THE WATER WHEEL

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DISASTER MITIGATION

Raging waters: New guideline aims to protect society from devastating flood impacts

WATER AND FORESTRY

Forestry – Boon or bane for the Western Cape?

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WATER RESEARCH COMMISSION

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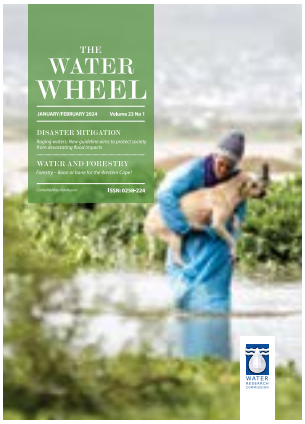

A new guideline developed with funding from the Water Research Commission in partnership with the Institute for Municipal Engineering of Southern Africa will assist municipalities to demarcate safer floodline development boundaries. Article on page 10.

NEWS

Climate loss and damage fund to be established

Minister of Forestry, Fisheries and the Environment, Barbara Creecy, has welcomed the agreement by the Transition Committee of the United Nations Framework Convention on Climate Change (UNFCCC) on the operationalisation of the Climate Loss and Damage Fund.

The purpose of the fund is to assist developing countries that are particularly vulnerable to the adverse effects of climate change in response to economic and non-economic loss and damage associated with those harmful effects, including extreme weather events and slow-onset events.

Creecy noted that developing countries, Africa in particular, have borne the brunt of the adverse effects of climate change and have not received the required multilateral support to face climate change, including to address loss and damage. "The projected economic cost for loss and damage by 2030 alone has been estimated to be between US$290 and 580 billion in developing countries alone. By 2050, the economic cost for loss and damage in developing countries is to be between US$1 trillion and US$1.8 trillion," Creecy said.

"The new fund will have a board, balanced between developed and developing countries and will take its guidance from the parties to the UNFCCC and Paris Agreement."

The agreement came only weeks ahead of the 28th Conference of Parties to the UNFCCC in Dubai.

UP acquires mobile lab to stress test mining waste

The University of Pretoria (UP), in collaboration with Anglo American, has established a top-of-the-range mobile soils testing laboratory to assess the strength of mining waste samples.

The laboratory, housed in an eight-ton truck, will enable sensitive soil samples to be subjected to a range of sophisticated tests in the vicinity of the area they are recovered in. As a result, sample disturbance associated with long-distance transport to laboratories will be avoided through the use of this mobile facility.

The mobile lab, which was launched towards the end of the year at UP's Engineering 4.0 complex, marks the first time that equipment of this nature has been assembled in a mobile unit. "Tailings engineering is a rapidly advancing field of research around the world," noted Prof SW Jacobsz, a lecturer in the Department of Civil Engineering in the Faculty of Engineering, Built Environment and Information Technology. "In addition to existing research facilities, such as the only active geotechnical centrifuge in Africa, this mobile laboratory places UP in a unique position to contribute significantly to advance the state-of-the-art in the important field of tailings engineering."

Mine tailings refer to a mixture of ground-up ore and water from which precious metal like gold is extracted, thereby leaving vast amounts of this waste product. This sludgy material is disposed of as tailings dams. "This very soft mud is used to build the dam higher and higher," Jacobsz explained. "However, if you build it too fast without allowing the mud to dry properly, you get stability problems. It is our purpose with this lab to testing tailings samples from these dams to determine whether the materials forming these dams are of adequate structural strength."

Driving a sample of this very soft material many kilometres to Pretoria to a soils laboratory will completely disturb it," he added. "It is difficult to transport a soft tailings sample intact, so we will drive the truck to the dam, take a sample and carefully walk it into the laboratory without vibrating it. That way, we can test a higher quality sample and will come to know the material's true properties, which allowed for more accurate assessment of the stability of tailings dams."

The laboratory is equipped with four advanced triaxial test systems, two dynamic cyclic simple shear systems, an automated oedometer system and ancillary equipment. It is anticipated that the lab will significant advance research into tailings behaviour.

Triaxial test systems apply all-round confining stress and downward pressure to a cylindrical sample, Prof Jacobsz explains. When the sample deforms, you've reached the strength of a sample. On the other hand, dynamic cyclic simple shear systems deform a sample by forcing it to tilt.

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Leading scientists converge over climate change strategy

The Department of Water and Sanitation (DWS), in collaboration with the International Water Management Institute (IWMI) assembled captains of industry, leading minds and various stakeholders in a hybrid Climate Change and Water Sector Consultation workshop on 24 November 2023 in Pretoria.

The workshop was aimed at fostering meaningful discussions and collaborative efforts towards sustainable development and climate security in the water sector. Inputs solicited from the consultation will be incorporated into the revised draft Climate Change Strategy. This will be followed by intense consultation with various stakeholders across the country to solicit more inputs to pave way for a development of a strategy that will ensure a climate resilient South Africa.

Speaker after speaker echoed each other's sentiments that the drive for water security calls for a collaborative response from government, civil society organisations, experts, and the private sector. They agreed that a shared global challenge, combined efforts are essential to ensure sustainable water management, improve access, and innovate resilient solutions. This tripartite alliance can drive impactful policies, fund crucial initiatives, and implement effective strategies to secure the world's water future. It is with this in mind that collaboration is critical in moving South Africa towards a more water secure future that in all essence, is the pursuit towards the fundamental preservation of life.

Spearheaded by Dr Gabriel Lekalakala, Specialist Scientist – Directorate Climate Change Analysis at the DWS, the consultation delved into two key areas which are namely, Water in National Determined Contributions (NDC) to place water at the heart of development pathways, and drafting the Climate Change Status Quo and National Response Strategy.

"The water and sanitation sector is faced with a wide range of challenges that are further exacerbated by climate change, and has a severe impact on water security. The development of response plans such as the draft National Climate Change Response Strategy for the Water and Sanitation Sector together with collaborative and coordinated responses from the sector can contribute towards reducing the potential impacts. The strategy is a blueprint for the sector to use in response to climate change related impacts and requires all hands on deck. Hence, the consultation is to afford the sector players an opportunity to contribute towards its robustness and all take ownership of it. There will be consultation process making use of all available platforms in the coming weeks. Its implementation process will involve awareness drives of the strategy to wider uptake. We encourage all stakeholder to take part in all these processes," said Dr Lekalakala.

WATER DIARY

Savanna
3-8 March 2024
The 21st International Savanna Science Network will take place at the Nombolo Mdhluli Conference Centre in Skukuza, Kruger National Park. The conference provides an opportunity for scientists to share their latest research findings conducted in national parks and other conservation areas within the savanna biome.
Visit: https://www.sanparks.org/scientific-services/events/savanna-science-network-meeting-2024

World water
18-24 May 2024
The 10th World Water Forum will be held in Bali, Indonesia, with the theme 'Water for shared prosperity'.
Visit: https://worldwaterforum.org/

Water in South Africa
27-29 May 2024
The WISA 2024 Biennial Conference & Exhibition will take place from at the Durban International Convention Centre.
Visit: https://wisa.org.za/event/wisa-2024-biennial-conference-exhibition/

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GLOBAL

Global report reveals hidden costs of agrifood systems

Although current agrifood systems provide nourishment and sustain economies, they also impose huge hidden costs on health and the environment – the equivalent of at least US$10 trillion annually – a new report by the Food and Agriculture Organization (FAO) has revealed.

The figure represents nearly 10% of the global Gross Domestic Product (GDP). This is according to the ***2023 State of Food and Agriculture***, which covers 154 countries.

The report introduces the concept of the hidden costs and benefits of agrifood systems, offering a framework through which they can be assessed. The aim is to help decision-makers steer global agrifood systems – the whole industry encompassing food and non-food agricultural production – towards greater sustainability. "In the face of escalating global challenges: food availability, food accessibility and food affordability; climate crisis; biodiversity loss; economic slowdowns and downturns; worsening poverty; and other overlapping crises, the future of our agrifood systems hinges on our willingness to appreciate all food producers, big or small, to acknowledge these true costs, and understand how we all contribute to them, and what actions we need to take," said FAO Director-General, Dongyu Qu.

The report found that the biggest hidden costs, more than 70%, are driven by unhealthy diets that are high in ultra-processed foods, fats and sugars, leading to obesity and non-communicable diseases, and causing labour productivity losses. This is particularly the case in richer countries.

One fifth of the total costs are environment-related, from greenhouse gas and nitrogen emissions, land-use change and water use, with all countries affected.

Meanwhile, low-income countries are proportionately the hardest hit by hidden costs of agrifood systems, which represent more than a quarter of their GDP, compared to less than 12% in middle-income countries and less than 8% in high-income countries. Hidden costs associated with poverty and undernourishment are also the most significant in these nations.

- To access the 2023 State of Food and Agriculture, visit: https://www.fao.org/documents/card/en/c/cc7724en

Taming wild north rivers could harm Aussie marine fisheries – CSIRO

Australia's tropical northern rivers still run free. These relatively pristine areas have so far avoided extensive development. However, there are ongoing scoping studies exploring irrigating agricultural land using water from these rivers.

New research from CSIRO, published in the journal ***Nature Sustainability***, shows disturbing the delicate water balance upstream can have major consequences downstream, even hundreds of kilometres away.

Using the latest computer modelling, CSIRO researchers found northern water resource development would have substantial effects on prawns, mud crab and barramundi fisheries in the Gulf of Carpentaria. These are valuable Australian marine fisheries which depend on healthy estuaries. Reducing river flows would also disturb mangrove and seagrass habitats and threaten the iconic endangered largetooth sawfish.

"We must avoid the mistakes made in southern Australia where too much water has been taken out of the system for growing crops," noted the institute in a statement. "That means carefully evaluating the design of dams or irrigation schemes, considering when, where and how much water should be taken – and the likely trade-offs."

In addition to their environmental significance, the northern rivers of Australia also have cultural significance for Aboriginal people, and represent a valuable resource, providing food and supporting livelihoods.

- To access the original article, visit: https://www.nature.com/articles/s41893-023-01238-x

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How pit latrine microbes could cut greenhouse gas

A new study sheds light on the complex microbial ecosystems found in pit latrines, which billions of people around the world use.

The findings are relevant for efforts to improve public health and reduce greenhouse gas emissions associated with climate change.

"Properly designed and managed pit latrines are not just holes in the ground to store human waste," explained Francis de los Reyes, corresponding author of a paper on the work and professor of civil, construction and environmental engineering at North Carolina State University. "They are biological reactors that help break down the waste and reduce the likelihood that mismanaged waste will contribute to human health or environmental challenges."

"This is one of the first efforts to use genetic tools to better understand basic sanitation technologies in low-income countries," said de los Reyes. "Improving our understanding of the microbial ecosystems in these pit latrines can help us develop new management techniques that influence the behaviour of those ecosystems. Those changes, in turn, could facilitate a more rapid breakdown of human waste and reduce greenhouse gas emissions."

For this study, researchers collected waste samples at three different depths from 55 lined pit latrines on the outskirts of two cities in Malawi. The researchers used genetic sequencing to identify the types of microbes present in each sample and the relative abundance of each type of microbe.

"One interesting finding was that the microbial community in any given pit stayed fairly constant, regardless of depth," noted Savanna Smith, first author of the paper and a PhD student at NC State. "In other words, the microbial community at the bottom of the pit was essentially identical to the community at the top of the pit.

"Also, while there was some variability from pit to pit, there was relatively little variation when you looked at all the samples together. That suggests we can draw some good general conclusions about the microbial communities of pit latrines, at least in peri-urban areas of Malawi. That's useful to know, because it can inform the development of new pit latrine management techniques in this region."

The findings also confirm an existing hypothesis about exactly how these microbial communities break down the human waste," said De los Reyes. Different subsets of the microbial community are more represented at different levels, with aerobic microbes more abundant near the surface and anaerobic microbes more abundant deeper in the pit. There is value here in terms of establishing experimental evidence for a longstanding hypothesis.

To full results were published in the journal, ***PLOS Water***.

