

State of water research

Identifying and prioritising water research questions

A completed WRC-funded study set out to generate research questions capable of addressing immediate and medium- to long-term water-related issues and challenges facing South Africa.

Background

Limited historical data are available to describe water research in South Africa over the first half of the 20th century. Many authors recognise that this period was dominated by technological developments, breakthrough research and projects in water storage and transfer, and frequently characterised by a positivist approach to nature and development.

A new era in water research in South Africa began with the promulgation of the Water Research Act No. 34 of 1971. The Act led to the formation of the WRC with the objective of coordinating, promoting and encouraging research in respect of a wide range of purpose and activities.

A shift in the political landscape, marked by the first democratic elections in South Africa in 1994, contributed to a major shift in the existing water resource management paradigm. Legislative reform coincided with growing concerns about the state of the country's waterways and the rising capital expenses in supply schemes, coupled with the growing environmental concerns globally.

The legislative reform in South Africa is lauded as being the first country in the world to have promulgated national water legislation which uses water to achieve societal transformation and focusing attention on environmental and social justice.

The overall aim of this WRC-funded project was to generate research questions capable of addressing immediate and medium-to-long term water-related issues and challenges facing South Africa, and to do so with some assurance that these questions will be acceptable to researchers and practitioners alike.

Results and discussion

The number of journal articles and research reports published per year shows an increase in annual publication counts; a rise in *Water SA* articles; and a marked increase in WRC research reports. South Africa's water-related research output has steadily increased and the research is found in more diverse, international journals.

Scientometric maps comprises five-year time-slices from 1977 to 2011 and is graphically depicted in label or density format. Label format presents more prominent words in the network as larger spheres.

Elements of the map using keywords for the period 1977 to 2011 shows the dominance of research output that focus on management, development, models, water quality and system treatment. The first time-slice of 1977 to 1981 shows a small, but scattered research effort with an emphasis on water quality. The map from 1982 to 1986 indicates further scattering of research output with a small shift to natural biological systems and the first elements of approaching water affairs at a catchment scale. Treatment systems and industrial water present the major focus in the time-slice for 1987 to 1991.

In the early post-apartheid years from 1992 to 1996, shows how disciplines start to connect with one another. While treatment systems still dominate, management, development and urban research begin to show prominence within water research.

These emerging areas of enquiry increase their presence during and following the country's major water policy reconstruction in the period from 1997 to 2001. At this point

the research is at its most polarised, with treatment systems and basic science dominating one area while development, assessment and management sciences dominate another.

The penultimate time-slice from 2002 to 2006 shows emerging research fields which relate to the increase in overall publications in which the word 'management' becomes more pronounced and more social science-orientated terms such as community, impact and application make an appearance.

The final time-slice from 2007 to 2011 shows management as the current dominant research area of prominence. While engineering sciences such as treatment systems are present, they are dominated by assessment research, modelling and community-related research.

Question gathering

The stakeholders captured by the research signed up and engaged in the process for numerous reasons. Some simply wanted to remain informed of the process and results.

Others saw an opportunity to participate in the surveys and discussions, while yet others used the portal to ask further information about water research. When the study was completed in December 2012, there were 2 260 unique stakeholder contacts on the database.

The stakeholders contained within the database were diverse in their involvement in the South African water sector, but appeared well connected with the water sector networks. Overall, stakeholders in the database were affiliated to 572 organisations or institutions.

By the time the main survey closed in December 2012, there were 641 completed responses. Of the 1 674 questions submitted, 4 629 keywords/categories were provided of which 844 of these were unique. The most striking result is that 245 occurrences of the keyword **management**. A large proportion of the submitted questions had a management-oriented line of inquiry.

Following further refinements a total of 401 questions were presented as the input data to the **Water research horizon scanning workshop** in October 2012 in Cape Town. Delegates were asked to reduce the list, and the final dataset amounted to 59 priority water research questions across the six themes.

Research output and links to paradigms

South Africa has undergone significant changes in the output and structure of water research over the past four decades.

There has been substantial growth in output with a total relevant sample publication record of 6 007 articles and research reports and a current annual output of over 350 articles and reports per year. The number and different sources of journal articles over this period have increased and diversified, while WRC research report output has also increased, albeit at a slower rate.

The emergence of two main areas of research or fields of specialisation in the democratic transition (1992-1996) period is supported by greater diversity of publications than in previous years. The engineering of technical research outputs cluster together and again focus on treatment systems, processes and evaluation. This time the clustering is associated with management-based and planning oriented research.

