The status quo of research on South Africa's water resource management institutions

Richard Meissner[1]*, Nikki Funke[1], Shanna Nienaber[2] and Cebile Ntombela[1]
[1]*CSIR, PO Box 395, Brummeria, 0001, South Africa*
[2]*Department of Science and Technology, Meiring Naude Rd, Brummeria, 0184, South Africa*

ABSTRACT

The South African water resource management institutional landscape has seen some dramatic changes since the new dispensation came into power in 1994. Not only have legislation and policies changed, but there has also been a significant increase in the number of non-state actors in the policy development process. Water resource governance has therefore become more complex and its regulatory component is being implemented by a number of legislative institutions: catchment management agencies, water user associations, irrigation boards, and international water management bodies. Policy development is influenced by a myriad of non-state actors, scientists included. A comprehensive literature review of research on water resource management institutions published between 1997 and 2011 shows that scientists are focusing predominantly on catchment management agencies and aspects regarding their institutionalisation and organisational functionality. There is much less of a focus on other entities, such as advisory committees, international water management bodies, irrigation boards, the water tribunal and water user associations. What the review has also revealed is that research on water resource management institutions has been conducted predominantly by scientists from the natural sciences. There is therefore an evident need for a research focus on water resource management institutions other than catchment management agencies. In addition, there should be a focus on informal aspects of water resource governance and new theoretical developments, also from disciplines other than the natural sciences, in the fields of water resource governance and politics.

Keywords: Water resource management institutions, literature review, catchment management agencies, water user associations, legislation, irrigation boards, catchment forums, international water management bodies

INTRODUCTION

South Africa's water institutional landscape has seen some dramatic changes since the new dispensation came into power in 1994. Government published the White Paper on a National Water Policy for South Africa (DWAF, 1997), and the National Water Act (Act 36 of 1998) (RSA, 1998) replaced the 1956 Water Act (Act 54 of 1956) (Union of South Africa, 1956; Turton et al., 2004). The National Water Act provides the legislative framework for the management of water resources in South Africa and as such presents an opportunity for the establishment of appropriate water resource management institutions. The institutional setting consists of legislative entities such as catchment management agencies (CMAs), international water management bodies (IWMBs), irrigation boards (IBs) and water user associations (WUAs). In addition, the National Water Act has a strong focus on decentralisation. The Act, contrary to previous water legislation, makes provision for public participation in the water resource management process. Another important element in the National Water Act, which is drawn from the Constitution of South Africa (Act 108 of 1996), is the subsidiarity principle. This principle stipulates that those functions that can be more efficiently and effectively carried out by lower levels of government should be delegated to the lowest appropriate level (Funke et al., 2007a).

The decentralisation tendency in South African water resource management over the past decade and a half has not only taken place within the legislative domain, but also at grassroots level. Prior to the start of the new dispensation, only a limited number of non-state actors, such as industry and the agricultural sector, had been involved in water resource management. This changed after 1994, when a variety of other non-state stakeholders, such as emerging farmers, the epistemic community (other than law professionals) and consultants also started becoming involved in water resource management. The involvement of these actors suggests a broader, dynamic and decentralised water sector where water resource management no longer only takes place at the bureaucratic, engineering or legal level (Meissner and Turton, 2003). Therefore, from a societal point of view, the water resource sector has become ever more complex (Lotz-Sisitka and Burt, 2006): not only has the number of actors in water resource management increased, there have also been substantial changes in the political environment which have had both intended and unintended consequences for water resource management in South Africa.

The purpose of this paper is to assess literature on water resource management institutions published since the promulgation of the White Paper, and to chart the 'landscape' of current knowledge regarding these institutions. This investigation not only discusses the past research agenda but also provides a foundation for future research. A key question formed the basis of the literature review that was conducted: 'What is the state of knowledge about South Africa's water resource management institutions, and where are the knowledge gaps that need to be filled?' The paper starts with background information on

* To whom all correspondence should be addressed.
☎ +27 12 841 3696; fax: +27 12 841 3954;
e-mail: rmeissner@csir.co.za
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the subject. This is followed by an outline of the methodology and an empirical analysis of the literature in terms of coverage of water resource management institutions, the scientific/academic background of the authors involved in peer-reviewed publications and cross-cutting themes. The implications of the investigation are discussed in the conclusion.