- To access the original article, Visit: https://journals.plos.org/water/article?id=10.1371/journal.pwat.0000171

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NEW WRC REPORTS

Using citizen science to protect natural untreated drinking water sources: Natural springs in rural catchments and B3 municipalities in the Eastern Cape

Citizen science is a well-known mechanism used by researchers to collect scientific data working together with citizens. It can also be used by interested and concerned citizens (social activists regarding environmental threats) to protect natural occurring things like biodiversity, rare species that are threatened extension and much more. Springs are useful for providing drinking water for people but also for livestock. In rural areas and small towns where service delivery is not reliable, natural occurring water sources become the reliable supply for these communities. Springs also provide ecosystem services as they are a keystone ecological infrastructure. These natural water sources can be threatened by pollution, especially that of livestock which is mostly unattended, because they are sometimes shared by people and animals. This poses health risks to the users. This study co-developed the 'spring protection and sustainable use' tool/s that can be used to guide communities and local government on how to protect these important water sources. Citizen science also creates opportunities for learning to take place among the participants as well as the researchers involved.

WRC report no. 3097/1/23

Web link: https://bit.ly/414t7GJ

Ultravoilet (UV) treatment of irrigation water at farm level to reduce microbial contamination for improved food safety

The poor microbial quality of many South African rivers is an undeniable threat to consumer health. The 2022 Green Drop Report furthermore emphasises the fact that a very limited number of wastewater treatment plants (WWTPs) function properly, which implies that improperly treated wastewater is released into the environment on a daily basis in the South African context. This is concerning from both a food security and food safety perspective, as most of South Africa's irrigation water is sourced from surface waters. The potential health implications this could have for the consumers of fresh produce urgently warrants some form of water treatment prior to crop irrigation, to prevent pathogens from entering the food distribution chain. Disinfection of surface water prior to agricultural irrigation has thus become a necessity rather than a choice, given the current South African context. This project looked at the potential of using UV-based disinfection.

WRC report no. 2965/1/23 (Volume 1) and 2965/2/23 (Volume 2)

Web link: https://bit.ly/3RadKaT (Volume 1) and https://bit.ly/3RqTDqy(Volume 2)

A national assessment of potential climate change impacts on the hydrological yield of different hydro-climatic zones of South Africa

This study is based on a solicited call from the Water Research Commission (WRC). The terms of reference highlighted the highly variable hydrological system of South Africa, which is characterised by a high-risk hydro-climatic environment. Climate change is likely to severely exacerbate risks and impacts on the hydrological system, the socio-economic system, the ecosystem and livelihoods. In light of these issues, a study was proposed that entailed the assessment of potential climate change impacts on the hydrological yield. This assessment was to include climate change scenarios for the short-, medium- and long term, their impacts on the hydrological yield and on hydrological responses (e.g. resultant changes in local runoff, accumulated streamflows and recharge), as well as adaptation strategies. To transfer the gained knowledge to key decision-makers, a capacity building programme for DWS staff was to be developed. The final reporting for this study takes the form of three reports. Report 1 contains background, methods, results and a discussion of the bio-physical projections of climate variables, hydrological responses and hydrological yield. Report 2 contains adaptation options and strategies while Report 3 contains verification studies of the ACRU hydrological model, which was used in this research.

WRC report no. 2833/1/22 (Volume 1), 2833/2/22 (Volume 2), 2833/3/22 (Volume 3)

Web link: https://bit.ly/3Rb0oLC (Volume 1), https://bit.ly/3RbSWjg(Volume 2), https://bit.ly/4180S9U(Volume 3)

A best practice guideline for design flood estimation in municipal areas in South Africa

The requirements for design flood estimation in urban areas are changing largely as a result of the pressure placed on flood prone land by rapidly expanding urban populations. This guideline document addresses the previous lack of design standards for urban flood estimation and risk assessment in South Africa. The document commences with an introductory overview that gives guidance on how to use the guide and notes that there is a close relationship between the techniques used for design flood estimation and those used in the design of stormwater drainage and stormwater management systems. The preliminary chapters, that discuss the legislation and principles applicable to design flood estimation, are followed by a detailed 'road map' that guides the user through subsequent chapters.

WRC report no. TT 921/23

Web link: https://bit.ly/3RbzT92

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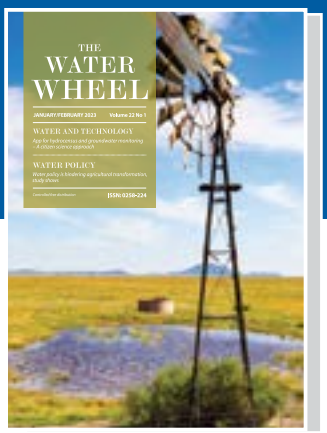

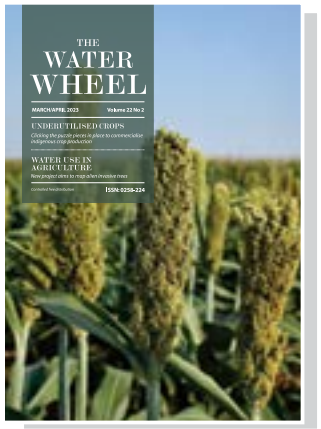

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DISASTER MITIGATION

Raging waters: New guideline aims to protect society from devastating flood impacts

Top water engineers and researchers have collaborated to produce a comprehensive guideline for municipalities to demarcate safer and more consistent floodline development boundaries. Tony Carnie reports.

Photo supplied

Thousands of people have been carried to their deaths by sudden and unpredictable floods in many parts of South Africa over the centuries. One of the most recent reminders of this terrifying power of floodwaters and mudslides came in April 2022, when at least 460 people died and more than 8 000 homes were destroyed in Durban and other parts of KwaZulu-Natal and the Eastern Cape.

According to researchers at the University of the Witwatersrand, nearly 40 000 people became homeless, and up to 45 000 people were left temporarily unemployed following that flood. Roads and bridges were also torn away, along with tap water and sewage reticulation pipelines – leaving behind an infrastructure damage bill at around US$2 billion.

While little can be done to stop major rivers from overflowing during such extreme and unpredictable weather events, the death toll and the extent of damage can be reduced by controlling or restricting the development of homes and other human infrastructure in the most flood-prone areas in built-up areas. The most common method used to reduce such risks is by demarcating a 'floodline' (an imaginary line on the ground that denotes the probable edge of the water during a flood). One of the most widely-used examples is a 1:100-year floodline, which delineates the probability of a flood exceeding this level once in a 100 years (or a 1% probability in any year).

Yet, at a time when the country's urban population is expanding rapidly, there are still no consistent design standards for urban

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flood estimation and risk assessment in South Africa – a situation that has been exacerbated by a decline in engineering expertise at municipality level. These were some of the factors that prompted the Institute of Municipal Engineering of Southern Africa (IMESA) and the Water Research Commission (WRC) to develop a new flood estimation guideline for municipalities.

The new 300-page technical tool, entitled ***A best practice guideline for design flood estimation in municipal areas in South Africa*** (**WRC report no. TT 921/23**), was produced by a group of six expert academic researchers and private practitioners and published by the WRC.

Chris Brooker, a Johannesburg-based civil engineering consultant who helped develop the guideline, notes that vulnerable communities living in shack settlements are often "left with nothing" in the aftermath of such events. Whereas more affluent families may be covered by insurance or could afford to relocate to a hotel or other accommodation while their homes are repaired – residents of informal settlements have to start from scratch after losing their only source of shelter, their clothes, their furniture – even their ID books.

"So, we need to be looking at protecting these vulnerable communities – from themselves, as well as from avaricious politicians or developers," he says, in reference to the illegal infilling of flood-prone land that is then sub-divided and sold for informal settlement. "Are development plans being interpreted in the best interests of society, or to provide a developer with a few extra property stands? I'm not sure that the potential social consequences are always addressed adequately at the municipal level," he says.

He notes that South Africa has always been exposed to flood events, with a corresponding need to provide guidance on locations where it is 'safe' to develop – or not. Yet it was not until the 1970s that regulation in this area was formalised, with the first references to floodline estimation published in an amendment to the Water Act in 1975.

The new National Water Act in 1998 further defined the rationale for floodlines, so that people could better understand the risks they were exposed to. Brooker notes that there are also several different methods for calculating flood risks – ranging from statistical analysis developed in the 1960s to more modern computer-based models.

And because different engineers employ different models or approaches, this can result in significant variations in flood risk estimation for the same rivers and IMESA recognised that this was a problem.

"So, the idea was to develop comprehensive guidelines that would allow for more reasonable and consistent flood line estimation."

Brooker notes that basing development decisions around the annual probability of flooding (e.g. a 1:100 year chance of

Shawn Herbst

The Umgeni River in Durban in full spate in April 2022. However, many flood estimation methods were developed in the late 1960s or early 1970s. As a result, there are still no universally applicable methods for design flood estimation in South Africa and practitioners should use their experience and professional judgement in selecting the most appropriate methods for a specific design situation.

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flooding) is fraught with problems, so there should be more emphasis on the lifetime risks of flooding, rather than annual risks. Equally, it was unacceptable to allow people to establish shelters next to flood-prone rivers and streams because, if their homes were washed away, they were left with nothing.

"This is not a situation peculiar to Africa. Just look at countries like Bangladesh where up to 100 million people can be displaced by a sudden flood in low-lying areas. I believe there is certainly sufficient land available for housing in South Africa that would not expose vulnerable people to such hazards. If necessary, you can engineer some of the risks away or manage the catchments more effectively to reduce water flows and flow velocity," he notes, pointing to the stormwater guidelines that have been developed by municipalities in major cities to mitigate the risks of urban development.

While high-rise development was often promoted as a solution to reducing urban sprawl, cramming more people into high-rise developments could also lead to negative social costs such as an increase in crime levels. "From a flood management perspective high-rise development might be a solution, but planners should be conscious of the potentially negative social impacts."

Brooker suggests that a 1:100 floodline is a "good start" and a reasonable boundary line for the bulk of urban development, but more conservative guidelines (e.g. 1:500 year or even 1:1 000 year) were also needed for emergency response infrastructure such as hospitals and police stations as well as hazardous facilities such as petrol and diesel filling stations, with even stricter floodlines for nuclear power plants.

Brooker and his fellow authors stress that municipal planners should not focus on flood depth alone. They should pay equal attention to how fast the water flows and how quickly the water rises during a flood event. "You have to be looking at the potential impacts of ankle-deep or calf-deep water flowing at several meters a second compared to waist-deep water that is standing still. You have to look at both water depth and water velocity."

"Municipalities can still be held responsible if they cannot prove that they followed reasonable practices before accepting a developer's plan."

While car parks or sports fields are often seen as acceptable 'low-risk' developments in flood prone areas, Brooker notes that many urban rivers are highly contaminated with chemicals and sewage-borne pathogens that can be deposited on grass surfaces during a flood – and remain there for months afterwards. "There is also another dimension to flood plains – and that is their right to exist for ecological reasons and also to mitigate the impact of floods," he says, noting that nature reserves and large natural areas are very valuable ecological assets.

Ethekwini Municipality

Vegetation, plastic and other debris piled up beneath several bridges during heavy rains across Durban last year, destroying infrastructure or forcing flood waters to tear through homes built on low-lying land.

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From an ecological perspective, it was crucial for these natural areas to remain connected, a bit like beads on a string. "Though it can be hard to persuade developers to leave such areas off-limits to development, there is a very good case to be made for the maintenance of riparian corridors in urban areas."

Capacity and skills

The authors of the new guidelines caution that many municipalities do not even have qualified engineering technologists – so there is no capacity to assess the flood related work of established engineers. One of the aims of the guidelines is to provide sufficient knowledge to municipalities to assess whether they are complying with their responsibilities.

The new guideline further emphasises and describes the critical legal responsibilities of municipalities and municipal managers for flood management planning and awareness, and the required level of expertise for officials and appointed external practitioners. It is therefore recommended that design flood practitioners should be either a professionally registered engineer (Pr Eng), technologist (Pr Tech Eng), or natural scientist (Pr Sci Nat), all with the required experience in engineering hydrology.

The guideline notes that the calculation of floodlines is complex and can entail a considerable degree of uncertainty, and hence they should be undertaken only by suitably qualified and experienced practitioners. Although current legislation holds municipalities mostly responsible for ensuring that all development requirements are met, engineers also carry a professional responsibility. Nevertheless, it remains the responsibility of municipalities to apply proper professional judgement in appointing appropriately trained advisors to ensure a safe environment.