A transition period in water research occurred over a period that became increasingly focused on quality constraints, field of management and planning. It also indicates that the second transition was occurring with a new social contract around water that came not only from a new political regime and democratic transition that focused on redistribution, but also one that was spurred on by a movement of South African environmentalism, the beginning of the global sustainability debate and the rise of civil society activism.

The period 1997-2001, around the major transformation of South Africa's water laws and post establishment of the national Constitution, shows a strong polarisation between the main technical and management orientated disciplines. Researchers began to focus further on understanding the broader water context, use systems approaches and were beginning to plan for more than just engineering solutions.

These results support the view that a transition was still underway with regard to the dominant paradigms, but the word system had shifted noticeably towards the management and development related research disciplines and away from the technical.

The most recent decade of water research represents the greatest change in water research paradigms. It represents over half of the collected and analysed publications, and constitutes the most representative sample of current recent water research. In this period, words become clustered and centralised, with the images being most clustered in their centres and with few stand-alone concentration areas. This indicates how research has become more diverse yet interconnected and a shift towards other disciplines.

The research effort in South Africa appears to have evolved into a new set of paradigms, albeit tentative and uncertain,

in which some emphasis is given to the social sciences disciplines and to concepts of governance and management. There is also evidence of research that focuses more attention on demand-side applications and interests, and integrated management.

However, a third or reflexive transition phase does not appear just yet. Keywords that relate to the green economy or risk awareness are not yet prominent. What is obvious is an increase in the prominence of collaboration across multiple disciplines over the last decade.

Identifying and prioritising questions: the link to paradigms

The launch and strategies undertaken through the Aqua d'UCT initiative far surpassed expectations with regards to participation, uptake and response. The robust and yet diverse nature of the results and community interaction during the study shows by the steady growth of interest from about 600 to over 2 000 stakeholders on the research contact database by the time the study was completed in 2012.

While many respondents wanted longer and more substantial research projects to be funded and established, the majority of research questions were categorised as short- to medium-term projects taking only one to three years, or ten years and more to complete respectively. Nevertheless, these questions reflect the diverse research disciplines and specialisations.

In general, the final list of questions confirms three important observations. Firstly, over 78% of the questions that were offered and refined at the workshop seek to address short- to medium-term research questions, typically questions dealing with service delivery, sanitation, access to water, pricing and water quality.

Secondly, the majority of the questions confirm the existence of a transition paradigm, similar to what was identified earlier in the scientometric analysis. Thirdly, there is a small set of questions that deal with medium- to long-term critical concerns of sustainability, establishing green economies, and implementing new forms of integrated, adaptive governance. These kinds of questions pose extraordinary challenges necessitating considerable financial and institutional support.

Conclusions

Scientometric results show that the publication record for water-related research in South Africa contained 6 007 articles and reports from 1977 to 2011. WRC research reports amounted to 1 760 (close to 30%) of this total. The remainder

were peer-reviewed journal articles published in Water SA accounting for 1 829 articles.

The publication record also increased in number dramatically since 1990, with more articles being published annually than each previous year before throughout the dataset.

Paradigms were identified through the scientometric mapping methods using the publication record to show a history of water research from 1977 to 2011. Overall, the research output focused predominantly on management, development, models, quality and system treatment. Technical matters dominate the historical record but other paradigms, such as allocative efficiency, uncertainty and risk are also present.

Two major paradigm approaches were observed in the analysis of water research publications along with one significant transition period. The first set of paradigms, from 1977-1991, emphasises the hydraulic mission that sought to secure supply and understand basic natural systems.

In the following ten years (1992-2001) there is transition in which quality constraints and fields of management and planning become prominent. This paradigm is in response to changes in water deficits and focus on end-use efficiency. A second transition occurs with a new social contract around water at a time when the new political regime enters government in a period of democratic transition, growing environmentalism and a rise of civil society activism. The need to plan, model catchments and include other disciplines is becoming evident in the research environment.

The question prioritisation activities using horizon scanning methods provided an opportunity for the study to engage with a wide and diverse population of water research stakeholders and practitioners. The survey resulted in a substantial collection of research questions from water stakeholders and researchers. Many questions deal with immediate- to medium-term concerns while only a few aim to tackle long-term or systemic problems. Others are coupled or integrated questions that cover a number of disciplines.

Further reading:

To order the report, *Identifying and prioritising water research questions for South Africa (Report No. 2170/1/13)* contact Publications at Tel: (012) 330-0340, Email: orders@wrc.org.za or Visit: www.wrc.org.za to download a free copy.