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FACT SHEET: Climate change adaptation for South African industry

CASE STUDY: Taylormade Water Solutions – Water stream transformation at Ibhayi Brewery adaptation

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Department:
Trade, Industry and Competition
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Spinach growing at Ibhayi Brewery using treated brewery effluent

South Africa is particularly affected by climate change hazards such as recurring and extensive heat waves and dry spells, rainfall increase and storm surges. The associated impacts of these extreme weather events have a bearing on economic and social aspects of the country's development. As the country embarks on a just transition to a low-carbon, climate resilient and environmentally sustainable economy, a clear window of opportunity exists to accelerate the shift to a domestic green economy.

Adaptation to climate change helps to address environmental and health-related impacts, boosts development and is a prerequisite for a prosperous economy. It contributes to reducing strong negative impacts on the economy but also on inhabitants, especially on vulnerable communities.

Climate resilience in an industrial context is the capacity to:

- absorb stresses imposed by climate change and maintain productive functions, and
- adapt, renew, re-organize and develop desirable pathways and more sustainable practices to better prepare for future climate change impacts.

The Industry Adaptation Project in South Africa (SAIA) aimed to assist industry in transitioning to more climate-resilient operations and better prepare for future climate change impacts, while avoiding negative impacts on the environment and people. The project was implemented by the United Nations Industrial Development Organization (UNIDO), in collaboration with the National Cleaner Production Centre South Africa (NCPC-SA) and the Technology Innovation Agency (TIA). It was funded by the Government of Flanders.

The Challenge: Climate impacts and vulnerability

Historic weather and climate in South Africa

- Observations indicate a rise in average annual temperatures of about 1.5°C since the 1960s with more marked increases in arid inland areas.
- Temperature extremes have increased significantly in frequency and intensity.
- Overall annual rainfall has not changed markedly, but the number of rain days has decreased which means an increase in intensity of rainfall coupled with prolonged dry spells.

Projected weather and climate

While predictions for South Africa vary, most climate models suggest:

- Further increases in average monthly temperatures by 2°C by the 2050s with most significant increases in the summer months, and in the western and central interior regions.
- Annual rainfall decline, while winter rainfall is projected to increase along the east coast and eastern escarpment. Southwestern regions are at high risk of severe droughts in this century.
- Rising temperatures and variable rainfall is likely to result in more extreme events like droughts and floods and associated adverse environmental impacts such as soil erosion, deforestation, desertification, land degradation and loss of biodiversity.
- As droughts become more frequent, and as warmer temperatures increase the rate of evapotranspiration, water resources are likely to be increasingly strained and agriculture will suffer. As floods increase, there is a threat of water contamination, affecting water supply and agriculture, as well as affecting biodiversity, homes and infrastructure.

- Rising temperatures already pose limitations to the cooling capacities of South African's coal fired power generating stations, reducing outputs. Rising temperatures are likely to alter future demand for electricity, increasing peak load demands during hotter summers. The country's strategy to increase renewable energy and energy efficiency will help to mitigate some risks.

Brewery vulnerability to climate change

Brewing relies heavily on water for its process as well as for the cleaning of process equipment. The most water-intensive processes are milling, filtration, pasteurisation, packaging and cleaning. Most breweries in South Africa source their water from municipalities and as water supply becomes more strained there will be issues with supply and the cost will increase significantly. This is a key risk for business continuity and competitiveness. Further, breweries produce considerable amounts of waste water which is composed of organic material. Breweries install in-house wastewater treatment plants to treat their own waste and produce biogas and sludge using anaerobic digestion and activated sludge systems. Reducing volumes and the strength of the brewery effluent lowers costs and environmental impacts.

Notably, since malted barley is the main input into beer production, there are key climate related challenges associated with the availability and cost of barley since water is a key constraint to domestic barley production and to the malting process.

Ibhayi Brewery, in the Eastern Cape, had installed an anaerobic digestion plant and a conventional activated sludge system to treat its effluent and then must pay to dispose of the sludge, which also poses environmental degradation risks. With its heavy reliance on water and energy, the brewery is still at risk from climate change.