The National Building Regulations and Building Standards Act imposes further responsibilities on local authorities and the new guideline recommends that they should refuse any building plans unless they are satisfied that a new building is not a danger to life or property during flooding.

Bylaws in major cities such as Johannesburg, Durban and Cape Town stipulate that developers bear the responsibility to show the 1 in 100-year floodline on all building plans, but municipalities can still be held responsible if they cannot prove that they followed reasonable practices before accepting a developer's plan.

Regular floodline revisions

The authors note that it is not sufficient to rely on existing floodline determinations. They have to be updated constantly to account for changed land uses and development in rapidly expanding urban areas.

More attention is also needed to account for the impacts of global climate change, says Brooker. "We don't know exactly what climate change is doing with respect to flooding in urban areas, but we are already seeing indications of change in biological systems and some evidence of more energetic storms – so that is another uncertainty that we need to be aware of when updating the floodlines."

Groundup / Ashraf Hendricks

A flooded informal settlement outside Kraaifontein during a flood in 2021. Vulnerable communities living in shack settlements are often worst affected due to flood events.

Given these changes in climate, the team provides guidance regarding which storm rainfalls need to be used in the determination of future climate induced flood events. There has also been a dramatic increase in impermeable areas (paved or hard concrete surfaces) in several municipalities. This increase in impermeable surfaces means that flood water flows are now more powerful because they are no longer able to soak downwards into soft soil or grass surfaces.

A third factor was the changing nature of water courses over time, such as the construction of new bridges, erosion or build-up of sediments in river channels. "Even if a dam has been built upstream, I would caution against revising floodlines downwards," says Brooker. "Local authorities should be looking at the combination of land use changes within their catchments to establish whether existing floodlines are still relevant or appropriate."

As a rough guideline, he suggests any floodlines older than 10 years should be revisited, but a target of 5 years for an update is recommended in the guideline. Brooker believes it could be impractical and legally problematic to regulate the extent of impermeable surfaces for new or existing developments.

Rather than attempting to police and place limits on the percentage of property that can be paved, a more practical approach would be to require the installation and regular maintenance of flood attenuation structures around development complexes.

- The authors of the new guideline were Chris Brooker (CBA Specialist Engineers), Prof Kobus du Plessis (Stellenbosch University), Stuart Dunsmore (Fourth Element Consulting), Prof Chris James (University of the Witwatersrand), Prof Jaco Gerricke (Central University of Technology, Free State) and Prof Jeff Smithers (University of KwaZulu-Natal). To download the report, Visit: https://wrcwebsite.azurewebsites.net/wp-content/uploads/mdocs/TT%20921%20final%20web.pdf

WATER QUALITY

Project tackles dumped Durbs diapers

Nappies and other absorbent hygiene products are unquestionably convenient, but if disposed of carelessly can do considerable harm to human health, watercourses and the greater environment. Matthew Hattingh reports on an initiative to flight the blight.

Sharlene Versfeld

A 'stain treater' at a central Durban laundry, Vuyelwa Mangqinda has "seen some things" on the dirty piles of hospital and hotel linen that pass through her hands. But she can't afford to be squeamish. Jobs are hard to find and to stretch her modest wage further, she is quite prepared to up the yuck factor.The mother-of-two recently quit her room in an RDP house in Clermont, to the west of the city, for a shack closer to work, saving on transport about R50 a day.

I met Mangqinda outside a spaza shop on a steep muddy track that winds its way through Johanna Road, an informal settlement a few kilometres from the mouth of the Umgeni River. It was a Wednesday on a wet Durban November morning and Mangqinda, who works nights at the laundry, was off to bed in about an hour. Happy to chat first, she told how moving to Johanna Road, with its dirt and its stinks, had been hard at first. "I wanted to go back (to Clermont). I had to adjust," the 29-year-old said.

Like many Johanna Road residents, Mangqinda hails from the rural Eastern Cape. Her children, five-year-old Snothile and two-year-old Nwanzeko, stay with family, back home in Matatiele. She visits them when time and money allow.

There's no shortage of children, playful and curious, at Johanna Road. But it must be a trying place for their care-givers. And for those with babies, more so. If you need the toilet or to wash yourself or your clothes, you must either trudge up or downhill

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to one of two municipal ablution blocks. Fancy trying that at night with a mewling infant on your hip?

All of which brings us to the soggy point of this tale – disposable nappies. I had joined a few volunteers, women from Johanna Road, for a cleanup at the settlement. Coordinating them and providing bin bags, gloves and a municipal truck to take away the trash was a team from Green Corridors, an NGO involved in several environmental and social initiatives in greater Durban. The clean-up doubled as something of a launch for the next phase of a project, in partnership with Swiss university ETH Zürich, that seeks to better understand and stem the tide of dumped disposable nappies.

For evidence of the practice, you needn't look far. We had barely begun the cleanup when Nick Swan, Green Corridors' programme development manager, beckoned. He turned over some rubbish and there it was, plain enough despite the mud, a nappy.

Nappies, both for babies and incontinent adults, along with wipes, liners and menstrual pads, are designed to absorb and contain fluids. And because the plastic fabrics that let them do this so well do not biodegrade, nappies and pads once tossed can stick around for a long time, becoming breeding grounds for nasties like salmonella, cholera, protozoan cysts, hepatitis and HIV. These can find their way into water, and the nappies frequently clog waterways.

Swan told me he had previously worked on a project in Clermont to clean the Aller River and train eco-champs – environmental monitors. They discovered that nappies were often to blame for blocked sewers, causing wastewater that might otherwise be treated, to find other ways into groundwater, rivers and ultimately, the ocean. The blight of badly-disposed-of nappies, pads and the like (collectively known as absorbent hygiene products, or AHPs) isn't unique to Clermont or Johanna Road, and bedevils informal settlements across the city, the country and indeed, the world.

Mangqinda agreed that chucked disposables were trouble, but she couldn't see her contemporaries switching to traditional cloth nappies and other reusable alternatives. "Our generation can't wash," she said. In fairness, a big switch to reusables hasn't happened in the 'burbs either (although some initiatives, including those promoting bamboo fabric nappies, have attracted a following). Besides, in shack settlements, where washing facilities are limited and other priorities more pressing, it's always going to be a hard sell.

Jonathan Welch, a technical consultant to Green Corridors who also manages its KwaMashu Waste Beneficiation Centre, said the NGO would love to recycle nappies, provided it was found to be feasible. A start right now would be to set up a network to separate nappies and pads from other waste, so that these could go for proper disposal at municipal landfill sites. This initiative would hinge on a campaign to encourage people to change their behaviour.

Sharlene Versfeld

Dedicated nappy bins are being installed at the Johanna Road informal settlement in Durban. Assisting with the project are (left) Dominik Huber, of ETH Zürich university, and Green Corridors consultant Jonathan Welch.

Matthew Hattingh

Vuyelwa Mangqinda, who lives at Johanna Road, pauses to chat on a steep path outside a spaza shop. The mother-of-two agrees disposable nappy pollution is a serious problem but doesn't see her generation switching to washable alternatives.

Green Corridors wanted to see an end to "flying toilets" – the plastic bags of human waste that get flung into bushes and streams in informal settlements. To prevent pads clogging Johanna Road's toilets or nappies piling up at its 35 informal dump sites, dedicated bins were being installed, as well as at the project's other site, the Blackburn Village informal settlement north of Cornubia Mall.

Green Corridors workers would empty the ***Inhlanzeko*** (it's clean) bins regularly and record and weigh the contents to be sent to landfills. Bin locations have been identified and mapped (using smartphone geolocation technology), building on the findings of a study of the two settlements by Timo Stutz, a mechanical engineering Master's student in the Chair of Global Health Engineering at ETH Zürich.

We will take a brief look at his study, made public earlier this year. We will also touch on a study by Dr Jurgita Slekiene, of the University of Zürich, and colleagues that found a correlation between the unsafe disposal of soiled nappies and pads, and the mental health of residents of the two settlements, as well as Mzinyathi, a settlement on tribal authority land east of Inanda Dam.

Let's first look at the special nappy bins, the baby, as it were, of Dominik Huber, a mechanical engineering student, also from Global Health Engineering at ETH Zürich. Huber, who's helping plan and install the network of bins and their management for his own Master's. Then, turning to the bins with his team, he set about laying small concrete foundations to support the South African-made plastic bins, which are located around the perimeter of the Johanna Road settlement.

How much waste was expected? Would the bins be sufficient? Was it realistic to expect people to pick their way across the settlement to use them? How often should they be emptied? These and other questions were raised as the volunteers gathered beneath a small marquee to catch their breath after the cleanup and take refreshments. They told Huber that emptying thrice weekly was do-able. He reminded them this was a pilot project, which sought to learn what worked and what didn't. Someone asked if there was anything to stop the bins being stolen. They would be bolted to the concrete, Huber replied.

We got a better feel for a few of these practicalities two days later when the work shifted to Blackburn Village, where there's a bit more room between the shacks. While Johanna Road perches precariously on a shale-and-mud hillside only a few kilometres from central Durban, Blackburn is on the city's periphery, amid rolling sugarcane fields. If you've driven between Durban and King Shaka International Airport, you've likely seen the place. You would have passed beneath the imposing cable-stayed pedestrian bridge that spans the N2, linking Blackburn, to the west of the highway, with affluent Umhlanga Ridge.

With the rains passed, it was agreeable to sit at the roadside in Blackburn and watch Huber and his team at work while taking in the views. In the distance, across the cane and towards the sea, "lifestyle apartments" (for sale from R2.3-million) have gone up on a hillside overlooking the highway. Near us, people were queueing at one of the settlement's few working taps. At

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Matthew Hattingh

Nick Swan, Green Corridors's programme development manager, at one of the 35 informal dumping sites identified at Johanna Road.

eight selected sites in Blackburn, Huber, interns Vuyiswa Khwela and Mbali Dlamini, and Siya "MC Hammer" Simbine, of the beneficiation centre, built the concrete bases for the bins.

Over the past two years the project has involved considerable community engagement, particularly in the training of local fieldworkers and more recently community health workers. Still, a few residents had no idea what the Green Corridors team was up to.

Towards the east of the settlement, the team pushed their wheelbarrows along a muddy track. Some 200-metres from the Ohlanga River (in the news in recent years for polluting Umhlanga's upmarket beaches) they halted at an open patch and set to work. Soon the sounds of digging brought a man out of his shack. Naked from the waist up, he appeared to have been busy shaving, because his scalp was lathered in soap. The man introduced himself, shook hands and listened politely as the team filled him in. He asked if there might be work for him and took the news that there was not with good grace.

Sadly, jobs are in short supply in Blackburn. As is reliable data on household solid waste, necessary for planning the project. To remedy this, as Stutz explained in his paper, "Bin it – Design of an AHP waste collection model for informal settlements in South Africa", he did a mapping exercise with Green Corridors fieldworkers drawn from the settlement. They went out on foot to get the lie of the land, pinpointing dumping sites and estimating their size.

Matthew Hattingh

Green Corridors facilitators Amina Keneta and Okuhle Mdutshane at Johanna Road.

Matthew Hattingh

From left, Dominik Huber, of ETH Zürich university, Siya 'MC Hammer' Simbine, and Green Corridors interns Mbali Dlamini and Vuyiswa Khwela shovel concrete to build a small foundation for a nappie bin at the Blackburn Road settlement.

Stutz and his team sampled solid waste at 151 households in Johanna Road and 82 households in Blackburn Village. The waste was sorted into 12 categories. It was found that the average Johanna Road household generated 2.47 kg of solid waste a day, with AHP waste making up 21.2% of this. In Blackburn, the figures were 0.85 kg/household/day, 43.6% of which was AHP waste. Both settlements have an estimated 700 households.

Stutz detailed some of the difficulties the study faced and offered explanations for why the figures for the settlements differed markedly (and in comparison, with the literature). Nonetheless, the findings helped him to determine that Johanna Road would need AHP bins with a total capacity of 4 060 litres/week, while Blackburn, needed 3 820 litres/week, preparing the way for the next phase of the project.

