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The WRC operates in terms of the Water Research Act (Act 34 of 1971) and its mandate is to support water research and development as well as the building of a sustainable water research capacity in South Africa.

TECHNICAL BRIEF

Water and the environment

Environmental water quality – historic vs current trends

A completed Water Research Commission (WRC) study provides a review of changes in water quality management structures, programmes and approaches over the last two decades.

Background

South Africa is widely recognised as having an admirable water law, and as being a leader in granting a right to water in terms of quality and quantity, to the environment. However, the water quality of South African water resources is deteriorating, although good water quality management structures, strategies, approaches, programmes, instruments and tools have been developed and implemented nationally.

This WRC project aimed to provide a review and critique of the development of policy, management practice and methodologies associated with environmental water quality, within water resource production. Further, recommendations are made for research that will support implementation of legal, policy and strategy requirements for environmental water quality. Lastly, the study assessed the long-term water quality trends in two catchments, namely the Crocodile River in Mpumalanga and the Olifants River in Mpumalanga/Limpopo.

Review of SA environmental water quality management

The WRC report focused on surface waters in rivers, though other sources did receive some attention. For the most part, the study reviewed methods and tools dealing with the resource and other management approaches, such as end-of-pipe assessment and treatment will receive less attention.

Management of water quality at the Department of Water and Sanitation (DWS) is undertaken via the Chief Directorate: Resource Directed Measures (CD: RDM) and the Sub-Directorate: Water Quality Planning (WQP). One function of the WQP is to undertake national reviews of water quality to determine status and trends in the resource with the aim of supporting strategic management decision-making.

The CD: RDM comprises three directorates: Water Resource Classification; Reserve Requirements and Resource Directed Measures Compliance. These directorates interact in various ways.

A decision support system, Assessment of Consideration for Water Use Application (ACWUA), has been developed to inform decisions on licence applications. Decisions are based in multiple criteria, including socio-economic factors, race and gender considerations, and alignment to catchment strategy.

Beyond ACWUA, a number of other tools are available or are planned to support water quality management in South Africa. Most of these are available, though uptake and application across the country varies.

Regulatory tools for water quality management have been developed and are available. As management of pollution at source is recognised as an efficient and cost-effective approach, tools addressing this end are important. Failure to comply with licensing or authorisation conditions may result DWS issuing a directive, with withdrawal of the license, and usually, as a last resort, prosecution.

Economic instruments for water quality management include the waste discharge charge system (WCDS), which has the following purposes: recovery of management costs;

recovery of mitigation costs; and discouragement of water discharge.

The WCDS initially applies to point source discharges, as diffuse discharges are more difficult to quantify. Although WCDS currently operates at a national level, local input and interaction with other government bodies is important.

A number of tools are available for self-regulation of waters' impact on the resource. Some of these, such as ISO 14001 certification, have been widely implemented in certain sectors.

Water quality issues in SA

South Africa faces a number of challenges with regard to water quality. Some of these are widely recognised, while less is known of the others.

Eutrophication is a consequence of nutrient enrichment that leads to ecological changes, most notably blooms of algae or macrophytes. This may impact on ecological systems, and also have aesthetic, recreational, agricultural, and human health impacts.

Acid mine drainage (AMD) is a major environmental problem in South Africa largely because of the cost in addressing it and because it is persistent and remains a liability after mines have closed.

AMD affects both surface and groundwater in the areas where it occurs. The extent of coal and gold-mining activities, particularly in Gauteng and Mpumalanga, has led to major water quality issues in rivers in those areas.

Management of increased salinities in these rivers have in the past led to the release of water from upstream impoundments for dilution. This, in turn, stresses water availability upstream of affected areas.

Contamination of water by poorly managed sewage effluents may lead to high nutrient and salt levels, decreased oxygen levels, and an increase in the number of pathogens present in the water body. Despite the DWS Green Drop certification process the majority of wastewater treatment works continue to release effluent that is not treated to a safe and acceptable standard.

Anthropogenic salinisation of water in South Africa has a number of causes, including industrial effluent, mining, poor treatment of sewage prior to discharge, irrigation practices and clear-felling. Diffuse inputs are more difficult than point effluents to address as the extent is not known, monitoring and control are difficult, and effects may only become apparent after prolonged exposure.

Insofar as environmental water quality in South Africa is concerned, the relationship between regulatory tools used for routine monitoring, for Reserve determinations and RQOs need to be clarified and refined. A part of this is to expand the toxicological dataset that underlies ecological Reserve determination and monitoring.

The range of toxic compounds potentially in water is very high, as toxins could consist of, among others, agrichemicals, persistent organic pollutants, polyaromatic hydrocarbons, and endocrine disrupting compounds.