The solution: Adaptation

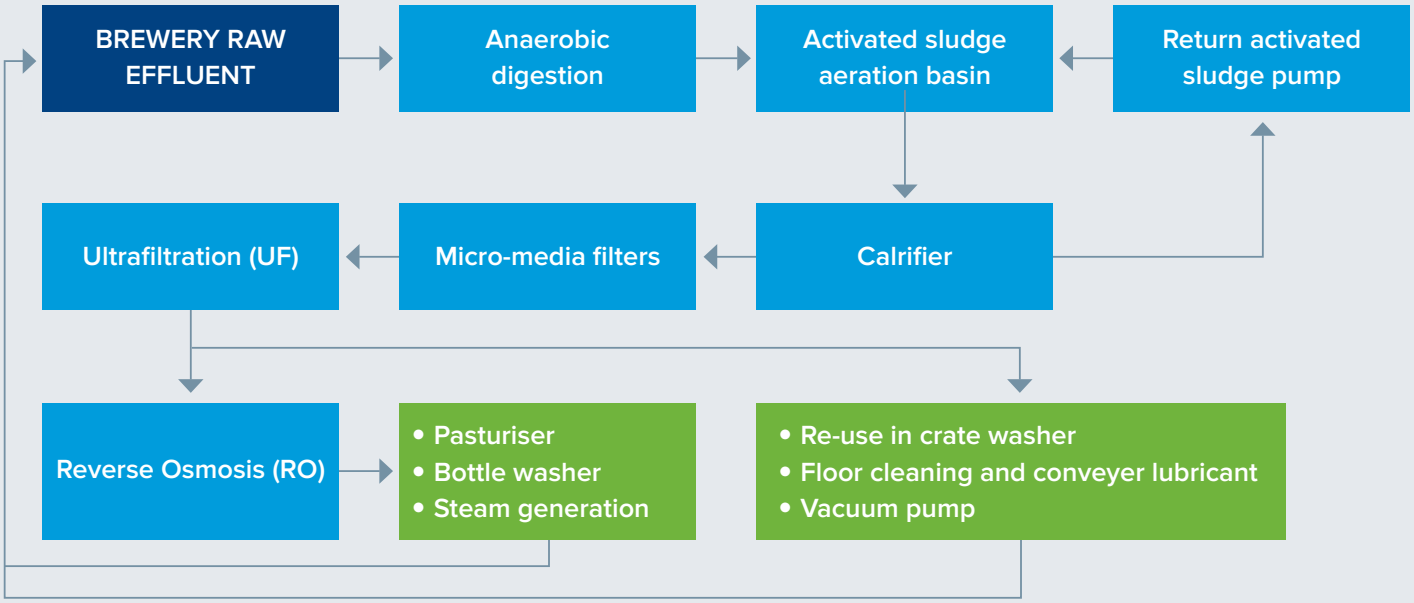
The aim was to increase the brewery's resilience by reducing water and energy demand through a circular economy approach, treating wastewater for reuse in the facility and producing fresh agricultural products for sale to local retail outlets and communities.