Stutz and Huber's work has been enabled by support from Green Corridors and Kimberly-Clark, the Texas-headquartered personal-care multinational company whose products include the popular Huggies brand of nappies. They also also supported Slekiene with 'Absorbent Hygiene Products Disposal Behaviour in Informal Settlements: Identifying Determinants and Underlying Mechanisms in Durban, South Africa,' which she co-wrote with Dr Marc Kalina of ETH Zürich, and Swan.

The paper explored psycho-social factors around the disposal of nappies. It surveyed 492 care-givers in Johanna Road, Blackburn and Mzinyathi, 93.1% of whom reported using disposables; nine-tenths of whom were women; and the largest proportion of whom, 38.9%, were in the 25-29 age group.

A questionnaire was used to detect psychological distress and to establish the respondents' understanding of the health risks and environmental consequences of unsafe disposal of nappies. It emerged that one-third of caregivers did not dispose of nappies sanitarily but intended to do so (86.9%). Moreover, caregivers with poor mental health (one in five of those surveyed) were "less likely to dispose of AHP sanitarily", confirming the literature.

The connection was considered particularly relevant within South Africa, "where the prevalence of mental disorders is particularly high (30.3%)". Slekiene and her co-authors hoped their work would inform "a future, contextually appropriate and sustainable, collection system". Such a system is now coming to Blackburn and Johanna Road.

Different bin designs are being trialled at the two settlements, but perhaps more importantly, different methodologies for fostering behavioural change are being tested. This includes providing incentives and training community health workers, who will visit caregivers at their homes and arrange community meetings to share information about the project and answer questions. Green Corridors teams will soon be rolling out WhatsApps, stickers, posters and videos to drive home the safe nappy-disposal message and encourage personal responsibility. It may be too early to foresee an end to dumped disposables and flying toilets, but things are certainly off to a flying start.

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BIODIVERSITY

In living colour – South African aquatic scientists make a splash in biodiversity campaign

A new age of satellite remote sensing is upon us. High-tech sensors capable of imaging the earth at over 100 spectral wavebands are now a reality. These sensors, known as hyperspectral radiometers, capture very fine spectral features of the colours emitted from the surface of the earth and its water bodies, offering opportunities for improved satellite-based environmental monitoring. South African researchers are primed and ready to make use of these new technologies to derive water quality parameters from hyperspectral radiometric measurements by applying it towards monitoring our diverse estuaries, dams and oceans. So writes Lisl Lain and Marie Smith of CSIR.

Bradclin Photography / Flickr

Famous for its biodiversity, South Africa displays corresponding diversity in ecosystems, as well as extraordinary dynamism within the aquatic realms. Water bodies can change dramatically overnight or during the course of a few days – for example when a coastal embayment turns green, brown or red when microscopic algal blooms, or 'red tides', are present. Pressure on the healthy ecosystem functioning of our coastal and inland waters is undoubtedly rising, with difficult challenges arising for governing and management agencies as South Africa experiences the impacts of extreme weather events, as well as increased drinking water demands by a growing population. The routine acquisition of satellite data, and the ability to retrieve water quality parameters from these data, provide the grounding for a far better understanding of our unique geophysical and ecological systems and their dynamics.

Aquatic remote sensing relies on the principle that the colour of any water body is determined by the type and amount of the

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particles that are present inside of it, and results from the way that these particles interact with light. These particles usually consist of things like sediments, plant matter, algae, or dissolved substances, all of which differ in the way that they scatter and absorb light in the visible range observed by the naked eye. Any variation in the presence or concentrations of these particles, or if the bottom substrate is visible in shallow waters, can affect the colour of the water. Hyperspectral radiometers are able to capture the very fine spectral features of the water's appearance, providing unprecedented detail of water colour and facilitating huge potential for improving the retrieval of water quality parameters and constituent concentrations.

The water colour signal is best understood using ***in situ*** measurements in combination with theory or modelling, and most valuable of all, coincident in-water measurements of individual parameters with surface, airborne and/or satellite radiometry. This allows the radiometric signal, or light spectrum, to be decomposed into its different parts, i.e. the concentrations and types of water constituents, which in turn supports the development of algorithms that are capable of reliably and routinely deriving these information from future radiometric measurements.

NASA's BioSCape hyperspectral airborne campaign (Western Cape Greater Floristic Region, October and November 2023) provided the ideal springboard from which to launch a comprehensive field campaign covering a variety of very different aquatic sites, in pursuit of these coincident measurements. Integrated teams of USA and RSA researchers provided instrumentation and expertise, with 'Gizmo', the CSIR's hyperspectral radiometric buoy, as the star of the show. Gizmo – the only buoy with these measurement capabilities in Africa – was deployed in Theewaterskloof Dam for the duration of the campaign, making continuous measurements of water colour and providing surface validation data for the airborne sensors and atmospheric correction processes.

Sentinel 2 colour images of Rietvlei, Milnerton (Cape Town) taken on the 22nd and 27th of September 2023, before and after a significant rainfall event. Credit: European Union Copernicus data processed with EO Browser.

The routine acquisition of satellite data, and the ability to retrieve water quality parameters from these data, provide the grounding for a far better understanding of our unique geophysical and ecological systems and their dynamics. Internationally funded environmental satellite missions offer such routine and freely available space-based data. However, due to the highly absorbing nature of water, it can be very challenging to accurately measure the colour of aquatic targets from space. Since water bodies are much darker than land and plants, satellite sensors need to be specifically designed to be sensitive enough to detect even the smallest variations in the colour of the water.

In addition, the water signal detected by the satellite can also be contaminated by sun glint or light signals reflecting off of the surrounding land, clouds and atmosphere, and need to be removed or corrected before it can be useful. One of the most highly anticipated satellites due for launch in early 2024 is the hyperspectral Plankton, Aerosol, Cloud, ocean Ecosystem (PACE) mission from the National Aeronautics and Space Administration (NASA). PACE is specifically designed to provide detailed information of the global ocean and will provide daily coverage of the globe at spatial resolution, or pixel size, of one kilometer. The PACE satellite also consists of different sensors that help to correct the water-leaving signal for influences from the atmosphere.

Michael Walker

Gizmo, Africa's only hyperspectral radiometric buoy, deployed in Theewaterskloof Dam.

BioSCape is a collaborative research project focusing on the assessment of biodiversity in the Greater Cape Floristic Region, built on deep scientific engagement between South Africa and the United States. The project is funded by NASA, the South African government's National Research Foundation (NRF) and South African Environmental Observation Network (SAEON), as well as the United Nations Educational, Scientific and Cultural Organization (UNESCO). The aquatics teams, comprising both inland and coastal sites, persisted through temperamental Cape weather and very challenging logistics to ensure sampling took place at a minimum of 8 different sites, culminating in the achievement of an enormously valuable dataset encompassing a wide variety of in-water parameter measurements coincident with overflight data, as well as opportunistically satellite overpasses.

The unusual diversity in water types and constituent composition make this a very exciting and useful dataset. The teams measured

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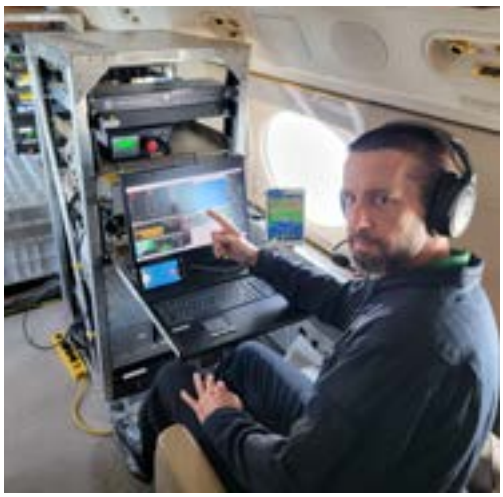
The BioSCape Aquatic sites represent an extraordinary diversity of environments, from algal bloom-vulnerable coastal areas to dynamic estuaries and inland freshwater bodies, both natural and man-made. Measurements made represent an unusually wide spectrum of conditions for one campaign, providing data which will ultimately support a range of applications including algal bloom monitoring and management, drinking water quality assessment, and ecosystem vulnerability mapping.

Photo by Rob Switzer



This photo and one to the left by Samantha Sharp

In-air measurements are taken over the water body by the NASA aircraft (left), while simultaneous radiometric measurements and water samples are collected by boat (middle), which are subsequently analysed in the lab (right).

clear, coastal waters with a fascinating array of algal types in a variety of marine environments; sediment-dominated Theewaterskloof dam waters, cyanobacteria-dominated urban vlei waters and the dark clear waters of the Klein River Estuary typified by high concentrations of dissolved tannins.

The full suite of measurements includes phytoplankton pigments and type, suspended solids, dissolved substances, particulate absorption and backscatter over a range of different water types, providing both validation data for existing satellite water quality retrieval algorithms, as well as parameterisation for new models and algorithms under development by South African scientists.

By leveraging the biodiversity focus of BioScape, the aquatics teams were able to go above and beyond the stated science objectives and collect optical data of a wide range of both living and non-living in-water constituents. This comprehensive approach to characterizing the full spectrum of water colour components is of enormous value to the international "optically complex waters" research community as well. All data from the BioSCape campaign will be made publicly available.

To learn more about the BioScape campaign, visit: https://www.bioscape.io/science

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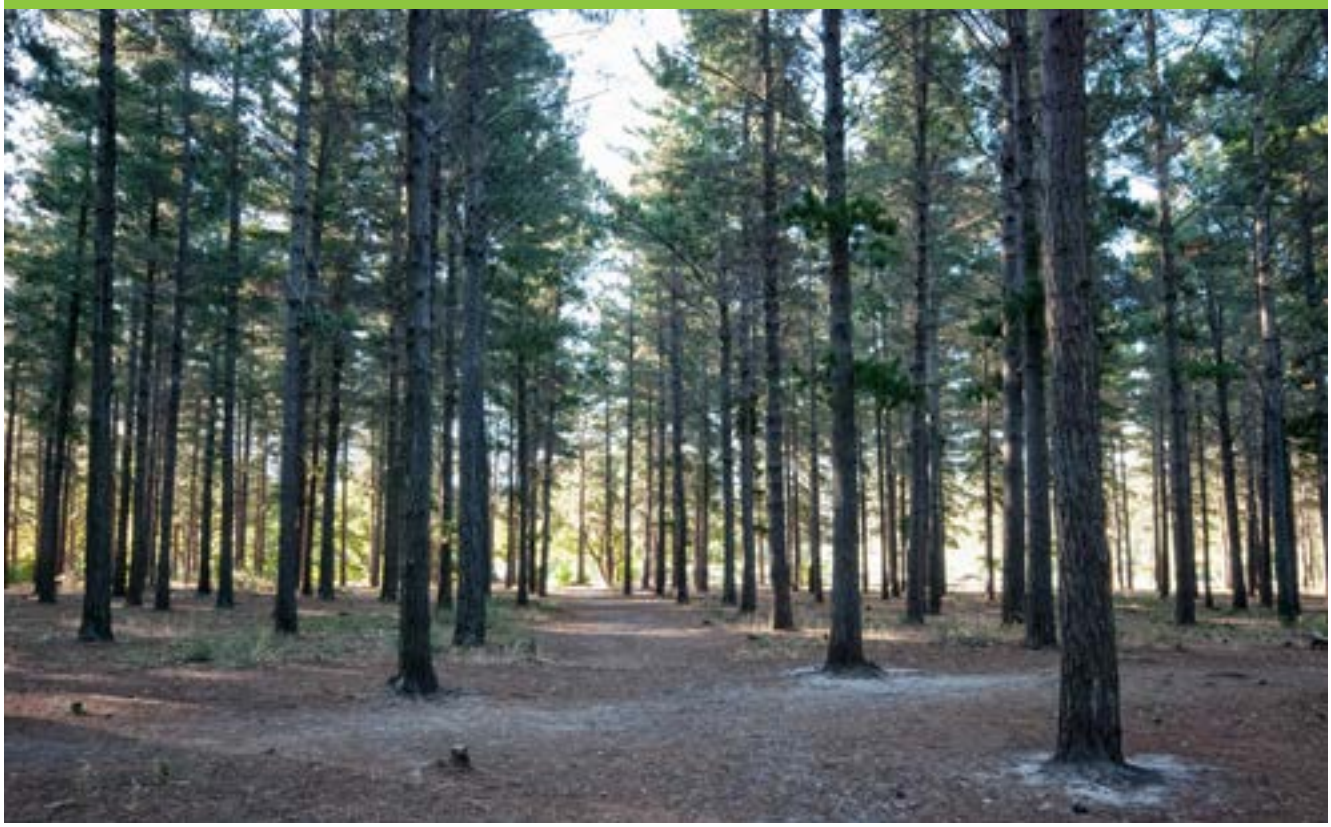
WATER AND FORESTRY

Forestry – Boon or bane for the Western Cape?

