

News letter

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Prof R. Wasserman, Chipso Mungenge (Ph.D. student) & Tafara Frank Bute (MSc student) discussing their interesting catch on a recent field trip in the Khakea/Bray

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Project Background

The Khakea/Bray Transboundary Aquifer (TBA) shared between Botswana and South Africa is experiencing rapid increase in water abstraction for agriculture and domestic use, which threatens the sustainability of its GDEs. Groundwater Dependent Ecosystems and Biodiversity in Khakea/Bray Transboundary Aquifer System project attempts to integrate Geographic Information System (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. Since project inception in 2020, studies have been carried out trying to identify and explain linkages between groundwater and surface water ecosystems, i.e., wetlands and rivers and identify hotspots where management interventions should be focused.

Overall, results from the study will be incorporated into the decision support system being developed for the Transboundary Aquifer. This 2nd edition of the project newsletter provides updates of the project thus far, on all four components: Hydrogeology, GIS and Remote Sensing, Gender Equality and Social Inclusion (GESI), and capacity development.

Progress of the Hydrogeology component of the Khakea/Bray TBA

We are now completing the second year of the Groundwater Dependant Ecosystem (GDEs) in the Khakea/Bray Transboundary Aquifer (TBA) and the project has been gaining momentum in terms of implementation. It is important to note that a lot has been achieved and several changes and progress have been made. One of the changes was the modification of the hydrogeology work scope. Following the field visit in October 2021, it was observed that only 3 out of 42 pans identified as potential GDE sites had water. Some of the pans that had water appeared to have originated from human activities which may have enhanced the capacity of the pan.

The absence of water in most of the pans during the dry season in October 2021 raised the question if the pans were indeed GDEs and whether they were connected to groundwater. Therefore, the initial planned site-specific hydrogeological investigations could not be executed on the pans (GDEs) and the hydrogeology research scope was revised to focus on the conceptual understanding of the geophysical properties of the TBA's dolomite rocks, hence establishing the factors influencing groundwater occurrence in the TBA. The revised project scope further aimed at comprehending the origins of the pans and understanding the linkage between the groundwater systems of the TBA and the pans.

During the field visit, the MSc student (Thandeka Ngobe) conducted the geophysical investigation using the magnetotelluric (MT) approach to appreciate the dolomite settings. Due to limited availability of historical borehole drilling data in the whole TBA, Thandeka focused her research study on the South African side of the TBA which had readily available drilling data from the National Groundwater Archive. In addition to the geophysical investigations, water samples from the pans that had water during the field visit and from some boreholes were taken for chemical and isotopic analysis at the laboratory. The

analysis of the water samples will enable in-depth understanding of interaction between groundwater and surface water in the pans. At the project level, the geophysical data is being analysed together with the borehole lithological data to develop a generalized hydrogeological conceptual model of the Khakea/Bray Dolomite aquifer.

The MSc student has made tremendous progress with her academic research, and she is expected to submit her dissertation for examination before 30 November 2022. The first draft of the thesis report was submitted and is under review by the academic Supervisor, Prof. Modreck Gomo of the Institute for Groundwater Studies at the University of the Free State.

During the 4th SADC Groundwater Conference held virtually in November 2021, Thandeka won the 2nd prize under the Young Professionals category for her presentation entitled "Using Magnetotelluric technique to investigate a typical bedding plane Karoo Fractured-rock aquifer". Two abstracts were submitted and presented at the 5th SADC Groundwater Conference which was hosted in Windhoek, Namibia from the 16th to the 18th of November 2022.



Brighton Munyai operating the Magnetotelluric tool while the rest of the team look at the results during the geophysical data collection.



Groundwater specialists (Brighton Munyai , Rachel Mpe, Thandeka Ngobe) led by Professor Modreck Gomo during the geophysical data collection at the Khakea/Bray Transboundary aquifer.

Progress of the GIS and Remote Sensing

Several activities have been implemented since the start of the project in August 2020. Some activities were reported in the first newsletter which was published in August 2021. After the first newsletter the GIS and Remote sensing project team has made few milestones.

