

# FOOD SAFETY

## Science in Action: The WRC and UP – celebrating 20 years of water quality and produce safety research

*The Water Research Commission (WRC) and the University of Pretoria (UP) reflect on a partnership of over two decades to ensure that the food we eat remains safe for consumption. Liza Korsten, Loandi Richter-Mouton, Manana Dlangalala, Eunice Ubomba-Jaswa, and Samkelisiwe Hlophe-Ginindza.*



World Food Safety Day is celebrated annually on 7 June to raise awareness about the importance of food safety and its impact on human health, trade, and sustainable development. This year's theme was 'Science in Action', highlighting the importance of sustainable funding, like that from the WRC. Over 54 years, the Commission has funded water research to ensure access to quality, fit-for-purpose water in South Africa. Its outputs inform policy, empower communities, promote sustainable solutions, and strengthen capacity in the water and science sectors. Over twenty years of research at UP's Department of Plant and Soil Sciences, led by Prof Liza Korsten, has focused on a multidisciplinary field of water, soil, and food safety from production to consumption. The work emphasises contaminated water's impact on food, while actively training students, from undergraduate to postdoctoral level, to develop future female

leaders, in particular.

Water is essential at all stages of food production, from irrigation and processing to final consumption. It supports crop and livestock health, but can also carry harmful contaminants, such as pathogens, heavy metals, and chemicals, posing significant food safety risks. Contaminated water can lead to foodborne illnesses, health issues, and economic losses. Ensuring water quality through a holistic, science-based approach across the farm-to-fork supply chain is crucial for protecting human and animal health and fostering safe, sustainable food systems within a One Health framework.

UP researchers have recognised the need for actionable science ensuring water quality and food safety, and have, over the

past 20 years, built up a pool of expertise to stepwise address the critical questions around the water-soil-plant-food nexus. The partnership between the WRC and the UP illustrates the progression of research initiatives, progressing from foundational studies in 2008, to applied research in 2015, and culminating in more complex and interconnected investigations in 2022.

#### At the farm level: Tackling contamination at the source

Small-scale farmers, who supply much of the fresh produce in informal markets, face significant hurdles in ensuring food safety. Research has shown that irrigation water is a critical point of concern. Studies have revealed diverse bacteria, including pathogens like *E. coli* and *Salmonella*, in irrigation water and leafy greens (Kgoale et al., 2023). Contaminated water can transfer bacteria to soil and fresh produce (Viviers et al., 2024), underscoring the urgent need for improved water management, routine monitoring, and treatment at the farm level.

Link to related research: <https://rdcu.be/epxgW>

Link to related research: <https://doi.org/10.1093/jambio/lxae091>

#### At the retail level: Addressing variability in food quality

Once produce reaches informal markets, its safety can vary widely depending on the vendor. One of the previous studies has shown higher *E. coli*, *Listeria* spp., and *Salmonella* spp. occurrence on spinach from street vendors versus formal retailers, highlighting the impact of poor hygiene and limited sanitation in these settings (Du Plessis et al., 2017).

Link to related research: <https://doi.org/10.4315/0362-028X.JFP-16-540>

#### At the consumer level: Confronting emerging threats

For consumers, studies on alternative water sources and antibiotic resistance raised critical concerns. Research on roof-harvested rainwater showed *E. coli* and *Enterococcus* spp. as indicators of quality risks for home gardening (Chidamba & Korsten, 2018). Meanwhile, studies in Gauteng found multidrug-resistant bacteria on vegetables, elucidating the food chain's role in spreading antimicrobial resistance (Richter et al., 2019;

Richter et al., 2020). These insights emphasise clean water's role in mitigating health risks and the need for policy action.

Link to related research: <https://doi.org/10.1007/s10661-018-6554-1>

Link to related research: <https://doi.org/10.1089/fpd.2018.2558>

Link to related research: <https://doi.org/10.3389/fmicb.2020.00638>

Each WRC-funded project builds on prior knowledge, employing advanced methods and expanding geographical scope, with active university collaboration, notably involving Prof Stefan Schmidt at the University of KwaZulu-Natal. One of the key outcomes to date was a policy brief that is **fit-for-purpose** for local conditions by providing water quality criteria and parameters that will contribute to food safety assurance in fresh produce (vegetable and fruit) production systems in predominantly formal (commercial) food systems (Du Plessis et al., 2021). Recent efforts focus on identifying knowledge gaps to develop tailored guidelines for small-scale farmers, including water irrigation standards that enhance mitigation, market access, and food safety. Current research (2022–present) emphasises antimicrobial resistance surveillance across the river system, informing evidence-based decisions to improve farm-to-fork safety. These projects demonstrate ‘science in action’ – using techniques like DNA sequencing and microbial profiling to convert data into practical solutions for irrigation, hygiene, and antibiotic resistance, safeguarding South Africa's food supply.

Link to related research: <https://www.wrc.org.za/wp-content/uploads/mdocs/2706%20final.pdf>

Over two decades, WRC projects have also built capacity and empowered women in science, providing hands-on training in microbial analysis and molecular diagnostics, fostering leadership, gender equity, and a skilled workforce committed to sustainable development and public health, in partnership with Department of Science, Technology and Innovation (DSTI) and National Research Foundation Centre of Excellence (NRF CoE) Food Security.

2009 – 2015	2012 – 2016	2017 – 2021	2022 – 2026	2023	2024 – 2028
<b>Project No. K5/1875/4</b> <i>An investigation into the link between water quality and microbiological safety of fruit and vegetables from the farming to the processing stages of production and marketing</i>	<b>Project No. K5/1875/4</b> <i>Evaluation of the risks associated with the use of rainwater harvested from rooftops, for domestic use, and homestead food gardens, and groundwater for domestic use and livestock watering</i>	<b>Project No. K5/2706/4</b> <i>Measurement of water pollution, determining the sources and changes of microbial contamination, and the impact on food safety from farming to the retail level of fresh vegetables</i>	<b>Project No. C2022/2023-00885</b> <i>Development of a fit-for-purpose water microbiological quality guideline for smallholder farmers and informal food traders</i>	<b>Solicited WRC Project</b> <i>An independent investigation and advisory on the role of water, sanitation and hygiene in the 2023 Cholera outbreak in Hammanskraal, South Africa</i>	<b>Project No. C2024/2025-01602</b> <i>Building a South African human pathogenic bacteria and antimicrobial resistance surveillance network in agri-food-producing environments through a water-focused One Health Approach</i>

Figure 1: Timeline of research projects and collaboration between the Water Research Commission and the University of Pretoria.