Most of the State forestry plantations in the Western Cape have been clear-felled over the past decade, but some are set to make a comeback – or are they? Sue Matthews reports.



More than 20 years ago, environmentalists in the Western Cape were overjoyed when government announced in September 2000 that its pine plantations in the province would be phased out. The region was experiencing a drought at the time, and commercial forestry was under renewed scrutiny, having been accused for decades of reducing runoff and then declared a streamflow reduction activity in the National Water Act just two years previously. And since the launch of Working for Water in 1995, the threats posed by invasive plants in the Cape Floristic Region – in terms of their water use, fire risk and biodiversity impact – had been repeatedly highlighted. Pine trees were by no means the only culprits, but vast tracts of mountain fynbos had been invaded by plantation escapees.

Fast forward to the end of 2022, when the Department of Forestry, Fisheries and the Environment (DFFE) issued a call for proposals from investors to lease plantations in the Western Cape representing half of the total area originally intended to be phased out. In the intervening years, much has transpired, and today many environmentalists consider this a positive development. Forestry stakeholders, on the other hand, generally feel it is too little, too late, and there will be harsh repercussions for the sector for years to come.

The decision to phase out the plantations, known as the Westen Cape Exit Policy or Cape Conversion Process, was primarily because they were viewed as not commercially viable – trees grew very slowly compared to other regions, so could only be harvested after 30 years or more in some parts. In 1999, when the plantations – then managed by SAFCOL – were put out

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to tender, no bids were received for the south-western Cape's Boland area package, and the preferred bidder for the southern Cape package withdrew from negotiations in mid-2000. This, on top of the environmental concerns, presumably resulted in the knee-jerk announcement a few months later of a phase-out, which was approved by Cabinet a year later.

The plantations still needed to be managed until the trees were ready for harvesting, though, so the Boland and southern Cape packages were combined as the Mountain to Ocean package and taken on by MTO Forestry (Pty) Ltd, which began as an entity of SAFCOL but was later privatised. Part of the agreement was that 15 000 ha in the Boland area and 30 000 ha in the southern Cape would be phased out over 20 years and converted to other land uses such as conservation, agriculture and human settlement. In addition, an agreement was reached with SANParks to incorporate the Tokai and Cecilia plantations on the Cape Peninsula into the Table Mountain National Park, with harvesting to be completed by 2024.

Shortly after MTO took over, a fire in the Tsitsikamma area in 2005 destroyed a massive swath of plantations, which prompted MTO to motivate for a review of the phase-out decision on the basis that socio-economic impacts and future timber shortages had not been adequately considered. The then Department of Water Affairs and Forestry (DWAF) commissioned a review by the VECON group of consultants, who found that some plantations were more commercially viable and/or socio-economically important than others, and made recommendations for specific areas to be retained.

In light of this, in 2008 Cabinet approved the partial reversal of the exit policy to allow replanting on almost 22 500 ha – half of the 45 000 ha originally identified for phasing out – once MTO had harvested the current rotation and handed the land back as per the 'exit lease' agreement. In 2014 the Industrial Development Corporation, on behalf of the then Department of Agriculture, Fisheries and Forestry (DAFF), commissioned Louis Heyl & Associates (LHA) to evaluate the feasibility of the reversal and the most commercially viable options for implementation. The study recommended that the total reversal area should be split into five packages – Boland, Jonkersberg, Bergplaas, Homtini and Buffelsnek – and that replanting should start as soon as possible.

Then the process stalled again, despite some progress being made. In 2015 DAFF signed a two-year agreement with MTO to replant approximately 2 000 ha by the end of 2017. In 2016 DAFF commissioned a land rights enquiry, since the 1996 White Paper on Sustainable Forest Development in South Africa recognised that some plantations might be subject to land claims. And because both the White Paper and National Forest Act promoted community forestry, which the LHA report had recommended would best be achieved by entering into community forestry agreements with community trusts, DAFF began organising the identified beneficiaries to form community trusts in 2018, and the following year facilitated community meetings on trust deeds and the election of trustees. In June 2019 the Forestry Branch was moved from DAFF to the new DFFE, which probably caused further delays, and Covid lockdowns no doubt put any community work on hold in 2020.

In the meantime, MTO had concluded its exit in October 2020, with much of the land handed back some years previously, and most of the trees that had been replanted having been lost to the devastating fires in Knysna in 2017 and George in 2018.

When the tender to lease the reversal areas was finally advertised in mid-December 2022, with a closing date in the first week of February, the plantation packages were essentially those recommended in the 2014 report. The Boland package (7 053 ha) is made up of portions of the Grabouw, La Motte, Hawequa and Kluitjieskraal plantations, and there are four separate southern Cape packages at Jonkersberg (4 106 ha), Bergplaas (4 868 ha), Homtini (757 ha) and Buffelsnek (4 507 ha), altogether totalling 21 291 ha.

Five bids were received by the closing date in February, but the tender for the Boland package is to be readvertised. It is not clear whether this is because none of the bids met the qualifying criteria, or because no bids were received for that package. The MTO-owned Stellenbosch Sawmill closed at the end of 2015, and none of the small sawmills still operating in the Boland area would have capacity for large-scale timber production. This means that logs would either need to be trucked to the sawmills in the Garden Route, or a new sawmill built at a cost of hundreds of millions of Rand, according to the Executive Director of Sawmilling South Africa, Roy Southey. It's unlikely that any investor would consider that financially viable given that the lease is for a 50-year period and the four plantations making up the package were clear-felled, so it may be at least 20 years before newly planted trees are ready to be harvested.

Another complicating factor is that portions of the cleared Grabouw plantation were illegally occupied in a 'land grab' in December 2020 by a group identifying as Khoisan descendants, and by the time the tender was advertised two years later the settlement of 'Knoflokskraal' had grown to between 2 500 and 4 000 people. Minister Barbara Creecy had already indicated that DFFE would be releasing the land back to its owner – the Department of Public Works and Infrastructure – and had abandoned plans for any form of forestry there, given that the Knoflokskraal community were not interested in a community forest agreement. It is unclear whether any other portions of the Grabouw plantation have been retained by DFFE, as VECON had recommended replanting 4 686 ha of its total 7 173 ha. However,

The Boland package – made up of portions of the Grabouw, La Motte, Hawequa and Kluitjieskraal plantations – and the four southern Cape packages lie within the Boland and Outeniqua Strategic Water Source Areas, respectively.

Part of the Grabouw plantation in May 2020 (left), following MTO's exit and handover in September 2019, and in January 2023 (right), after the land was illegally occupied in December 2020. This is just a small part of the much larger area now settled by the Knoflokskraal community, and DFFE has abandoned plans for forestry there.

some of those portions are adjacent to the town of Grabouw, where there are over a dozen informal settlements with a long history of land invasions. At Wolsley, some 80 km to the north as the crow flies, part of the Kluitjieskraal plantation has also been illegally occupied.

"There's a big concern that it will happen elsewhere," says Dr Brian van Wilgen, who originally studied forestry and nature conservation but made his mark researching the impacts of invasive alien vegetation in fynbos. "Unless you have some viable form of land use and a means to protect the land, there's going to be a risk from this kind of thing."

A preferred bidder was selected for the Outeniqua area, but negotiations were still taking place at the end of November, and it was not revealed whether the lease was for all four packages or only one or two. The preferred bidder was the only one of the five to include a community partnership, even though the final of four objectives listed in the advertised tender document was "partnership with communities who have tenure rights and are resident in former forestry villages and the surrounding areas". Of course, organising such partnerships in a little more than a month and a half over the Christmas holiday period was a tall order.

"It's not the impact of the plantation on water resources so much as the impact of the invaded catchment of the plantations that's the big worry."

MTO Forestry did not tender for any of the packages and will instead focus on its so-called sustainable lease areas, where the lease expires no earlier than 2075. Apart from Jonkershoek in Stellenbosch, which was ravaged by fire in February 2021 but is to be replanted, these include a few small plantations in the Outeniqua area and much larger ones in the Tstsikamma area, east of Plettenberg Bay.

The forestry and wood products sectors have long been champing at the bit for the exit reversal areas to be replanted because there is already a dire shortage of logs in the Cape, but environmentalists and others familiar with the southern Cape landscape see the benefit now too.

"There's a number of issues – one is the roads," says Cobus Meiring of the Garden Route Environmental Forum. "If you don't take care of them, they become erosion channels. There was one in Bergplaas deeper than I am tall, so I don't know where all that soil is washing away to! Some of the areas have become very seriously infested, and massive amounts of clearing will need to be done before replanting can start. We need a responsible landowner that has the funding to manage the land, and the two main forestry companies here, MTO and PG Bison, have been really good in taking their environmental responsibilities seriously."

The four plantation packages that were offered for leasing all lie within the Outeniqua Strategic Water Source Area, which supplies water to the Garden Route – an area that has experienced its share of droughts. But the potential streamflow reduction is no longer considered a reasonable justification to prevent their replanting.

"It's not the impact of the plantation on water resources so much as the impact of the invaded catchment of the plantations that's the big worry," says Van Wilgen. "If you're running a forestry plantation properly, you're using water but you're getting a product for it. With the invasions you're getting nothing for it except damage – damage to the soil, damage from fires, damage to biodiversity."

Plus, of course, invasive trees in riparian zones along rivercourses and in wetlands are likely to use more water than pines in plantations, where a buffer of at least 20 metres is normally maintained between the outer boundary of a riparian zone or outer edge of the temporary zone of a wetland, in accordance with DWS guidelines. This requirement is included in the Forestry Stewardship Council (FSC) National Forest Stewardship Standard for South Africa as well as the Forest Management Standard of the South African Forestry Assurance Scheme (SAFAS), which has been endorsed by the Programme for Endorsement of Forest Certification (PEFC). Both standards require forestry companies or small-scale owner-managers to show that they are implementing measures to restore wetlands and riparian zones and to control alien invasive species. Forestry South

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Africa's 'Code of good practice for managing alien and invasive species', compiled and updated by a team led by John Scotcher to incorporate the 2021 NEMBA: Alien and Invasive Species Regulations, is no doubt helpful in this regard.

Nowadays it's the fire risk associated with self-seeded pines and other alien invasive vegetation on the forestry exit areas – both those that have been made available to conservation authorities and the reversal packages to be replanted if and when the leases are agreed – that is the chief concern in the Garden Route.

The threat, which was comprehensively discussed in a 2011 paper by Kraaij, Cowling and Van Wilgen in the ***South African Journal of Science***, was starkly brought home by the 2017 and 2018 fires. Since then, DFFE and the Working on Fire Programme launched the Forestry Support Programme in December 2019, with the objectives of ensuring compliance with the National Veld and Forest Fire Act, protecting government plantation assets, reducing fire damage and spread, and creating employment for surrounding communities.

But what it's achieving is not nearly enough, says President of the Southern African Institute of Forestry, Braam du Preez, who lives in George. "The Forestry Support Programme are doing some basic fire protection actions, primarily making fire breaks, but to the best of my knowledge they're not doing much to address the build-up of fuel loads, areas becoming overgrown with alien invasive vegetation, and deterioration in the infrastructure due to heavy rains."

He explains that bridges have been washed away by flooding in places and some roads are littered with trees blown over by galeforce winds, hampering the ability of firefighters to get in with their equipment should a fire break out. This means that residential areas adjacent to the exit areas will be completely exposed if a fire coincides with bad weather conditions.

"It's all fair and well to say the land must go to the conservation organisations, but they're in even a worse state than the forestry companies – they haven't got money."

The Garden Route National Park, declared in 2009, initially comprised the region's indigenous State Forests and mountain catchment areas that DWAF inherited from the Department of Forestry, with the Tsitsikamma and Wilderness National Parks and the Knysna National Lake Area added two years later. The park's 2020–2029 management plan, completed in mid-2019, indicates that more than 10 000 ha of plantation area had by then been transferred from MTO to SANParks, and there is a plantation exit landscape restoration plan that is updated annually, following assessments of the areas exited.