In general, data on all of these is extremely sparse, largely owing to the cost of analysis, the scarcity of appropriate laboratories, the number of potential pollutants, and a general lack of resources.

The potential for contamination of groundwater by these compounds is of concern, as is their potential to accumulate through the food chain. Sub-acute effects like endocrine disruption are also a potential threat. The National Toxicity Monitoring Programme is tasked with assessment of levels of these compounds in surface and groundwater.

Monitoring initiatives

There are several monitoring programmes in place in South Africa. A major gap in monitoring is the failure to undertake follow-up monitoring after completion of a Reserve study.

The National Chemical Monitoring Programme is well established in South Africa, with ongoing monitoring at hundreds of site assessing both surface and groundwater. Very good data exist for certain aspects of water chemistry of surface waters, such as pH, salinity, major ions, and major nutrients, but data on turbidity, metals, organic pollutants, temperature and oxygen levels are more scarce.

Groundwater datasets are less standardised, and although thousands of sample sites are recorded, many have very little data. Improved institutional cooperation between DWS and other organisations assessing groundwater would facilitate standardisation of data and monitoring practices.

The National Eutrophication Monitoring Programme has a brief to undertake monitoring to support assessments of eutrophication in South African reservoirs. Implementation

started in 2002 and the programme replaced the previous and smaller Trophic Status Project.

The National Microbial Monitoring Programme monitors the extent of faecal contamination of surface water in the country. The programme aims to locate and prioritise areas in the country where health risks are highest, and to assess the status, trends and health risks of faecal pollution in these areas.

The National Toxicant Monitoring Programme aims to measure, assess and report on the status and trends in toxicants in surface and groundwater resources. The programme was initiated as a response to increasing concern about the present and extent of toxicants in water resources and to respond to the lack of coherent information in this regard. The National Aquatic Ecosystem Health Monitoring Programme provides a means of directly assessing ecological health in water resources. The programme currently consists only of the River Health Programme, a joint programme in which provincial nature conservation agencies are responsible for much field work and reporting.

The programme has produced a number of valuable State of the River reports, which cover various environmental aspects of rivers as well as bio-assessment of the resource.

Long-term trends in environmental water quality

Investigations into the quality of water in the Crocodile and Olifants rivers showed that the water quality in both rivers tended to degraded with distance downstream. Overall, water quality from sites in the Crocodile River was better than that found from the Olifants River.

Sites in both catchments showed a general tendency to increased orthophosphate levels with time. The increase was also observed in relatively undisturbed sites upstream.

Another widespread trend observed at many sites in both catchments was an increase in pH levels from a stable base that commenced in the late 1980s. Levels increased slowly for about five years, then stabilised against a level that was generally 0.5 to 1 pH unit greater than before.

The impact of coal-mining and associated AMD is pronounced in the upper Olifants catchment. Despite this, only one site showed the classic signature of low pH levels, high sulphate levels and elevated metal ion concentrations.

The remainder of the sites showed increased conductivity and sulphate levels without matching pH decreases.

Sites in both catchments, though without the elevated sulphate signature characteristic of the upper Olifants basin, showed increased levels of sulphate in the early 1980s. This increase was temporary. No cause is known, however, industrially produced sulphate aerosols may have contributed to this temporary peak in sulphate.

The Elands River in the Crocodile River catchment is perhaps the clearest example from this study of a river impacted by salinization as indicated by increased sodium and chloride levels. The river supports much agriculture and, in particular, irrigation agriculture, and passes through an area with relatively low rainfall.

Increased levels of sodium and chloride are major drivers of an elevated electrical conductivity. Changes in salinity are correlated with rainfall, and increase in periods of low rainfall.

Conclusions

Overall, trends with time generally show a movement towards decreasing water quality at sites in the mid- to low catchments, although sites high in catchments may be more stable (depending on local impacts).

Sites that were impacted at the start of the data record generally continue to show that impact over time (though there are some improvements). Changes in water quality are driven by increased orthophosphate levels (through recent records suggest this trend may be changing), increased pH levels, increased salinity and for sites in the Olifants River catchment, increased sulphate and calcium levels.

Some river showed elevated chlorine levels consistent with salinization, but this was not widespread, finally, microbial levels were unacceptably high, though no trends were apparent.

Data on potential toxins are inadequate and a reassessment of monitoring in this regard is recommended.

Further reading:
To order the report, *Critical analysis of environmental water quality in South Africa: Historic and current trends* (**Report No. 2184/1/14**) contact Publications at Tel: (012) 330-0340, Email: orders@wrc.org.za or Visit: www.wrc.org.za to download a free copy.