The perceptions of research values and priorities in water resource management from the 3rd Orange River Basin Symposium

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Abstract

Research has played an important role in water resource management and a consensus on research objectives would increase the efficiency of these practices. In this paper we aimed to elicit the views of attendees of the 3rd Orange River Basin Symposium regarding water-related research, by using both quantitative and qualitative responses to a questionnaire survey, and purposeful sampling methods. Overall, research was perceived to play an important role in water resource management and there was significant agreement on which sectors are responsible for carrying out this research. Although clear strengths in water resource management in southern Africa were identified, we found that most perceived weaknesses related to the lack of enforcement or to human resource constraints. Despite this fact, the identified research priorities, which were aligned to those of the Water Research Commission, tended to be technical in nature and would not address these perceived weaknesses. Our recommendations were that, by incorporating previously ignored sectors into research, such as private consultants and non-governmental organisations, and addressing human capacity and enforcement issues, unique and unexplored research opportunities could improve water resource management.

Keywords: Governance, interdisciplinary research, stakeholders, strategic planning, policy implementation

Introduction

The availability of water underpins the very social and economic fabric of the southern African sub-region (Hirji and Molapo, 2002; Toerien and Seaman, 2010). As a consequence, there are obvious incentives for effective water resource management. Research has, in the past, played an important role in addressing issues relating to water management, both nationally (Walmsley, 1992) and internationally (National Research Council USA, 2004). Scientists and practitioners have often identified human perceptions as primary determinants of success and failure of environmental plans (Mascia et al., 2003); so it would be beneficial for future water-related research to be aligned with these perceptions. Interdisciplinary research and cross-sector collaboration in integrated water resource management will only be possible if there is collective buy-in from all stakeholders. A shared understanding of the need and purpose of research, will better prepare all sectors for research outcomes, leading to more effective diffusion and adoption of knowledge (Breen et al., 2004). Since consensus on objectives and/or methods increases performance by promoting interdisciplinary collaboration (Dess, 1987), this paper aims to provide some clarity on the perceived research priorities of various stakeholders involved in water resource management in southern Africa.

The Orange River Basin Symposium is hosted annually in central South Africa; individuals who carry out water-related research and management convene to report on activities within the region. South Africa, Namibia, Botswana, Lesotho and other non-SADC countries were represented by the 2011 conference attendees, who were deemed to have a specific interest in water resource management and, as a consequence, were viewed as a reliable source of opinions on the issues in question.

A questionnaire, specially designed for this survey, was distributed among symposium attendees, the purpose of which was to assess the views of the attendees with regard to the following:

- The perceived importance of water-related research by various sectors of assorted levels of experience
- Identifying which sectors were perceived to play a leading role in water-related research
- Eliciting the perceived strengths and weaknesses of past water resource management
- The categorisation of future research directives as a prioritised hierarchy

There is a general perception that positive attitudes towards environmental practices (in this case, research) are likely to elicit pro-environmental behaviour (St John et al., 2010). Research in water resource management is not simply a means of knowledge generation, but is, instead, a value-based tool for improving the wellbeing of the country and its citizens (Offringa and de Wet, 1996). This survey could assist research organisations in identifying positive synergies with other stakeholders in integrated water management because research needs to deliver public value (especially when it is state funded) and not just research papers (as pointed out in a recent editorial published in *Nature* (Anonymous, 2011)).

Methods

We compiled a questionnaire, according to the best practices prescribed by White et al. (2005), to assess the perceived

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expectations of research in water resources management. Purposeful sampling was used for this study and the questionnaire focused specifically on the attendees of the 3rd Orange River Basin Symposium that was held on 8-9 June 2011 at the University of the Free State, Bloemfontein. We assumed that conference attendees were people who have some vested interest in water management and were therefore a well-informed source of opinions. Since the conference was broadly marketed across multiple sectors, we also assumed that the respondents were a fair representation of the make-up the wider population of water-related stakeholders in the region.