BACKGROUND AND SCOPE

Water resource management in South Africa is facilitated and implemented through a number of institutions that derive their mandate from water legislation and non-legislative arrangements. The National Water Act denotes a water resource management institution as a CMA, WUA, IWMB, 'or a person who fulfils the functions of a water management institution in terms of the Act' (RSA, 1998, Chapter 1). In addition to the water resource management institutions defined by the National Water Act, other institutional entities that deal with water resource management exist. These include advisory committees (our literature search only picked up one publication in which advisory committees are mentioned, namely Wester et al., 2003), catchment forums, IBs and the water tribunal (our literature search did not pick up any literature that had been conducted on the water tribunal during the period under review) (RSA, 1998). Catchment forums are not provided for in the Act; these forums are considered to be the forerunners of CMAs (DWAF, n.d.). Chapter 7 of the Act calls for the institutionalisation of CMAs (RSA, 1998; Schreiner and Van Koppen, 2001; Van Koppen et al., 2002; Mosai, 2004), while Chapters 8 and 10 focus on WUAs and IWMBs respectively (RSA, 1998). Most WUAs were previously IBs, and, as such, WUAs are mostly focused on water provision for irrigation purposes. According to the National Water Act, existing IBs, water boards for stock-watering purposes as well as water control boards responsible for groundwater management will, in future, be transformed into WUAs (RSA, 1998). The transformation of IBs and related entities into WUAs, and the accompanying decentralisation of water resource management are continuous processes and should be seen as a dynamic progression in the South African water resource management landscape.

In October 1999, Government established 19 water management areas (WMAs) through Government Notice No. 1160 (DWAF, 2004). Their boundaries are along catchment divides and do not coincide with the administrative borders of different local government institutions: local, district and metropolitan municipalities. Every WMA will eventually have a CMA for water resource management and for coordinating the activities of users and institutions. The CMA will fulfil this judicial function through the establishment of a catchment management strategy, which will determine 'the principles according to which available water will be allocated among competing user groups' (DWAF, 2004: 94). Institutionally, the CMA governs the activities of the various water-related entities in a given catchment. To date only the Breede-Overberg and Inkomati CMAs have been established (Simpungwe, 2006; Warner, 2006; 2007).

In addition to the challenge of establishing effectively functioning WUAs and CMAs, it is also challenging for the Department of Water Affairs (DWA) to achieve the National Water Act's dual goal of 'water use for development' and 'protection of the resource'. This predicament stems from the presence of various management styles, with managers and government officials operating in a democratic yet globalised environment, characterised by the increasing generation and diffusion of knowledge (Rogers et al., 2000). Water resource management institutions are operating in highly complex and ever-changing institutional, socio-political, regulatory, economic and bio-physical environments influenced by multi-varied institutions and individuals at numerous levels of time and scale (Rogers et al., 2000).

Research subsequent to Rogers et al.'s (2000) observation has investigated ways in which water resource management institutions are able to cope with the ever-changing institutional landscape in which they operate (e.g. Pegram and Palmer, 2001; Schreiner and Van Koppen, 2001; Mazibuko and Pegram, 2006; Pegram et al., 2006; Pollard and Du Toit, 2008; Roux et al., 2009). In particular, themes that this research addresses include, among others, lessons learnt (Van Wilgen et al., 2003; Fowkes, 2007; Funke et al., 2007b), optimising stakeholder participation (Van Wilgen, 2003; Wester et al., 2003; Gueze, 2007; Du Toit and Pollard, 2008; 2010) and popular articles on leadership (Dent's CMA Leadership Newsletters, 2004a-u; 2006a-d; 2007a-b; 2008a-c; 2009a-e; 2010; 2011). In the section below, we summarise the methodology that was applied in this study.

METHODOLOGY

In order to ascertain what the status quo of research on South Africa's water resource management institutions is, it was necessary to conduct an extensive literature review. This was done by conducting a comprehensive database search and using a variety of search terms that relate to the research topic or agenda. These terms included: articles, water resource management institutions, CMAs, WUAs, IBs, international water management bodies, integrated water resource management (IWRM), catchment forums, biophysical-societal, national water legislation, governability, challenges/constraints, opportunities, transformation, multi-stakeholder platforms, reform, decentralisation, integrated information management and modelling systems, co-learning, complexity, cooperative governance, dialogue, leadership, stakeholder, community, finances, financial resources, institutional transformation, groundwater, irrigation, learning, learning organisation, National Water Act, science-policy interface, stakeholder participation, public participation, pricing strategy, multiple stakeholders, capacity building, adaptive management, Inkomati, water, resource, governance, South Africa, Breede and CMA Leadership Newsletter. Combinations of search terms included: water, resource, governance and South Africa; South Africa, water, governance and articles; and Water Research Commission, water and governance. Databases that were searched include: Google Scholar, the Water Research Commission (WRC) database, the Council for Scientific and Industrial Research (CSIR) database and Scopus. Scopus covers almost all the databases to which the CSIR has access. Because Scopus is part of Elsevier, Science Direct is also covered by Scopus as well as abstracts from Taylor & Francis, Springer, Nature, Wiley and others (Van Heerden, 2013). According to the Scopus website, 'Scopus is the largest abstract and citation database of peer reviewed research literature with more than 20,500 titles from more than 5,000 international publishers' (Elsevier, 2013).

