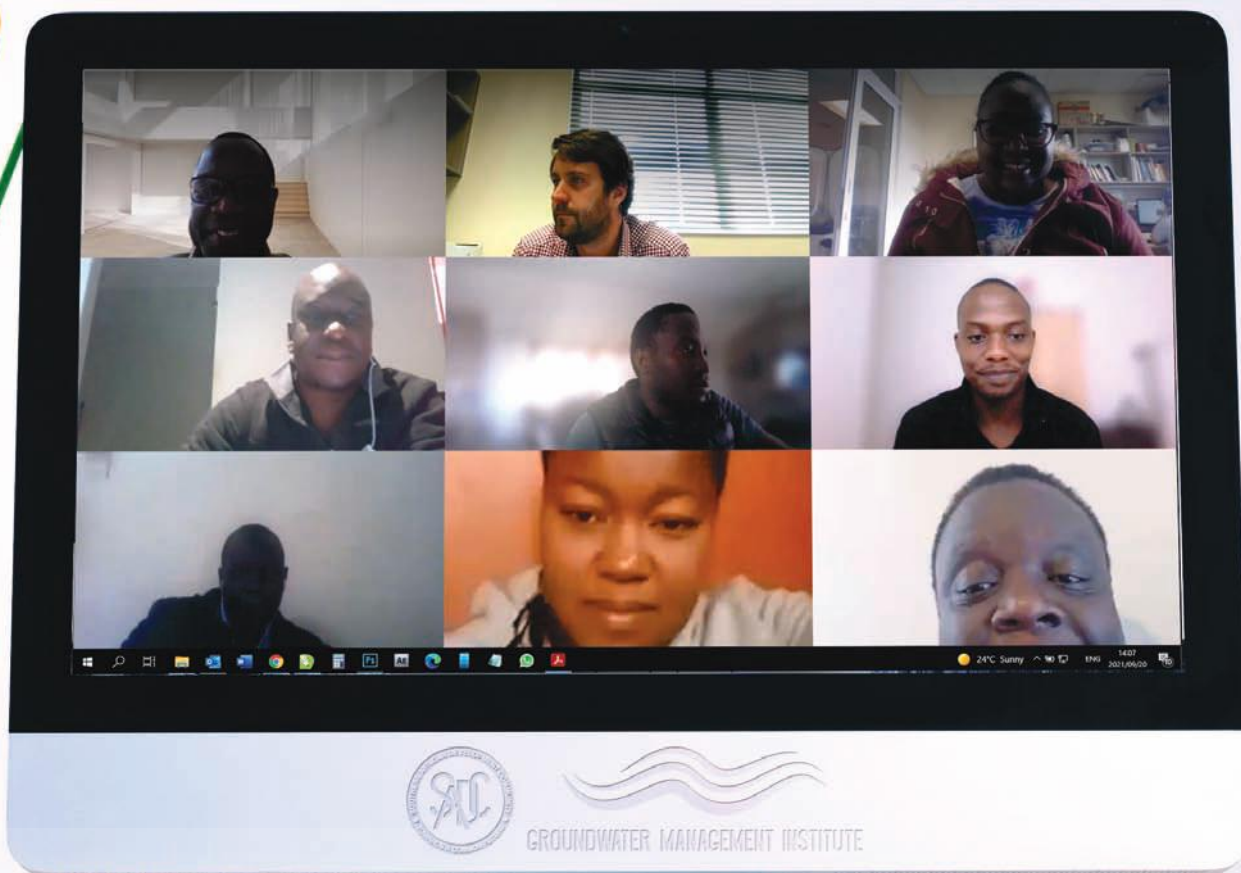


Ms. Thandeka Ngobe – MSc University of the Free State

Thandeka Ngobe is currently enrolled for MSc degree at the Institute for Groundwater Studies (IGS), University of Free State. She holds a bachelor's degree in Environmental and Engineering Geology and a BSc Honours degree in Hydrogeology from the University of Pretoria. On this project her

focus is mainly on the investigations of Groundwater Discharge processes in Groundwater Dependant Ecosystems (GDEs) in the Khakea/Bray Transboundary Aquifer.

First Virtual Workshop



On the 8th of July 2021 a first virtual workshop was held where all postgraduate students who are part of the project presented work progress in their respective components. Setting the scene Engineer James Sauramba, SADC-GMI Executive Director and the Project Lead said this workshop was imperative as it allowed students to virtually meet for the first time since joining the project. He further said Covid 19 has prevented us from our physical meetings but thanks to the power of technology which still allows us to find ways to engage, interact and deliver on our respective mandates.