The anonymous questionnaire comprised of a short section to capture demographic data, a quantitative section aimed to bring forth the importance (or lack thereof) of research, using Likert scales, and a qualitative section of open-ended questions to capture opinions pertaining to the strengths, weaknesses and priorities of water research management. The 1-page (double-sided) questionnaire went through 2 rounds of pilot surveys of people in various sectors of the water industry to eliminate any redundancy and ambiguity. Since no changes were made after the second round of pilot surveys, the data for the second-round respondents (n = 5) was added to the analysed data. We distributed questionnaires to 129 conference attendees. Questionnaires were distributed during the conference registration and respondents were requested to drop off the completed questionnaires into 1 of 3 sealed boxes within the venue. After excluding incomplete and/or illegible questionnaires, the data from 32 (24.81%) respondents were added to those of the pilot survey for analyses, giving a total of 37 completed questionnaires. The qualitative nature of most of our survey and the presumed proficiency of the survey population with regard to water-related issues compensated for the low proportion of responses.

The occupational sector, type of work, the positioning in the structural hierarchy of the organisation, age and experience of the respondents were assessed using the questionnaire, but we found that many of these variables co-varied (such as age, experience and position in hierarchy) or were too broad to be categorised for accurate analyses (such as type of work). To overcome this, we only selected the level of experience and the occupational sector for further investigation because these 2 variables encompassed much of the information contained in the abandoned data. To determine whether experience level and/or occupational sector influenced the perceived importance of research in water resources management, we performed a rank-based 2-factor unbalanced fixed (Model I) ANOVA. This rank-based transformation allowed us to extend the non-parametric data to a more complex design, although it must be noted that doing so increased the likelihood of Type I errors (Logan, 2010). We used a Kruskal-Wallis test and Steel multiple comparisons post-test for non-parametric data to determine whether certain sectors were perceived to play a more important role in water-related research. Analyses were performed in R version 2.12.2 (R Development Core Team, 2011) and significance was determined within a 95% confidence level ($p \leq 0.05$).

We determined the past strengths and weaknesses of water resource management as well as the priorities of water-related research by evaluating the qualitative responses of the conference attendees. Data reduction was attained by performing thematic analysis on the responses obtained from the conference attendees. Evaluation consisted of an inductive phase in which key themes were identified, followed by the analytic hierarchy process (AHP) to generate judgements based on consensus. Opinions that were vague, unclear or did not cluster into definitive themes were excluded from the analyses. Since the questionnaire extracted multiple opinions per respondent, the actual numbers of opinions were greater than the amount of completed questionnaires, adding to the robustness of the data.

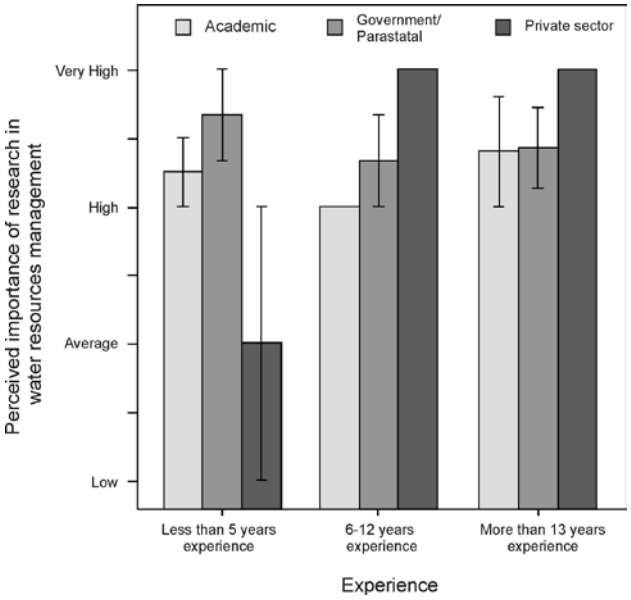

Figure 1
The perceived importance of research by respondents in terms of occupational sector and level of experience

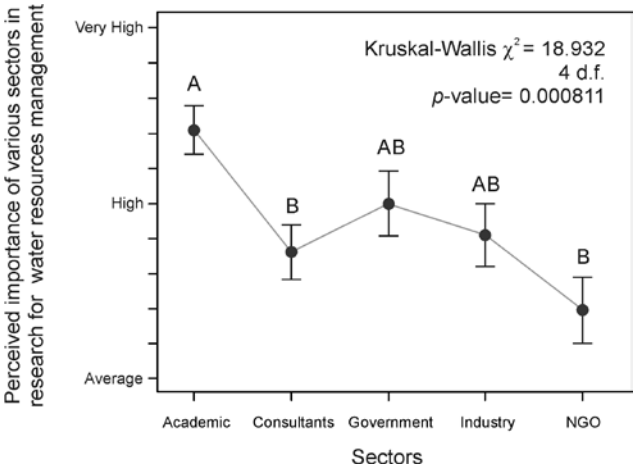

Figure 2
The perceived importance of various occupational sectors in terms of carrying out water-related research, according to respondents. Letter annotations indicate groupings according to the results of a Steel multiple comparisons post-test for non-parametric data.