The provincial conservation authority, CapeNature, was also allocated State Forest Reserve land in the region, back in 2006, but has since been offered 20 parcels of forestry exit area totalling 12 621 ha, according to the 2023–2033 management plan for the 'Garden Route Complex World Heritage Site and Nature Reserves'. The Garden Route Complex is conservation land that was included in the existing Cape Floral Region Protected Areas World Heritage Site in 2015, and consists of CapeNature-managed protected areas together with the SANParks-managed Garden Route National Park. One of the goals stated in the management plan is that all forestry exit areas and other identified state land will have been transferred and secured into the conservation estate by 2033.

This is a long way off, and in the meantime the protected areas of the national park and provincial reserves are a patchwork of fynbos, indigenous forest, and forestry exit areas in various states of recovery and alien infestation, interspersed with privately owned plantations, farmland and urban areas. That makes things very difficult from a fire- and biodiversity-management perspective, particularly since fynbos does best when burnt on a 10–20 year cycle, while foresters have historically done more frequent controlled burns on land adjacent to plantations to keep the fuel load low.

It is widely understood now that the battle against invasive alien plants is being lost. Although Working for Water has spent considerable sums of money on control operations, studies detailed in a number of reports and papers by Van Wilgen and co-authors have estimated that alien plant invasions are spreading more rapidly than they can be cleared. While there has been progress in some areas, the outlook for reducing invasions to manageable proportions in areas like the Garden Route is not good.

Asked whether it is preferable to replant the reversal areas rather than having unmanaged areas invading river corridors and fynbos, Van Wilgen replies: "It's no use shutting the stable door after the horse has bolted. The mountains are already invaded with pines that came from previous plantations, so if you put some of those plantations back where they were, there could be an argument for saying that's better than just leaving them, because at least you're creating some value. It's more complex than that, because you're then creating an additional seed source, which will mean the catchments will become more quickly invaded than they would have had the plantations not been there."

"The ideal would be to return some of these areas to nature conservation, with proper budget to rehabilitate them, but we know that's unlikely to happen," he says. "They should never have planted trees there in the first place."

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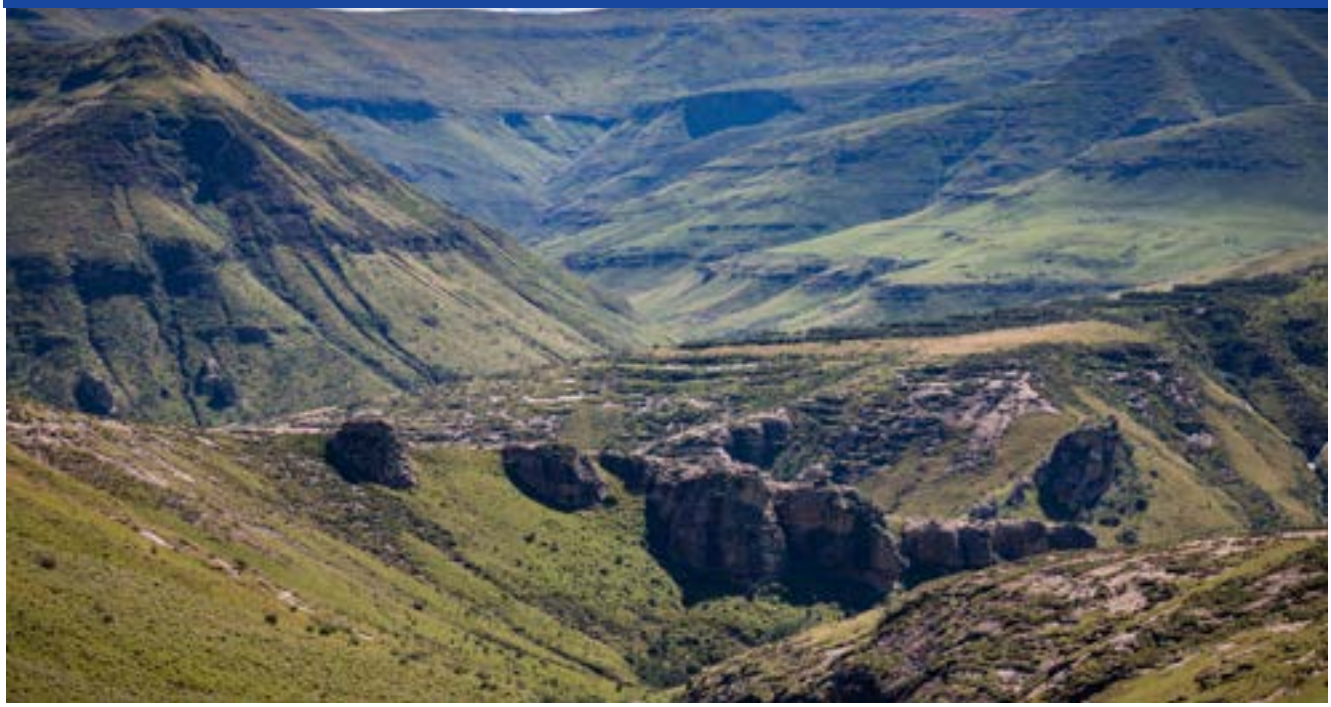
WATER AND THE ENVIRONMENT

New protection area offers valuable lifeline for South Africa's grasslands

A South African multi-stakeholder protected area sets an example for the conservation of a globally endangered biome. Article by Petro Kotzé.



Angus Burns

Grasslands are one of the most prolific habitats on Earth. Depending on the definition, they cover between 20% and 40% of the world's land area. Mostly because of its agricultural potential, the biome is also one of the fastest to have been converted. The tropical grasslands, savannas, and shrublands biome is now one of the planet's most endangered, while temperate grasslands are considered the most altered terrestrial biome on the planet.

The key to securing grasslands, and the knock-on benefits they provide, is the integration of agriculture and conservation in these biodiversity-rich landscapes, says Thembanani Nsibande, Manager of the Grasslands Programme at WWF South Africa. South Africa already has a long history of grassland conservation, practiced through a mix of formal protection, policy and collaboration with different landowners. The latest, and arguably most ambitious effort is taking place in collaboration between WWF, SANParks and other stakeholders, and entails the establishment of the 30 000-hectare Grasslands National Park in the mountains of the Eastern Cape close to the Lesotho border. The park will be established in a working agricultural landscape through voluntary stewardship agreements with both communal and private landowners.

When it was announced by SANParks in 2021, then-acting CEO, Dr Luthando Dziba, said that "the establishment of this national park will mark a new and innovative approach to protected area expansion."

Over and above the combination of different land uses,

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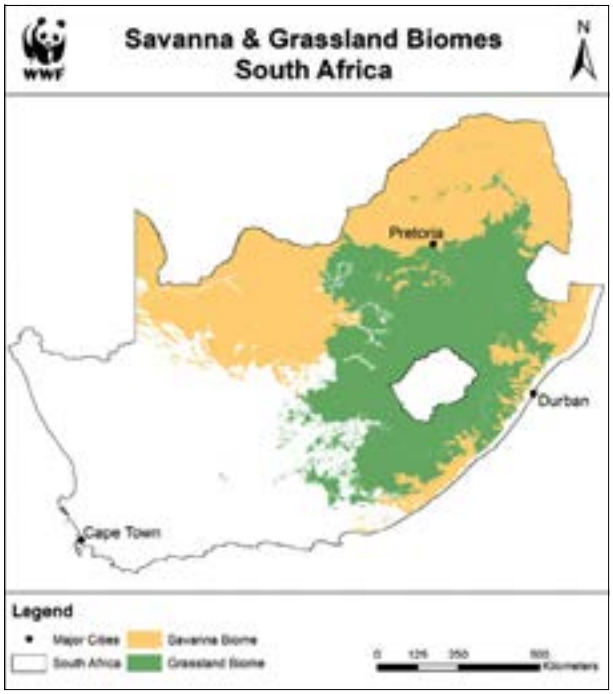
the new national park will contribute to the protection of one of a strategic water source area, which is an area that supplies a disproportionate amount of mean annual runoff to a geographical region of interest. While these areas cover about 10% of the country's land surface, they generate 50% of the country's water to support the economy, the people and agriculture. "They are regarded as our national assets," Nsibande says and, he adds, without healthy catchments these areas will be compromised with serious implications for water security. "Thus, healthy grasslands play a significant role as functional ecosystems providing clean water for many South Africans."

Yet, conserving these areas is challenging, involving multiple stakeholders and land owners with competing demands on the land. Nevertheless, good progress has been made and, Nsibande says, they anticipate that a notice of an intention to declare the protected area, initially around 10 000 hectares, will be published by the Minister of the Department of Forestry, Fisheries and the Environment in the first half of 2024. When so, the country will take one more step towards the conservation of one of our country's, and the planet's, most poorly protected terrestrial ecosystems.

A short overview of grasslands

Grasslands occur in almost all climatic zones except for the poles, extreme arid zones and the highest mountains. Fundamentally, a grassland consists of grasses and grass-like plants. Vegetation height varies from under 0.3 m to over 2.1 m, with roots extending 0.9 to 1.8 m deep into the soil. Grassland plants have evolved to cope with climatic extremes, specific soil conditions, fires and herbivory. These elements sustain the biome because they limit the establishment and dominance of woody vegetation.

Grasslands are commonly divided into temperate and tropical and subtropical grasslands. Temperate grasslands commonly don't have trees and large shrubs, like the Eurasian Steppe, central North American prairies and plains, the pampas lowlands of South America, the Patagonian Steppe and 'veldt' here in South Africa.



Source: WWF

Tropical and subtropical grasslands or, savannas, are scattered with trees and are found in Africa and Australia, but also the north of South America, the southern United States, South Asia and Southeast Asia.

In South Africa's nine official biomes, the Savanna (subtropical) and Grasslands biomes are split, with grasslands slightly smaller than savannahs, which is the country's largest. The Grassland Biome of South Africa, Lesotho and Swaziland covers an area of over 360 589 km^2 (28% of the land area) straddling the high central plateau of the highveld in South Africa, the mountainous areas of Lesotho, and the high-lying ground of the eastern seaboard (including the uplands of KwaZulu-Natal, Eastern Cape, and Mpumalanga).

Grasslands globally are some of the most species-rich habitats on Earth, including many endemic, rare and endangered ones. In the Southern Africa Grasslands Biome, the topography varies broadly, and ranges from flat to the highest mountain in southern Africa, Thabana Ntlenyana at 3 482 m above sea level. The biome includes four bioregions, namely the Drakensberg Grassland, the Sub-escarpment Grassland, the Dry Highveld Grassland and the Mesic Highveld Grassland, as well as three centres of plant endemism. These are the Drakensberg Alpine Centre, the Wolkberg Centre and the Midlands Putative Centre. Three more centres of plant endemism are shared with the Savanna Biome. These are Barberton, Sekhukhune and Soutpansberg Centres. The biome also includes three World Heritage Sites, namely the uKhahlamba Drakensberg; Cradle of Humankind and Vredefort Dome.

The habitats provide several integral functions to life on Earth. They are essential for climate mitigation, as they store carbon in their extensive root systems. They are often the source of, or support, many of the world's biggest rivers and wetlands. "Healthy grasslands act as a sponge and blanket for covering and protecting the soil, catching, and releasing clean freshwater into rivers and wetlands for the benefit of both upper catchment and downstream users," Nsibande says.

A biome rich for the pickings

The combination of underground biomass with moderate rainfall tends to make grassland soils very fertile and appealing for agricultural use. Major loss of natural grasslands due to their conversion to croplands started at the beginning of the 19th century, with the largest declines seen in the North American prairie (up to 99%), the pampas of South America, and steppes in Europe, middle Asia and in the Mediterranean region.

According to the WWF's 2023 ***Plowprint Report***, which analyses the rate of grassland plow-up across the US and Canadian portions of the Great Plains, close to 6 500 km^2 of grasslands were destroyed in 2021, contributing to a total of nearly 130 000 km^2 ploughed across the region since 2012. The Northern Great Plains region of the ecosystem, the report elaborates, is currently one of the world's last four intact temperate grasslands, and the annual area ploughed increased from 2020 to 2021.

