Title of the Impact Case Study: The Accessible Greywater Solutions for Urban Informal Townships (URBWAT) project.

Submitting University: University of the Witwatersrand

Summary of the impact:

The project had direct impact on the people of s'Swetla. They benefitted from the installation of grey-water treatment infrastructure in their communities, which were integrated with their wash areas. The project injected capital directly into the community, no external service providers were used. They were directly involved in the procurement of supplies, in the construction and maintenance and in the project management. The City of Johannesburg, the Department of Science and Innovation and the Department of Water and Sanitation benefit through the reports presented to the Water Research Commission, detailing designs for the treatment, in-situ, of grey water in an urban, informal settlement.

Underpinning academic work:

This project is led by Prof. C Sheridan (a chemical engineer) and Prof. A Thatcher (a psychologist) and focuses on the application of constructed wetlands in a social context. A system of three constructed wetlands was built in gravel-like beds to establish a microbial consortium using plants that essentially eat chemical components in discarded wastewater.

The URBWAT project used an iterative participatory design approach to build and evaluate greywater treatment solutions in an urban informal settlement (the intervention and study location was Setswetla informal settlement in Alexandria, Johannesburg) using a nature-based solution over a period of four years. UN-HABITAT estimates that there are more than 10 million people in South Africa living in informal settlements (238 million across sub-Saharan Africa) with poor access to formal services and no access to greywater collection and treatment. Given the highly impoverished nature of the research site, an iterative participatory design process was adopted. Through the co-design approach small, constructed wetlands were designed and installed in Setswetla. The iterative co-design strategy enabled the researchers to deal with setbacks and challenges as they arose such as the rapidly evolving physical and social space and a sewer spillage that flowed through the informal settlement for months (and destroyed one of the constructed wetlands – but the constructed wetland still saved the community from sewage flooding people's homes).

The initial design phase of the project involved comparative interviews with another greywater treatment system installed in a rural informal settlement in the Western Cape called Langrug. The interviews were conducted with key stakeholders, including with City of Johannesburg representatives, Joburg Water, the local Ward Councillor, and community leadership in Setswetla, to construct a stakeholder map. This was followed by six design workshops with residents to develop solutions to greywater collection and treatment. Evaluation of the constructed wetlands involved more than 36 months of resident and key informant interviews, two sets of resident surveys, two structured activity analyses, and photo-ethnographic observations across three intervention phases. The complexity of the environment made this intervention project unique.

The evaluation of the water quality and treatment effectiveness was done through intermittent grab samples from the constructed wetlands and the Jukskei river (upstream and downstream of Setswetla), and a six-month structured survey sampling strategy for one of the constructed wetlands which assessed chemical and biological parameters.

It was the intention of the URBWAT project team to invest as much as possible in the community. This included sourcing building materials locally (where possible), sourcing labour and building skills locally, and embarking on an active engagement process with the community to generate design suggestions and to provide feedback on our progress and investigations. All the labour, building expertise, and project management was sourced from within Setswetla. Building materials such as cement, building sand, river sand, and concrete mix were sourced from local suppliers. Recycled bricks were sourced from two locations in Setswetla. Not only did the team use user-centred design techniques to deliver multiple solutions (beyond greywater treatment) to the residents, but also invested in building rapport between scientists and residents through investing in local skills development.

Using the same development model there is great potential to roll-out constructed wetlands to other areas in Setswetla (and other urban informal settlements) reducing health risks while creating job opportunities for locals for design, labour, building supply, and maintenance jobs for a low-cost, nature-based solution.

Narrative description of the impact:

The saying 'water is life' proves true when it comes to its various uses, but it can also be extremely harmful when mixed with a range of disease-causing contaminants. Globally, water resources are under threat. Increased urbanisation, increased industrialisation, increasing populations, climate change and pollution all have harmful effects on water as a resource. The Accessible Greywater Solutions for Urban Informal Townships in South Africa (URBWAT) is a project studying the implementation of treatment wetlands in an urban megacity slum context. Through URBWAT, three constructed wetlands were built in s'Swetla, Alexandra township, Johannesburg to treat grey water run-off that ultimately leads to the Jukskei River. Residents who carry their tap water home may wash fruit and vegetables, bath children, wash textiles, and clean the floor. Disposal of this wastewater amidst inadequate or non-existent drainage systems poses health and environmental risks.