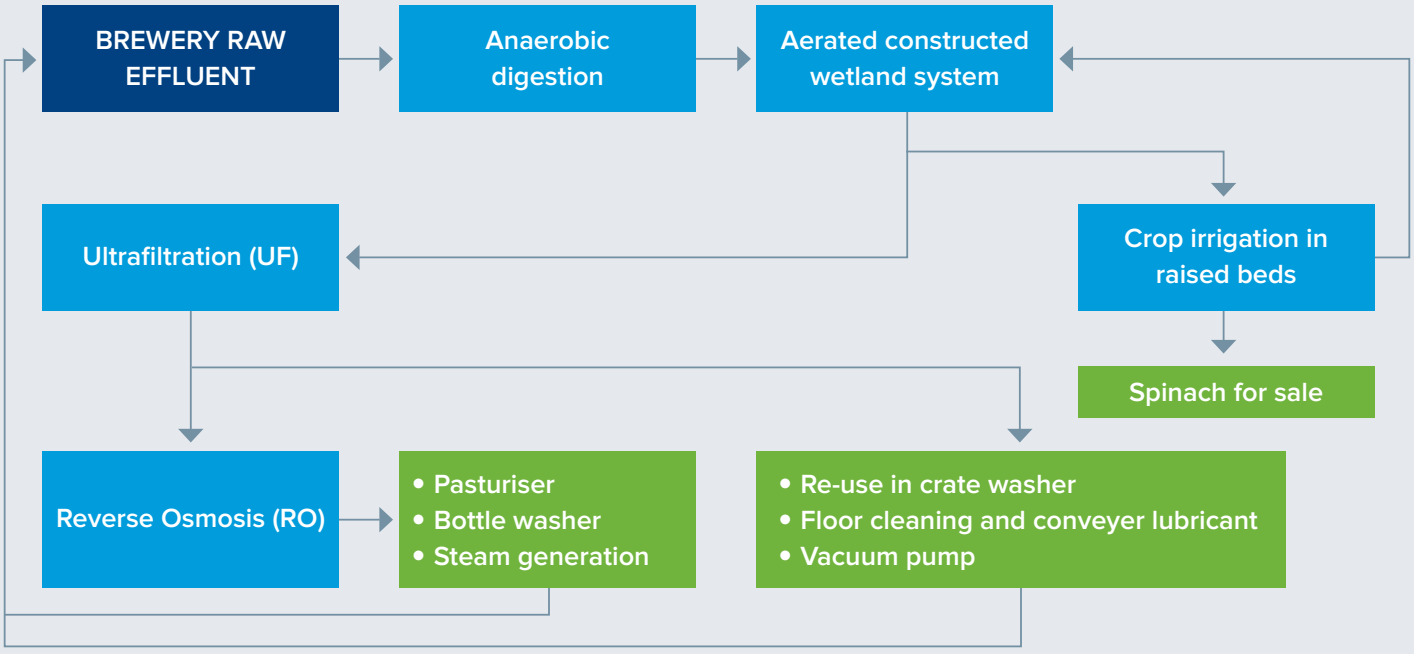
The demonstration project, **Project Imifino**, comprises a partnership between a South African company, Taylormade Water Solutions (TMWS), ABInBev, and Flemish technology provider Waterleau Group NV, with Rhodes University as academic partner.

The initial project proved the concept of replacing the current activated sludge system with water recovery from the brewery's anaerobic digester's effluent using high-rate algal ponding and constructed wetland technology (i.e. aquaculture, hydroponics algal biomass production and agriculture). Effluents treated via aerobic technologies (ie. activated sludge systems) produce waste sludge while Project Imifino allows nutrients to be recovered into valuable biomass not sludge.

Following its success, the effluent treatment performance was improved using ultrafiltration (UF) and reverse osmosis (RO) to allow for onsite water reuse. Effluent that has undergone UF treatment is utilised onsite for crate washing, floor washing and conveyer lubricant while a portion is further treated via RO for steam generation and use in the bottle washer and pasteuriser. At the same time a 2000 m^2 raised bed, soil-based agricultural system was built to grow vegetables using the brewery nutrients. The before and after processes are shown in the following figures.

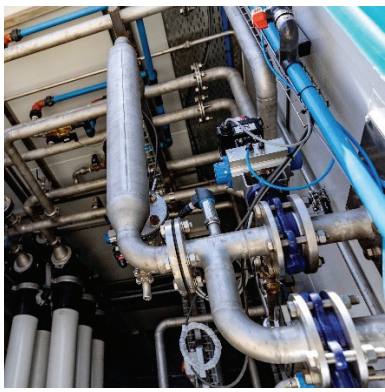




Effluent process diagram at Ibhayi Brewery before with conventional activated sludge system (top) and after with aerated wetland system (bottom)

Technical assistance and grant support was provided through SAIA for the first of its kind pilot including the containerised ultrafiltration (UF) solution by Waterleau to address the UF plant bottleneck for water recovery. The equipment was co-funded by Waterleau, Taylormade Water Solutions and ABInBev, and included installation and capacity building. The results of the project have been impressive. *(Right: Containerised UF plant)*



Improved water quality:

The wetland system reduces the effluent Chemical Oxygen Demand (COD), ammonia and turbidity (cloudiness) significantly. The quality of the water is suitable for UF feed water, which requires the turbidity of the water to be below 10 NTU. The UF plant's function is to subsequently reduce the turbidity of the treated effluent to below 1 NTU, making the water suitable for onsite re-use or as feed water for a reverse osmosis plant. The turbidity of treated effluent exiting the UF plant has consistently been 0.2 NTU. This water is of excellent quality for onsite re-use. The actual water quality parameters are shown in the table below.

Table 1: Average water quality parameters entering and exiting the wetland system and ultra-filtration plant from the pilot from 01 September to 13 December 2024.