Results and discussion

Overall, research was perceived to be of above-average importance across occupational sector and experience level (Fig. 1). Our findings suggest that neither occupational sector ($F_{2,22}$ = 0.281, p = 0.757) nor experience level ($F_{2,22}$ = 2.106, p = 0.1457) played a role in the perceived importance of research in water resources management. The interaction between occupational

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Table 1
The strengths and weakness of water resource management according to the proportion of responses by conference attendees

Aspects of water resources management	Proportion of all respondents	Number of responses per sector		
		Academic	Government/ Parastatal	Private sector
Weaknesses (n = 27)				
Implementation and enforcement of policy and legislation	0.296	2	4	2
Lack of institutional capacity	0.222	2	2	2
Lack of leadership and progressive vision	0.111	0	1	2
Water provisioning	0.111	0	3	0
Inadequate collaboration, information handling and sharing	0.111	0	3	0
Lack of continuity; excessive turnover of staff	0.074	0	1	1
Inadequate research funding	0.074	2	0	0
Strengths (n = 29)				
Progressive research and institutional funding across disciplines	0.241	4	1	2
Excellent water-related legislation and policy	0.207	0	3	3
Technical planning across sectors	0.207	0	3	3
Integration of inputs through collaboration	0.172	2	2	1
Environmental education through engagement with stakeholders	0.172	1	3	1

sector and level of experience caused disparities in the perceived importance of research but these disparities were, overall, not significant ($F_{4,22} = 2.629$, $p = 0.062$). Attention must, however, be drawn to respondents within the private sector who had less than 5 years experience; this demographic rated the water-related research as of 'average' importance whereas all other groups rated the importance as 'high' to 'very high'. This could either mean that, within the private sector, experience brings about an appreciation for water-related research, or, alternatively, could relate to a generational influence, i.e. that the newer generation of private sector employees do not value research in water resource management as highly.

Since research was considered important by most respondents, we investigated which sectors were expected to carry out water-related research. The importance of the various sectors was significantly different (K-W $\chi^2 = 18.932$, 4 d.f.; $p < 0.005$) according to the respondents. Not surprisingly, academic institutions were regarded as the protagonists in water-related research. Government and industry were also regarded as having an important role in research. Private consultants and non-governmental organisations (NGO) were perceived to play the smallest (although still above average) role in research in water resource management. This highlights a potential opportunity for future strategy: NGOs, with their unique resources and skill sets, have played an ever-increasing role in international environmental management (Jasanoff, 1997; Raustiala, 1997) and it is possible to extend these benefits to research. The same can be said for private consultants. These 2 sectors are responsible for much of the application of research findings; thus they could act as feedback channels to guide future research endeavours. Similarly, they could play a central role in collating research findings due to their unaffiliated statuses and objectivity.

The past successes and failures of water resource management in southern Africa are listed in Table 1. There was little overall consensus regarding the weaknesses of past actions, but the 2 views that topped the list were the 'implementation and enforcement of policy and legislation' and 'the lack of institutional capacity'. The continuing and escalating damage that is being done to the environment is often attributed to the lack of effective enforcement of legal instruments (Olivier, 2002). This is particularly disheartening as most of the perceived strengths are related to progressive research, policy and planning. This would suggest that any gains made by these advanced roadmaps are being undone by a lack of implementation caused, not by external environmental factors (with the possible exception of 'water provisioning'), but by human inefficiency. Water policy reviews (MacKay et al., 2003; De Coning and Sherwill, 2004; De Coning, 2006) repeatedly identify the above-mentioned weaknesses as major limitations of the South African water policy. Reasons for this include the failure to develop implementation options during the water policy formulation stage, inadequate financial resources available for implementation of the policy, and the fact that too few people, with a diverse range of competencies, are available to implement and enforce water legislation (De Coning and Sherwill, 2004).