The workshop also allowed the Key Experts under each component to present the objectives of the components and the progress that had been achieved to date under their supervision. As Prof. Timothy Dube the academic supervisor of the postgraduate students at the University of the Western Cape said, "Key Experts would speak a little and allow students to shine as this project provides them with a big capacity development opportunity and they are the ones grinding on the ground".

The following Key Experts presented briefly at the workshop:

- Mr Farai Dondofema - GIS and Remoting sensing
- Dr Tatenda Dalu - Biodiversity,
- Prof Modreck Gomo – Hydrogeology (delineating the hydrogeology boundary of the Khakea/Bray transboundary aquifer)

- Ms Batanayi Gwangwawa – Gender Equality and Social Inclusion of the Khakea/Bray transboundary aquifer

The critical component of the workshop was the presentations by the students, as such, the workshop provided them with an opportunity to present their work to SADC-GMI team, Key Experts and fellow students. The workshop also allowed fellow students and other participants to further engage presenters on their research activities and seek clarity where it was necessary. The workshop was key to forge the way forward as the team continues to implement the project.

The following students presented during the workshop:

- Ms. Mangana B. Rampheri – PhD University of the Western Cape
- Ms. Chipso Perseverance Mungenge – PhD Rhodes University
- Mr. Brighton Munyai – PhD Candidate University of the Free State
- Mr. Kudzai Shaun Mpakairi – MSc University of the Western Cape
- Mr. Fannie Mfaniseni Masina – MSc University of Mpumalanga
- Mr. Tafara Frank Bute – MSc Rhodes University
- Ms. Thandeka Ngobe – MSc University of the Free State



[Presentations](#)

Project update per component:

GIS and Remote sensing research theme:

The first focus of this research theme is to perform a RS based delineation of the GDEs in the TBA. This will be achieved by determining spatio-temporal changes of Groundwater Dependent Ecosystems over time (1995-2021). Through the Evaluation and mapping Normalised Difference Vegetation Index (NDVI) for GDEs during 2020 and 2021 as a proxy for spatial and temporal changes of groundwater levels and quality. Changes in NDVI will be correlated with groundwater changes to infer the relationship between GDES and Groundwater.



Ms. Chipo Mungenge, PhD Student at Rhodes University, South Africa holding a phytoplankton net used to sample the pan ecosystems. *Photo credit: Chad Keates*



Ms. Chipo Mungenge and Mr. Fannie Masina, are checking the sample from one of the Khakea/Bray TBA Pans, on the South African side.



Ms. Chipo Mungenge PhD Student at Rhodes University, South Africa looking at the zooplankton sample collected from one of the pans during the field visit to the project site. *Photo credit: Fannie Masina*

Geo-Hydrology research theme:

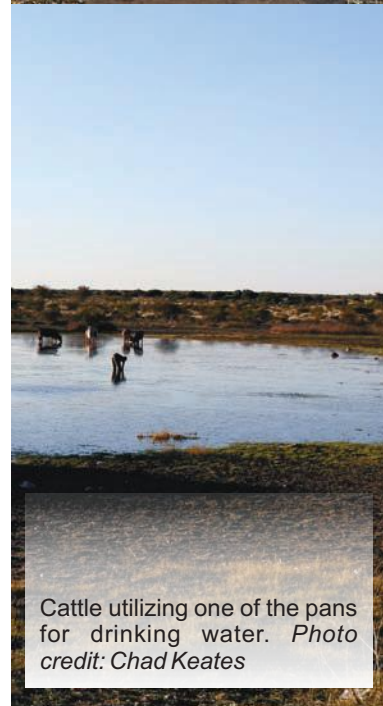
The first focus of this research theme was to improve the conceptual understanding of the extent of the Khakhea/Bray TBA and its hydrogeological process at regional level. This has been achieved through delineating the initial hydrogeology boundary of the TBA. The delineation utilises the basis of the geology and general groundwater flow principles. As part of the team working under theme, two postgraduate geohydrology students, a PhD and MSc were recruited, both students are pursuing their studies at the University of the Free State, under the supervision of Professor Modreck Gomo in the Institute for Groundwater Studies. Ms Thandeka Ngobe is an MSc student from the Kingdom of Eswatini and her research focuses on understanding the groundwater recharge processes in the Groundwater Dependant Ecosystems in the Khakea/Bray Transboundary Aquifer. Mr Brighton Munyai, the SADC-GMI Senior Groundwater Specialist is the Geohydrology PhD student. His research focuses on the development of a coupled numerical groundwater and surface water model to inform the management of GDEs using the case study of the Khakhea/Bray Transboundary aquifer. The Numerical model will provide an important tool for conjunctive use and management of surface water and groundwater resources at the same time incorporating GDEs water needs.