We consulted published documents from 1997, when the White Paper was promulgated, to 2011, as the post-apartheid period marks a significant departure from previous water resource management styles. The focus was on literature from

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peer-reviewed articles in scientific journals and books, government publications (including the National Water Act, White Paper, policy documents and guidelines), working papers, conference papers, conference proceedings, WRC reports as well as masters and doctoral theses and scientific reports by, for instance, the CSIR and the International Water Management Institute (IWMI). Masters and doctoral theses are included since these often culminate in peer-reviewed articles published in scientific journals. The thinking of influential individuals in the field of water resource management institutions was also considered (e.g. Mark Dent's CMA Leadership Newsletter series).

After having identified and collected a number of sources of literature (189 publications in total), we summarised the key message(s) of each document, its relevance to the topic of water resource management institutions, and which other relevant sources it may link to. From the summaries of the data that we had collected from different sources, we started distilling key cross-cutting, content-related themes that emerged out of the research. This is known as a cross-sectional code and retrieve method, and enables the researcher to devise a common system of categories which are then applied to the whole data set to search for and find chunks of labelled data. This is also a useful approach to make comparisons and connections across the data (Spencer et al., 2003). The cross-cutting themes that were identified are:

- Adaptive management
- Biophysical-societal
- Challenges/constraints
- Co-learning/learning organisations
- Complexity
- Cooperative governance
- Finances/financial resources
- Governability
- Groundwater
- Institutional transformation
- Irrigation
- IWRM and stakeholder participation
- Science-policy interface

Subsequently, the themes that we had identified were downloaded into the Weft QDA software programme. Weft QDA is a software tool developed to analyse textual data such as interview transcripts, documents and field notes, and is available free of charge under a public domain licence. The Weft QDA programme facilitates the qualitative 'coding' of textual data (Fenton, 2006; Nortje et al., 2011). This is a useful tool that has been used to good effect in a number of research projects at the CSIR that have required qualitative analysis.

The purpose of identifying themes in the literature and coding them with the WEFT QDA software was to ascertain to what extent the literature covered each of these themes, or, in other words, to ascertain in how many documents each of the themes appeared as an important area of focus. We also looked at the scientific/academic background of the authors of some of the key peer-reviewed literature we collected to determine from which disciplinary backgrounds the topic of water resource management institutions has been analysed.

By conducting an extensive literature search, organising the data into a structured summary and identifying key emergent themes coming out of this data set, it was possible to construct a good overview of the state of existing knowledge about water resource management institutions in South Africa.

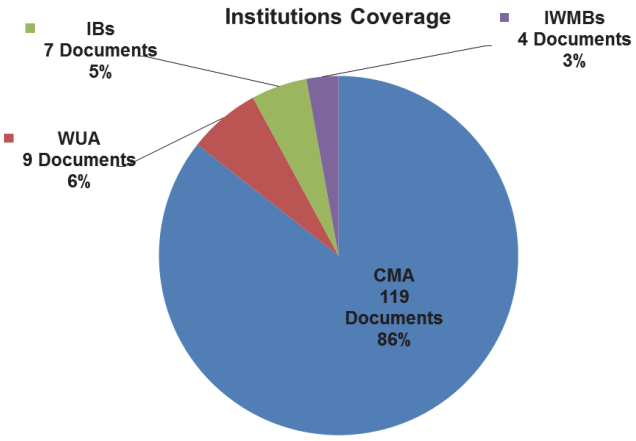

Figure 1
Water resource management institutions coverage

EMPIRICAL ANALYSIS

This section includes an analysis of the following focus areas that were identified as part of the literature review: coverage of water resource management institutions, authors' scientific/academic background and authorship status (i.e. lead or co-author), and cross-cutting theme coverage.