Interestingly, none of the future research priorities suggested by the respondents aimed to address these human resource inefficiencies (Table 2). The research priorities were grouped in a 2-tier hierarchy with 6 level-I priorities (A-F) and 16 level-II Priorities (A1-F1), and these priorities were consistent across sectors. Of the level-I priorities, only 'Stakeholder engagement (E)' was not technical in nature. Could this suggest that it is believed that research cannot aid in improving 'soft skills' like leadership, collaboration and management? If so, then there might be a need to include non-traditional research fields, such as sociology, industrial psychology or management sciences, in future water resource management. Another alternative would be the implementation of formal capacity-building mechanisms in research projects throughout the entire lifespan of the project and not only at its culmination (Breen et al., 2004).

The top 2 level-I research priorities, 'Optimising the water usage cycle' and 'Water quantity management', were both technical in nature and deal with physical phenomena. Based on these findings, research efforts should concentrate on technical innovations that ensure effective and efficient water usage. What was counterintuitive was the perceived need for research toward 'Strategy and policy (C)'. This is unexpected since this division was listed as being one of the strengths of past water resource management. One explanation could be that there is a perceived need for these strategies to be reassessed to eliminate the lack of enforcement and increase collaboration between

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Table 2
The hierarchical priorities of water-related research based on the proportion of responses by conference attendees

Priorities (n = 77)	All responses		Responses per sector		
	Level I	Level II	Academic	Government/ Parastatal	Private sector
A- Optimisation of the water usage cycle (n = 23)	0.299				
A1- Reducing water usage through conservation techniques		*0.348*	2	3	3
A2- Improving waste water treatment technologies		*0.304*	2	1	5
A3- Recycling and reusing water		*0.217*	1	2	2
A4- Increasing efficiency of water provisioning systems		*0.131*	0	2	1
B- Water quantity management (n = 15)	0.195				
B1- Managing water demand and storage		*0.333*	0	3	1
B2- Managing water availability		0.333	3	1	1
B3- Quantification of water resources		*0.2*	1	1	1
B4- Groundwater-surface water interactions		*0.133*	1	1	0
C- Strategy and policy (n =14)	0.182				
C1- Progressive water-related strategy and policy		*0.429*	1	2	3
C2- Review of legislation		*0.286*	0	3	1
C3- Integration of objectives across sectors		*0.286*	1	3	0
D- Water quality management (n = 13)	0.169				
D1- Reducing environmental water pollution		*0.769*	3	4	3
D2- Improving water quality resource management		*0.231*	1	1	1
E- Stakeholder engagement (n = 6)	0.078				
E1- Understanding the social aspect of water usage		*0.5*	0	2	1
E2- Public education in water resources management		*0.5*	0	3	0
F- Ecological Integrity (n = 6)	0.078				
F1- Basic research into the ecology of freshwater habitats		*1*	2	3	1

sectors. If so, it is a positive sign of continuous adaptation and refinement. The success of such an adaptive management strategy is dependent on a proactive culture of learning and adjustment across all sectors (Mackay et al., 2003) which, again, emphasises the need for progressive vision and leadership.

A positive outcome of our findings is that most of the perceived research objectives align with the Key Strategic Areas of the South African Water Research Commission (WRC, 2011). This strategic alignment is progressive because consensus on unstated and assumed objectives is a fundamental prerequisite for environmental research of an interdisciplinary nature (Campbell, 2005).

Conclusions

Research was perceived by stakeholders as being important to water resource management. The expectations as to which sectors should carry out research were clear but opportunities could arise if previously uninvolved sectors (NGOs and consultants) are incorporated into research strategies. Although there were positive aspects to water resources management in southern Africa, a worrying finding was that most perceived weaknesses relate to human resource constraints. The absence of this factor in future research priorities suggests that stakeholders are not confident that research can address the absence of 'soft skills'. Addressing these constraints would offer a distinct research prospect that was not listed by respondents. Overall, the respondents' research priorities are aligned with those of the Water Research Commission which is a promising development towards interdisciplinary water research management.

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