The project team has been carrying out extensive research on the applications of GIS and remote sensing in understanding the biodiversity of the Khakea/Bray TBA. Two trips to the Khakea/Bray TBA were undertaken in 2022 (January and May). The GIS and Remote sensing MSc student completed writing up his thesis. The PhD student has one more field sampling to undertake in January 2023. The next GIS and JRS report will be submitted to SADC-GMI on the 15th of January 2023.

Since the commencement of the project, the team undertook three field trips to the Khakea/Bray Transboundary Aquifer - in the dry season (June 2021) and the wet season (January 2022 and May 2022) with the aim of achieving SADC-GMI's project objectives. The last trip was undertaken on the 9th to the 14th of January 2022, both on the South African and Botswana side.

Sampling and Fieldtrips

From January 9 – 14, the project team undertook a field visit to both sides of Khakea/Bray (Botswana and South Africa). To cover more GDES and save time, the team was split into two. January seemed like a good time for such field visit since pans were expected to have water. During the field trip the team collected spectral data about the vegetation using a Licor spectroradiometer covering a wavelength between 400 and 700 nanometers.

Licor spectroradiometer can detect a variety of plant characteristics, such as growth rate, chemical composition, and more. The spectral signatures were collected for all the dominant plant species around the GDEs.

The students also worked on processing the water samples taken in winter and some of the results are captured in Deliverable 5 – Preliminary Results submitted as part of the progress report to JRS Biodiversity Foundation.

The team collected different types of data on GIS and remote sensing and biodiversity. The team also collected GPS coordinates for different land cover types found in Khakea/Bray. The data collected during the field trip contributed in drafting of the main objective of the SADC-GMI project of identifying and delineating of Groundwater-Dependent Ecosystems (GDEs) in the Khakea/Bray Transboundary Aquifer.



Mr Kudzai Mpakarai MSc student at the University of the Western Cape is seen on the picture using the measuring wheel to map the area around one of the ephemeral pans surveyed in Khakea/Bray



Dr Chad Keates with a stack of raucous toads (Sclerophrys capensis)



Project team on the Field at the Khakea/Bray Transboundary Aquifer

Progress of the Gender Equality and Social Inclusion (GESI) Component.

The project on Groundwater Dependent Ecosystems (GDEs) and Biodiversity in the Khakea/Bray Transboundary Aquifer focuses on different components, one of the components is the Gender Equality and Social inclusion analysis. In view of the overall research objectives and its intended results, GESI responsiveness is a very important consideration, particularly considering that the research will propose a project design that will serve the needs of groups identified in the stakeholder engagement mapping exercise. Stakeholders include women, persons with disabilities elderly, youth, and other socially marginalized groups.

In a quest to attain the above-mentioned GESI objective, the Gender Equality and Social Inclusion Expert with a student provided by the Department of Water Services undertook a field trip aimed at addressing several GESI issues in relation with the communities that are inhabitants of the Khakea/Bray transboundary Aquifer.

Some of the key issues covered during the field trip were local leadership structures, local economy, and its major players. The field trip also tried to establish if ponds are manmade or natural, and if there were any negative effects brought by pans, e.g., in terms of keeping livestock astray from their vicinity.



Obed Mutupi (Kawano Farm), Morokweng, explains to Ms Batanayi Gwangwawa (Gender Equality & Social Inclusion Specialist) that the community wishes to participate in the conservation activities of the Khakea/Bray TBA, but do not know how to do so.

Ponatshego Ponka, Morokweng Farm explains that the pans are useful for them and their small livestock such as goats.

During the field visit, the following was discovered:

- On both sides of the TBA (RSA and Botswana) all groups of people, men, women, indigenous people, and persons with disabilities have equal access to the ponds.
- Communities believe that the ponds and pans inhabit sacred marine spirits and should not be disturbed.
- Pans get polluted by illegal dumping and religious activities that are carried out around the pans. Ritualists performs different acts of sacrifices using cloths, animals and ornaments which they then dump in the ponds.
- Even though community leaders warn the community not to pollute the pans, pollution continue which is a problem to groundwater dependent ecosystem.
- Community members travel above the required distance radius of 200metres for alternative water sources such as community taps when the ponds dry up.
- Women, youth, indigenous and persons with disabilities do contribute to conservation programs in Morokweng but have little knowledge on how to do so effectively
- Community members are not allowed to build houses anywhere close to the pans.
- The youth and persons with disabilities are not heavily involved in problem solving and protection of these pans. The youth only follow the rules approved by the elders.