Under this component fieldwork has been planned to take place in August/September 2021.

Gender Equity and Social Inclusion

In view of the research objectives and the project intended results, a Gender Equality and Social Inclusion (GESI) lens is a very important consideration particularly because the research proposes a project design whose purpose will serve the needs of groups identified in the stakeholder engagement mapping exercise i.e women, People With disability, the elderly, youth and other socially marginalised groups. GESI and biodiversity have important effects on management interventions that this research will propose.

The project activities are subject to an operating context that has highly been compromised



Cattle utilizing one of the pans for drinking water. *Photo credit: Chad Keates*



Clicking Stream Frog (*Strongylopus grayii*) *Photo credit: Chad Keates*

Project update per component:

by COVID-19. This has resulted in limited physical interactions with stakeholders. The project team had to postpone some planned stakeholder meetings twice and eventually cancelled. Such engagements remain pending and will hopefully be held in August/September, should the Covid-19 situation change in the two countries.

Based on the literature review undertaken at the start of the project and pending the visit, socio-demographic data sets for one privately owned village i.e Tosca, is still missing. Collection of such information is critical for the project team as it will provide some understanding of the gender roles and differential dependency of men, women, youth, people with disability, the elderly and other socially marginalised groups on Groundwater Dependant Ecosystems (GDEs) and Biodiversity in the Khakhea/Bray Transboundary Aquifer. Following the restrictions in physical movements and gatherings, the engagement approach has been adapted by the GESI expert to accommodate virtual stakeholder engagement dialogues with some farmers in the project area. This has allowed the project to make the much-needed contact with stakeholders and gather their views on the project.

Biodiversity Component

The first deliverable of the component entailed undertaking Literature Review which was completed. The group made an extensive literature review that showed lack of data for the Groundwater Dependant Ecosystems in the region and highlighted areas where the team will do extensive works ranging from microbial, plankton, invertebrates, vertebrates and plants. It is anticipated that the PhD student, Ms Chipo Mungenge will start working on a draft systematic review manuscript focusing on the biodiversity of these systems.

One of the deliverables was the recruitment of three students which was completed, and all recruited students are listed in the student's biography section. There are also two postdoctoral research fellows attached to the project working through Rhodes University and these are Dr Adam Wyness, an aquatic microbiologist who will assist Mr. Bute with microbial analysis and Dr. Chad Keates who is a herpetologist and will assist with reptile and amphibian diversity of the pans. Other components such as the aquatic plants will be undertaken by Dr Tatenda Dalu with the help of Prof Ryan J Wasserman from Rhodes University.

The three students and a postdoctoral fellow linked to the biodiversity have already been to the field and they collected valuable information ranging from microbial, plankton to invertebrate samples including doing some preliminary assessment of vegetation i.e., macrophytes which were dominated by Potamogeton and four-leaf clover. Furthermore, soil samples were collected for hatching experiments and soil cores for benthic chlorophyll-a and microbial analyses from the 20 pans sampled from the South African side.

Thus far, the students have managed to work on 20 pans (i.e., GDEs) within South Africa. These include 10 wet and 10 dry which were sampled during the cool-dry season, and it is anticipated that during the next sampling season i.e., hot-wet, all the pans will have water. Another 10-15 pans are expected to be sampled in Botswana which has a small part of the Khakhea/Bray TBA, thus, to bring the total to between 30 and 35 pans. The next sampling is expected to take place in November/December 2020 both in South Africa and Botswana. It is anticipated that during this time, all the pans will have water and that will allow for a full comprehensive survey of the Khakhea-Bray area.

Currently the three students are busy with the sample processing from the winter sampling, and we expect the results to contribute to Deliverable 5 of the project, namely "Preliminary Results" which is due in December 2021/January 2022.



Students and their supervisors during the field trip.



From L: Chads Keates, Tafara, Frank Bute and Chipo Mungenge at the Kkakea/Bray TBA during the field trip



From L: Mr Farai Dondofema from the University of Venda and Dr Tatenda Dalu from the University of Mpumalanga, they both on the field working with students who are under their supervision.



An example of a pan ecosystem on the South African side of the Khakhea-Bray Dolomite TBA. Photo credit: Chad Keates

Key Experts:



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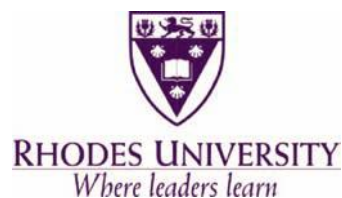


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