The URBWAT project has directly benefitted a relatively small number of residents (approximately 300 residents) living in close proximity to the installed constructed wetlands. However, these residents have personally observed marked improvements in their immediate environment (as evaluated through our activity analyses and surveys) with potential knock-on effects to residents downstream along the Jukskei River with the reduction in pollutants from the community. However, to make a significant impact on community (and the river) will require a much larger upscaling of constructed wetlands installations and we haven't yet formally evaluated the feasibility of upscaling given the considerable challenges around land and space in an urban informal settlement. In presenting the findings to the City of Johannesburg and other key stakeholders, including Joburg Water and the national Department of Science and Innovation, there was much excitement about how well the URBWAT project improved residents' livelihoods.

The URBWAT team has recently applied for funding to upskill residents to roll out the constructed wetlands to more areas of the informal settlement. Not only will this create entrepreneurial opportunities, but this promises to have an impact on a larger number of people and the environment. The work on the URBWAT project has also involved educating the secondary education sector and the general public. Prof. Thatcher gave a keynote presentation at the South African Geography Teachers' Association annual conference in 2019.

Perhaps the most significant (and fulfilling) educational initiative has been to work with the residents of Setswetla in a truly transdisciplinary fashion. In many respects this has been a two-way educational process. They have learnt about the dangers of greywater and co-designed one option in how to collect and treat greywater using a nature-based solution. The URBWAT project also involved educating residents in building techniques and plant management to ensure the sustainability of constructed wetlands. But, it should be emphasised that we have also been students in this process. We have learnt about the precarious life of living in an informal settlement, the multiple inter-related service

delivery challenges, and the creativity and resilience of people living under these circumstances. We have also had to learn to deal with the immense tragedies this community faces every day.

Evidence and sources to corroborate the impact:
The project was well received at the COJ feedback session. The DSI requested the team apply for follow-on funding through the SASTEP programme. The project was presented in the public domain, in particular articles on the project have been written and published by the Independent Media Group (Saturday Star – 12 February 2019), Plumbing Africa (https://plumbingafrica.co.za/index.php/news-events/news/614-artificial-swamps-to-deal-with-grey-water -1 March 2019. In addition to this, radio interviews have been given to Power987 and on Kaya FM. The following publications (more are currently under peer-review) on the project have been published:
Thatcher, A., Metson, G. S., & Sepeng, M. (2024). Applying the sustainable system-of-systems framework: wastewater(s) in a rapidly urbanising South African settlement. *Ergonomics*, *67*(4), 450–466 was published on this work and has been cited 3 times already on Scopus.
Davy, J., Todd, A., Metson, G. S., & Thatcher, A. (2023). Designing a greywater treatment system in a highly adaptive urban environment: an ergonomics and human factors observational analysis. *Urban Water Journal*, *20*(5), 624–637
Thatcher, A. (2021). Uncovering Sustainable System-of-Systems Elements in the Design of a Greywater Treatment System for Urban Informal Settlements. In Lecture Notes in Networks and Systems (Vol. 220).
The report on the project was published as a WRC report: Accessible Greywater solutions for urban townships in South Africa: URBWAT. Craig Sheridan, Chris Bode-Aluko, Uwe Kappelmeyer, Geneviève Metson, Taraz Rawhani, Ruth Stephenson, Andrew Thatcher, Karin Tonderski. WRC Report No. 2953/1/22 ISBN 978-0-6392-0257-0.

The final indicator of evidence is that this project was selected for the Vice Chancellor's Innovation and Impact Award, 2023, being awarded to Professors Sheridan and Thatcher.