The GESI findings have been shared with the entire project management team and the key experts for incorporation in the final report.

Knowing the views of the communities regarding the pans will be very important in including their needs and priorities moving forward. The stakeholder engagement adds the human and social aspects to any research and helps to explain phenomena that hard science such as hydrogeology may not be able to explain.



Ms Chipo Mungenge PhD Student at Rhodes University receiving a 1st Prize from Eng. James Sauramba, SADC-GMI Executive Director for the best presentation under the Young Professionals Category at the 5th SADC Groundwater Conference held in Windhoek Namibia, 16 – 18 November 2022. Chipo made a sterling presentation on “Assessing chlorophyll-a and nutrient concentration dynamics in temporary pan systems along a human population gradient (Khakea/Bray Botswana and South Africa).



Dr Tatenda Dalu collecting a sediment sample from a pan in the Khakea pan system.



Chad is a Post-doctoral fellow based at Rhodes University. Pertaining to the Khakea/Bray Transboundary Aquifer (KBTA) Project Chad is contributing to the understanding of the herpetofauna of the region, with a specific focus on the frogs that utilize the temporary waterbodies. In the picture Chad is holding a helmeted terrapin that was found in one of the pans.

Segomotso joins the project from the University of Botswana

Segomotso Sekgweng is a University of Botswana graduate who holds a general Bachelor of Sciences Degree with a major in Biology and a minor in Chemistry. She also possesses a Post Graduate Diploma in Education Certificate (PGDE) for Biology. She worked as a full time Laboratory Demonstrator at the University of Botswana for Biological Science courses, demonstrating practical work for undergraduate students.

She is currently pursuing a Master of Philosophy in Biological Sciences at the University of Botswana under the JRS project. Her study focuses on “Developing baseline information on Groundwater Dependent Ecosystems (GDEs) and biodiversity of invertebrate and amphibian communities in the Khakea/Bray Transboundary Aquifer, Botswana.” Segomotso is a diligent, self-disciplined young woman who is motivated to explore knowledge from the ecological field.



Overview Project Status

The project on Groundwater Dependent Ecosystems (GDEs) and Biodiversity in the Khakea/Bray Transboundary aquifer (TBA) shared between Botswana and South Africa commenced on 1 August 2020 and is destined for completion on 31st July 2023. It is being implemented by a consortium of research experts under the leadership of the SADC-GMI with grant funding from the JRS Biodiversity Foundation.

As the project draws towards the last 6 months of implementation, it is worth reflecting on what this project has achieved for SADC-GMI, its partners and the SADC region at large. Firstly, this project being the first of its kind for GDEs and TBAs in the region, has set the pace on how similar future work can be undertaken. There are more than 30 TBAs in SADC, hence the scope for rolling out this type of work is huge. While pioneering this type of work in the region, this project also demonstrated the power of successfully collaborating with research institutions and

universities to undertake applied research. This success story was amplified by the integration of capacity building through the PhD and Masters' postgraduate programme as well as ensuring that Gender Equality and Social Inclusion are mainstreamed into the applied research. By July 2023, we will also have a database from this project linked to the SADC Groundwater Information Portal (SADC-GIP) which will serve as a launching pad for further work on GDEs in TBAs of the SADC region and beyond.

We are therefore excited to be a part of this innovation that defines our future as SADC-GMI in fulfilling our mandate as a Centre of Excellence for groundwater development and management in SADC. We are also overly grateful to JRS Biodiversity Foundation for their generosity and trusting SADC-GMI to initiate such a project. This also demonstrates to us that the SADC-GMI brand has accrued credibility which makes it possible to access funding to continue fulfilling our mandate.

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