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Angus Burns

Strategic water resource areas make up only 10% of South Africa's land area, yet provide 50% of our water. Only 12% of these areas enjoy formal protection.

The report further states that there is still an opportunity to change course, because more than 1.5 million km^2 across the Great Plains remain in grass cover, managed by private landowners, native nations, and federal entities.

In the tropics, the loss of grassland has been lower compared with temperate grasslands (24% and 46% of area, respectively), but large areas of tropical grasslands are currently undergoing a wide agricultural expansion too.

In South Africa, Swaziland and Lesotho, the Grassland Biome has also been impacted by large-scale conversion. The biome supports both dense human populations and large-scale agricultural use. The primary drivers of agricultural transformation have been the dairy, wool, beef, maize, sorghum, wheat, and to a lesser extent, sunflower industries. A further 65% of the biome is grazed for livestock and game.

Large stretches of grassland have also been flooded for the construction of large dams and, as an extensive coal belt is located within it, conversion for mining and coal-fired power stations have also taken place. Gold mining is a further transformer of temperate grasslands.

Another threat to grasslands is woody encroachment, the increase in abundance of indigenous woody plants, such as shrubs and bushes, at the expense of herbaceous plants, grasses and forbs. This phenomenon can be driven by overgrazing, fire suppression, grassland abandonment, nitrogen pollution, and increased atmospheric CO_2.

Land-use change, followed by climate change and nitrogen deposition, have been predicted as major drivers of grassland loss in the near future.

Nsibande says the landscapes that they are working on are impacted by invasive alien vegetation, erosion due to poor land management practices such as overgrazing and overstocking, and uncontrolled fires which also contribute towards soil erosion. Particularly in the Grasslands Biome, both water quality and quantity are compromised because of loss of vegetation cover. This leaves the soil exposed and unprotected making it prone to erosion which leads to high silt load in rivers located in the lower-lying areas," Nsibande says.

Protection of grasslands

Regarding the establishment of the new national park, over and above limited funding for implementation and incompatible land use activities, one of the largest challenges to the project is to find willing landowners, Nsibande says. "The entire process is voluntary and purely dependent on landowner willingness." Ultimately, Nsibande explains they aim to increase South Africa's level of protection for the Grassland Biome from 3% to 15% at the very minimum so, success for them would be seeing more landowners buying into the project objectives.

Just recently, WWF announced that the 4 400-hectare Balloch Protected Area would potentially be enlarged with a further 7 000 hectares of either Protected Areas or nature reserves, as the owners of the properties Avoca, Glencoe and Reedsdell committed their land to stewardship agreements through arrangements with Eastern Cape Parks and Tourism Agency (ECPTA) and partners. Notices for intention to declare were published in the Eastern Cape's provincial gazette earlier this

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year. The properties are close to the proposed new Grasslands National Park, in the poorly protected Southern Drakensberg's grasslands.

Another important step has been an external grasslands speciality-led biodiversity site assessments of approximately 30 properties, veld condition assessments on 29 properties, and three 'bioblitz' surveys across the landscape with support from SANBI CREW programme and partners in the landscape. These surveys are conducted to gain a clearer understanding of distribution patterns, species of conservation concern and the identification of endemic and range-restricted species. Veld condition and the general health of the rivers and wetlands in the area were also investigated.

The findings concluded that the high-altitude sites were still in relatively pristine condition and that the area offered a multitude of natural attractions, among them birds, floral diversity, geology, stargazing, and cultural heritage. Furthermore, this was said to hold great potential for training local guides from surrounding communities to meet the needs of the ecotourism market as the park project progresses.

In September last year, the assessments' findings were presented to the very first SANParks review panel, Nsibande says. The purpose of this was to determine the biodiversity merit of each assessed property to allow the review panel committee to recommend and agree on the protected area category that the property qualifies for. "This immensely important milestone is one of the key project achievements in paving a way forward for the declaration process, assessing the biodiversity merit of the properties where landowners have indicated a willingness to be included in the national park," he says.

The next step will be the signing of contractual agreements with participating landowners followed by the publication of a notice of intention to declare, and a 60-day public participation process.

Their ultimate is then the actual declaration of the national park and unlocking the incentives associated with its establishment, such as tax incentives and the financial benefits of agricultural produce with sustainability credentials.

Showcasing this unique national park would be a game changer in the way protected areas are established, and break the stereotype associated with the traditional way of doing so, Nsibande says. At the same time, it will strengthen the co-existence between conservation and sustainable agriculture through an inclusive and collaborative approach. "We would also like to see improved management and protection of the Grassland Biome and strategic water source areas for the benefit of both present and future generations, to allow for a healthy ecosystem where people and nature thrive."

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Angus Burns/WWF South Africa

The area in the vicinity of Rhodes/Maclear in the Eastern Cape, where a national park is being created. The declaration of the national park status on private and communal land is voluntary, involving willing landowners and SANParks.

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NATURAL CAPITAL

Greening the city: A framework for integrating natural capital into urban asset management systems

Like many countries, the increased urbanisation and industrialisation of South Africa have led to significant amounts of environmental degradation. This has made cities more vulnerable to multiple climatic crises, resulting in many seeking to adopt successful adaptation strategies. Unfortunately, still more follow unsustainable development pathways. Article by Kyle Harris.

Through extensive literature review, natural capital, such as wetlands, rivers and forests, have been recognised as having the potential to complement grey infrastructure while reducing the adverse effects of economic practices on societies and the environment. Several case studies have proved that a drop in property value follows degradation of the natural capital. Much like grey infrastructure, natural capital can be seen as an asset and delivery of ecosystem services can be described as the annual rent received from the asset. The presence or condition of ecosystems is similarly linked to the economics of associated built infrastructure. These conceptual similarities and linkages between natural capital and built infrastructure provide a valuable opportunity for exploring the integration of these natural assets into existing urban asset management.

Despite the increasing awareness of the importance of natural capital, few formal institutional arrangements, specifically economic policy instruments, exist that formalise and internalise decision-making around these assets into day-to-day economic decision-making. An ongoing Water Research Commission (WRC) funded project (**WRC project no. C2021/2022-00788**) is investigating a municipal asset management system as a specific economic policy instrument for the formal institutionalisation of urban or municipal water-related green infrastructure. The central hypothesis is that the structure of existing municipal asset management systems can accommodate natural capital, as defined by existing natural capital delineation systems. The project seeks to test the hypothesis at the hand of a case study, located within the City of Tshwane (CoT).

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The Hartbeesspruit, which incorporates the Colbyn Valley Wetland, is an ideal urban river system for piloting this project for multiple reasons. Firstly, the Colbyn wetland system covers a wide area and is currently in fair condition, indicating that it has the capacity to provide key ecosystem services to residents of the CoT. Secondly, most of the riverine system is in close proximity to urban built-up areas and performs an important role in reducing erosion, regulating flow regimes and regulating nutrients and toxins at little to no operational or capital cost, a huge saving to the Metro. These are benefits that the residents of the CoT essentially receive for free and could be enhanced through the rehabilitation of this ecosystem.

To integrate natural capital into the asset management systems of the CoT, we propose the following framework:

- ***Asset delineation:*** The geographical boundaries of each natural capital component are delineated using desktop studies and ground truthing. Attribute data was collected for each wetland and mapped across the catchment. Attributes refer to the specific properties of an asset component, such as type, size, class, condition, location, and identity.
- ***Asset classification:*** The assets are then classified based on their function, asset type, or a combination of the two.
- ***Valuation of the asset:*** Valuation of the natural capital asset will be based on the financial benefits the municipality derives from the asset. This will be calculated using a cost-benefit analysis (CBA) where the cost of rehabilitation of the ecosystems by the CoT and the benefits to the residents and the CoT are calculated.
- ***Integration:*** Integration into the asset register: The asset is then integrated into the CoT's asset management system.

The integration of natural capital into the CoT's asset management systems presents an opportunity to transform our methods for creating sustainable and resilient urban landscapes. It also provides the chance for us to review practical means for linking ecological valuation studies with urban economies and asset planning structures. The successful implementation of the proposed framework will enable the city to benefit from the green ecosystem services offered by these assets more effectively, improve public health and well-being and mitigate the impacts of climate change, through adaptation and resilient systems.

Utilising this framework will also elevate the city's environmental credentials (i.e. making a case for the value of natural capital in mitigating urban degradation and resulting risks, trajectories of change, future loss of benefits and working towards Sustainable Development Goals, like 6, 13 and 15, in particular), changes that will likely attract more investors and foster economic growth. This framework emphasises the need for collaboration among various stakeholders, including local government authorities, citizen scientists, community groups, private sector entities, and environmental experts. Moreover, it highlights the importance of data-driven decision-making, long-term planning, and continuous monitoring and evaluation. As CoT takes decisive steps towards incorporating natural capital into its asset management strategies, it can pave the way for other municipalities to follow suit and build a greener, more sustainable future for generations to come.

There can be no successful business and healthy society on a sick environment. The images illustrate the need to maintain the natural capital as it would be to any asset.

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FOOD SECURITY

Role of dams in providing food security – lessons from Vanderkloof

South Africa's second-largest dam, Vanderkloof, may have been constructed with irrigation in mind, but today also serves as an important source of food for local communities. So writes Peter Ramollo from the Northern Cape Department: Agriculture, Environmental Affairs, Rural Development and Land Reform.

Flowcomm / Flickr

The Vanderkloof Dam is the second largest and longest water body found in the Northern Cape. The dam was built as part of the Orange River water supply scheme and was completed in 1977, mainly for irrigation purposes. Today, the dam is primarily used for agricultural and urban water supply. Hydroelectricity is also generated at the dam, feeding electricity into the Eskom grid during emergency situations and peak periods.

The Vanderkloof Dam also provides recreational opportunities. Examples include the Vanderkloof Boating Club, a group of kayakers and sports enthusiasts, and an angling club. The most well-liked activities taking place in the dam are fishing activities. Anglers cast their lines from the dam's banks in search of various types of fish. The busiest fishing months to fish for the prized largemouth yellowfish seem to be April and December holidays.

On occasion, a small number of weekend anglers crowd to the area, setting up their angling gears for catch-and-release. Their fishing activities are mostly undertaken for fun and do not impact negatively on fish populations.

Privileged anglers often clash with local communities who fish for their livelihood at the dam. Conflicts mainly revolve around fishing grounds and access to the dam. Local fishermen were denied access to fish in the dam during the apartheid regime. Even during the post-democratic dispensation, the accessibility to the dam is still a challenge because recreational anglers claim to be in full charge of dam management.

Government has recognised these challenges, and zoned the dam for recreational and subsistence fishing activities so

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that local people can also access and benefit from this natural resource. Recreational anglers have expressed concern that if more intensive fish harvesting by non-recreational members are allowed that it could adversely affect fish populations and consequently eco-tourism which brings millions of money in the area. It would therefore be important to establish fish stock estimates, followed by regular monitoring to ensure (and proof) small-scale fisheries' sustainability.

Although this article is not focusing on inland fisheries policy, it is important to note that the country did not have an inland fisheries policies or guidelines to guide state dam management and resource allocation until February 2022. Policy development occurred concurrently with an experimental study by Rhodes University, who provided additional information towards policy development.

Guidance has accordingly been provided for decision-making towards the sustainable development of South Africa's inland fisheries sector. One of the challenges still remaining is the limited information on economic contributions of small-scale fisheries for rural communities across the country. Contrary to the longer history of recreational fishing, small-scale fishing is largely an informal activity with no established systems for advocacy. Therefore, data is absent. Poor management has further hindered the development of inland fisheries as a contributor to rural economy and livelihoods.

Fish studies in the eighties

In the early eighties, Allanson & Jackson; Tumi Tommasson conducted a study in the dam. Their studies revealed that the fish stock in the dam presented an opportunity for a cheaper protein option to communities in the area. The researchers reported that harvesting of stocked fish in the dam could potentially increase the economic benefits for small-scale and subsistence fishermen. Consequently, this could create financial benefits and provide communities with livelihoods and cheaper sources of protein. Though their study revealed that the dam has potential for small-scale commercial fisheries they did not provide management guidance towards balancing recreational and eco-tourism and community beneficiation. Unfortunately, no small-scale fish harvesting commenced, leaving communities without the opportunity to improve social and economic benefits.