Parameter	Wetland Inflow	Wetland Outflow	UF inflow Target	UF outflow	Re-use target
NH4-N (mg/l)	52	0.78	< 1.0	0.76	< 1.0
N03-N (mg/l)	0.00	5.2	< 15.0	5.2	< 15.0
pH	7.9	8.37	6-9	8.37	6-9
Chemical oxygen demand (mg/l)	528	64	< 75	48	< 75
Total dissolved solids (mg/l)	1842	1771	< 2000	1771	< 2000
Electrical conductivity (us/cm²)	2874	2759	< 3000	2753	< 3000
Turbidity (NTU)	74	4.3	< 10.0	0.2	< 1.0

Improved water re-use/supply:

The wetland is able to produce in excess of 250 m^3 per day of UF feed water and the UF plant then provides the brewery with 200 m^3 per day of water for direct onsite reuse, saving 127,000 m^3 of water a year.

Reduced energy consumption and greenhouse gas emissions:

The wetland system utilises 32% less energy than the conventional activated sludge system, when treating anaerobically digested effluent to UF feed quality. This, in turn, results in a reduction in GHG emissions by up to 19 tonnes CO_2/year. The energy consumption reduction is due to efficient aeration technologies and no need for multimedia filters in the wetland system.

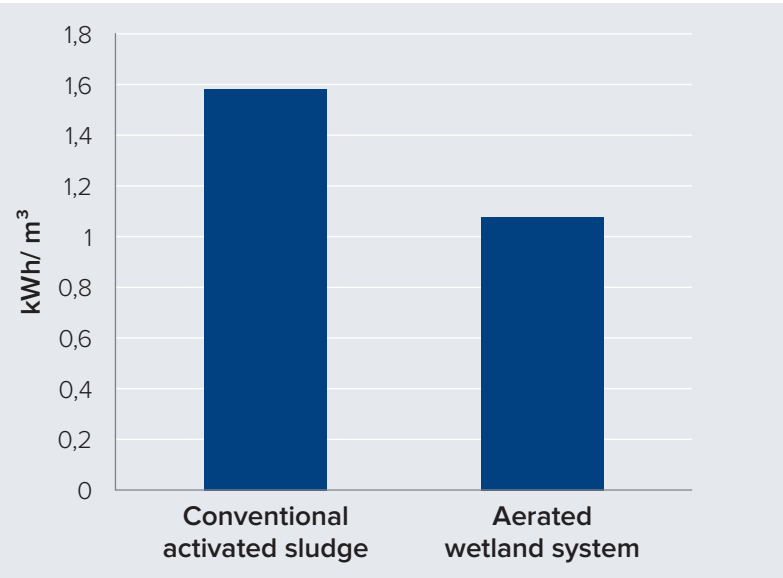


Figure 4: Energy usage comparison between conventional activated sludge system and aerated wetland system

Improved food security and job creation:

In addition, 1500 kg of spinach plus mint, parsley and spring onions is produced per week for retail supply generating income of more than 1 million rand which covers the operation and maintenance of the site and allows for a profit. Eight full-time jobs have been created for local community members with staff trained in driving, computer literacy and agribusiness operations. Research and development on incorporating fish production into the system is being conducted in conjunction with Rhodes University where barbel and Tilapia are being cultivated in the treated effluent and have the potential to increase the nutritional value of the effluent to crop production prior to being further treated for onsite re-use.

Profitable business:

In addition to the income from the sales of crops and treated effluent, it is also possible to obtain carbon credits from the crop production system. In the pilot project, the wetland and ultrafiltration system will cost about R 4.70/m^3 less than conventional systems and has the added benefit of being able to sequester carbon.

Conclusion

The model is highly replicable at other breweries as well as in other agri-processing sub-sectors such as food and beverage sites and sugar mills; wherever the COD <600, there is anaerobic digestion pre-treatment and where there is land availability. There are also further opportunities in terms of selling treated effluent and in reducing costs versus conventional treatment methods. Challenges remain in that the system is heavily reliant on functional anaerobic digestion; three months of downtime in 2023 disrupted Project Imifino operations, and the project is dependent on vegetable output as the sole income source. There is a need for diversified revenue streams to ensure stability.

Project Imifino exemplifies sustainable industrial adaptation by integrating agribusiness with waste treatment. Its replicability, economic benefits and environmental impact demonstrate how industries across South Africa and globally can manage waste while supporting local communities.

Get in touch – get involved

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