Rhodes University surveys in 2012

According to the University of Rhodes, approximately 250 tonnes of fish can be harvested every year using gill nets and longlines; which would meet the market demand at the time of the study. Their socio-economic research report has showed that there is a suitable market, and people around the area are willing to pay for fish, suggesting that you could expand the market in the area, and possibly into other provinces. Their conclusion was that the dam offers great opportunities to develop rural and establish community-based fisheries, hence these findings were used to make use of the opportunities the dam offers.

Challenges in Implementation

South Africa's Constitution recognises the sustainable use of natural resources to protect livelihoods, but national and provincial policies do not provide for small-scale fisheries and its management. Policies are found to still be old and outdated within the context of the New Administration, i.e. post-1994. These outdated regulatory frameworks are geared towards advancing fish conservation and recreational fishing while excluding any form of small-scale inland fisheries. In fact, small-scale inland fishing is regarded an illegal activity. The new national legal framework finalised in 2022 now addresses current situations and challenges of food security and unemployment, the provincial legislation largely remained the unchanged. Amending these old provincial Ordinances, Acts (existing rules) and regulations takes time while fishermen continued to suffer in the meantime. With this slow legislative alignments' (amendments) progress, it was decided to develop the Vanderkloof Experimental Fisheries Management Plan (VEFMP) to guide the process in the meanwhile, in recognition of human rights towards sustainable use of natural resources while also protecting livelihoods.

During the development of the VEFMP, public engagements were held where heated discussions and disputes about the legality of inland fishing in the area were deliberated. Opponents to the small-scale fishing project indicated that the dam contains the threatened largemouth yellowfish and that gillnets (a non-specific fishing method) might cause the extinction of this threatened fish species. In addition, they also contended that commercial inland fisheries are illegal under both national and provincial regulations. In contrast, local communities contended that they require complete access to the dam in order to fish for food security and livelihoods, as opposed to recreational fishing that is purely for enjoyment (no livelihood dependency). Irrespective of these arguments, stakeholders were still able to draft, and obtain approval, for the VEFMP through the establishment of an Advisory Group who aids in resolving any disagreements that may emerge throughout the implementation of the VEFMP project.

The Advisory Group consist of all of the relevant parties and stakeholders, namely the Northern Cape Department of Agriculture, Land Reform, and Rural Development; the Northern Cape Department of Environment and Nature Conservation; the Department of Water and Sanitation; the Free State Department of Economic, Small Business Development, Tourism, and Environmental Affairs; the Department of Environment, Forestry, and Fisheries, Rural Fisheries Programme; Rhodes University; and Masifundise Development Trust, South African Sport Anglers and Casting Confederation; South African Consolidated Recreational Angling Association; Renosterberg Municipality; Kraal fishers; Vanderkloof Rates Payers Association; Vanderkloof Angling Club-Recreational Anglers and South African United Fishing Front. Their role is to provide oversight, advice, and to set and amend rules on the kraal and experimental fishery project.

After careful consideration, the management authorities agreed to issue the necessary fishing permits containing a special condition instructing the release of protected fish species back into the dam. The reasoning for issuing research permits was to allow for a phased approach towards a commercial project. To date, the VEFMP appears to have clear and implementable objectives, as preliminary information suggests it is advancing the interests of local fishermen and food security, while regulatory amendments are underway.

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Management of fisheries

The FAO (Food and Agriculture Organization) of the United Nations is an international organisation that leads international efforts to defeat hunger and improve nutrition and food security. In 2015, FAO released a report '***Voluntary guidelines for securing sustainable small-scale fisheries in the context of food security and poverty eradication'.*** The report states that fish resources should be accessed by all fishermen and managed sustainably to minimise stock depletion and overharvesting, and there should be a balance between conservation and economic development agendas. It further reiterates the principle of co-management in bringing all roleplayers together to deal with the conflicts and matters of concern.

The management committee should then share information, be inclusive, consultative, transparent and democratic to enhance the principle of responsible governance. These principles were encapsulated in the VEFMP, outlining a theoretical approach for fisheries management. Subsequently an experimental small-scale project at Vanderkloof was established, summarising the pertinent issues to be considered during the management and development of this fisheries project. The VEFMP allows for long-term change, and urgent short-term adaptive management, with the advisory committee fundamentally functioning as a co-management structure, as outlined by the FAO in terms of reaching consensus decisions and oversight. With the advisory committee consisting of all relevant stakeholders, they are able to make recommendations, oversee implementation and make adaptive management changes whenever new information emerged in order to ensure sustainable fisheries and project development.

During the development and implementation of the VEFMP, principles of effective governance, inclusivity, transparency and consultation processes were duly applied and taken into consideration. Though the objectives of the FAO Small Scale Fishery guidelines are not legally binding, it provided assistance in establishing criteria, principles and information to achieve sustainability in developing small-scale fisheries for livelihoods. To date, the management of small scale-fishing at Vanderkloof Dam appears to contribute to income generation in the Renosterberg area.

In terms of the ecosystem approach principle, the FAO suggests that governments should recognise the potential for inland small-scale fisheries and the need for legislative frameworks to manage and develop this fishery sector. Thus, legislative frameworks should follow the principles of an ecosystem approach that is inclusive and consultative, and parties need to strike a balance between conservation, economic development and social justice. Indeed, the VEFMP is aligned with the ecosystem approach principle as the Vanderkloof fisheries project seem to contribute towards job creation, poverty alleviation, maximising economic potential and social benefits; and empowering disadvantaged local communities to participate and realise opportunities associated with inland fish resources. This is backed by the fact that people fished for a living, and where high conservation value (protected) fish were caught, the fishermen released the fish uninjured back into the water.

During the implementation of the VEFMP, subsistence fishing for livelihood was implemented in a wide range of areas within the permitted zones at Vanderkloof Dam. The zoned areas stretched from the dam wall to upstream where the river flows into the dam. All the sites were accessed through boat. Therefore, fishermen were allowed to fish for livelihoods except on weekends. The harvested fish were measured, and data was collected to determine the biological and economic sustainability of small-scale fisheries. The records keepers were DENC and Rhodes University. The reasons for data collection and record keeping were for proper management of the fisheries activities in order to avoid over-exploitation of fish and to leverage the inland fisheries policy direction.

Community beneficiation

The FAO suggest, as captured in the VEFMP, that small-scale fishing communities should benefit from fisheries development, meaning that communities should promote social responsibility by encouraging cooperation with other stakeholders in adjacent business areas so that they can benefit fairly from resources. The VEFMP encourages and promotes fishing activities to provide employment opportunities for local rural communities. It is suggested that community-based fisheries can generate income, fight poverty and continue to provide local fishing communities with an affordable source of protein for sustainable socio-economic growth. This was done primarily to support and improve the socio-economic status of fishermen in the Vanderkloof region.

Fish caught was sold in the area, enabling members of the community to generate extra money that enabled them to purchase basic necessities such as bread, vegetables, flour, and some vegetables they could not produce themselves. Most of the household income of fishermen in the Renosterberg area comes from fishing and working on farms, potentially making the fisheries income stream an important area for further development. During the COVID-19 crisis fishermen were unable to catch fish because the government did not define fishing as an important service (most probably due to the outdated legislative frameworks and policies), leaving fishing villages across the country without the means to provide for their families. This has undoubtedly had an impact on fishermen's lives, irrespective to the fact that inland fisheries are acknowledged to offer significant potential in enhancing food security, economic growth and poverty reduction.

Capacity building

FAO advises that countries should have capacity building programs to improve beneficiation of small-scale fishing communities, focussing on the marginalized and vulnerable communities to ensure equitable beneficiation across the small-scale fisheries value chain. Through training of communities they would be equipped with a range of skills and knowledge of fishing methods, on how to adapt to adverse changes in the system (building resilience), and manage fish stocks sustainably. This is in line with the VEFMP, which says there is a need to strengthen and develop capacity for community economic activity, participation and building resilience to the fisheries sector.

The cost of carrying out the experimental research was projected

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to be more than R5 million, with the department also offering further help by committing to managing and transforming the sector. The budget was used to provide fishing equpiments and a boat to facilitate an access to the fishing areas. Procured items have enabled fishermen to increase their catch rates, improve their incomes and provided improve food security. Part of the budget was spent on the training of crew fishermen in 2018, purchase of freezers, a vehicle, and salaries for the experimental fisheries crew. Training in all aspects related to fishing activities seemed very important during the Vanderkloof dam's experimental fisheries phase. Though the focus was not on training up to now, the limited training offered to crew members and kraal fishers it does enable sustainable fishing and use by fishermen in future efforts in the fisheries sector or in seeking employment elsewhere.

Value chain and food security

Inland fisheries value chains are important for the long-term viability of small-scale fishermen's livelihoods and if benefits like social justice, socio-economic, rural development, food security, job creation and poverty alleviation are to emanate. Once again, the FAO SSF guidelines capture the importance of including the entire value chain into the development of the inland fisheries industry; from fishing to all other activities related to fishing, such as processing, marketing of fish products, and distribution of fish. In order to maximize social and economic benefits, the inland fisheries sector, its governance, and sector support should be centred on a value chain approach.

The Vanderkloof Dam's experimental fishers collected fish, dissected, weighed, and sold them to assess the market viability in the area. A deal was also struck with local fishermen fishing below the dam wall using traditional kraal fishing methods, to buy fish from the experimental fishers, but it did not work out as expected. The traditional fishing operations below the dam wall are carried out by adult and youth, predominantly African and coloured people, who lack formal schooling, a source of income, and government support.

The majority of these fishermen are married with children, and have some understanding of the economic ramifications of fishing but little knowledge of overfishing and fish migration patterns. Instead, these kraal fishermen refused to weigh their fish in order to determine an accurate price. They wanted to purchase and trade fish based on their size. They also had difficulties in buying fish, while some kraal fisherman even believed they should be given fish for free. Despite the full explanation of how the initiative works, some fishermen had unrealistic expectations of obtaining free fish and inheriting project equipment.

When they learned that things were not progressing as planned, they joined those who were against the project. Some of them previously went on a TV broadcast and said that Rhodes University was using gill nets and harming the dam ecology. It appears that some fishermen misunderstood the objectives of the project, or the initiative did not attract the correct individuals to sell fish for optimise earnings, or the project attracted opportunistic persons who saw a chance to inherit project equipment such as gill nets, a boat and a bakkie.

Communities who purchased fish from the project, as well as those who fished behind the dam wall in stone kraals, found it difficult to sell their catches door to door. Poverty in the Renosterberg municipality has a significant impact on the buying power of residents. Majority of people have little or limited income, making it difficult for them to buy basic necessities and non-essential items. This lack of buying power also limits their access to quality healthcare, economic growth, and education further perpetuating the cycle of poverty and hampering overall development.
Accordingly, fishermen would frequently take any price because the fish decay quickly in the spring and summer due to a lack of cold storage facilities. Customers also commonly purchased fish on credit at low prices, and occasionally failed to make payments on time or at all. Another reason why fishermen give fish on credit is to build and keep an acceptable customer network in order to consistently deliver fish to those local communities.

Other challenges for fishermen in expanding their market into the nearest towns are transport and storage (or preservation) facilities. If the government could improve fishing infrastructure and facilities, fish could be preserved conveniently for extended periods of time and sold at market prices. As a consequence, it could be feasible to distribute products equally to retail dealers in big towns and other places. The lack of facilities for preserving, filleting, smoking, or salting fish results in the catch of kraal fishermen being sold whole, which is another issue. It demonstrated that fishermen require government assistance in order to access the deeply competitive official market, stop post-harvest losses, and conform to health regulations.

In conclusion, in order to move the small-scale fisheries project forward, the community need to organise themselves and form a cooperative. The initiative should attract people who want to fish for commercial purposes, not simply people who want to fish for fast cash to buy few items. Fishing is a physically demanding occupation, therefore individuals must be willing to work long hours to catch fish, process, and sell them in order to recover the money spent on fuel, maintenance, and to pay their salaries. The abrupt handing over of the project to the community most probably would result in it collapsing, just like many other government projects. Inland commercial community fisheries projects would necessitate a medium to long-term investment and support from government for it to be successful.

Inland fisheries value chains are important for the long-term viability of small-scale fishermen's livelihoods.

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