Coverage of water resource management institutions

Of the literature that was reviewed, 139 documents focus specifically on 4 water resource management institutions: CMAs, IBs, WUAs and IWMBs. The other 50 documents that we reviewed either did not focus on water resource management institutions, or did not deal with South African water resource management institutions, and were therefore excluded. For the purposes of this paper we focused on the research done on different water resource management institutions, but did not analyse the functionality of these institutions.

Figure 1 indicates the percentage of publications covering the different institutions: of the 139 documents reviewed that deal with South African water resource management institutions directly, 86% cover CMAs, followed by 6% for WUAs, 5% for IBs and 3% for IWMBs. For the purpose of this paper we focus on CMAs in particular as they are covered by the overwhelming majority of the literature reviewed. Here follows a brief summary of some of the issues related to CMAs that were discussed in the literature we identified.

Considerable effort has been put into determining how CMAs can operate effectively, although this has been done mostly in theory and not in practice. So, for instance, Dent's CMA Leadership Newsletters cover a wide range of topics including leadership, financial viability, implementation, knowledge management, capacity building, complexity, cooperation, integration, absorptive capacity and communities of practice. For example, the Department of Water Affairs and Forestry (DWAF) (now known as DWA) in 2002 developed guidelines for viability studies prior to the establishment of CMAs, which need to consider organisational, social and financial viability (DWAF, 2002). Schreiner and van Koppen (2001) focus on the need for developmental CMAs that are required to stimulate poor people's water use for productive purposes to improve their livelihoods through cooperative governance. Mazibuko and Pegram (2006) write about the need for CMAs,

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as the future managers of water resources, to cooperate effectively with local government in order to realise IWRM.

A key problem around CMA formation has been the challenge of effective decentralisation which necessitates DWA to delegate considerable authority and responsibility to local role-players and accept this devolution. For various reasons, this entrustment has been taking place at a very slow pace (Denison and Karar, 2010). A further possible impediment to CMA formation could be the competition over water use between high-volume and poor water users, as the former may feel entitled to a considerable amount of control over the water resources they are making use of (Schreiner and Van Koppen, 2001; Brown and Woodhouse, 2004).

Since the establishment of the Inkomati and the Breede-Overberg CMAs, DWA has decided on the consolidation of multiple WMAs into a single CMA for the purposes of more effective governance. This move, which will reduce the planned number of 19 CMAs to 9, is envisaged to have several advantages for DWA and the private consultants involved in CMA establishment. These advantages include reducing the management, technical and administrative demands of CMA establishment (as well as associated costs) (DWA, 2013). This logic implies that CMA establishment will be a more top-down process in future, with stakeholder engagement becoming more streamlined and stakeholders only being consulted when needed.

A further suggestion on moving forward CMA implementation is to recognise that catchments are complex systems (Pollard and Du Toit, 2008; Roux et al., 2009), and to formally adopt an action-learning cycle, which lends itself to modifying processes if necessary (Mackay et al., 2003; Denison and Karar, 2010), within a framework of adaptive management (Rogers et al., 2000; Pollard and Du Toit, 2008; Roux et al., 2009; Roux et al., 2010). Roux et al. (2009) identify 4 essential learning-related abilities for CMAs: to learn from external sources, to effectively process this learning to create internal knowledge, to transfer knowledge internally and externally, and to adapt where necessary to remain focused on the CMA's vision. Action-learning would also introduce the use of research and monitoring tools in order to inform decisions made by the CMA Board (Denison and Karar, 2010).

The scientific/academic background of the authors involved in peer-reviewed publications

In order to reflect on the implications of the scientific/academic background of some of the authors of the literature we consulted, we identified 37 peer-reviewed (influential) publications from the literature set that deal specifically with water resource management institutions. By influential we mean studies that were published in peer-reviewed journals such as *Water SA*, research funded by the WRC, as well as technical reports written by organisations such as the CSIR and IWMI. We therefore excluded government documents (e.g. guidelines and policy documents), working papers, conference papers, masters and doctoral theses and Mark Dent's CMA Leadership Newsletters, because these are not peer reviewed. A total of 62 key authors were involved in the drafting of the peer-reviewed documents that were consulted as part of this exercise, and the majority of these were South Africans (see Fig. 2). Of these 62 authors, 52 or 84% have a natural science background (e.g. aquatic biology, hydrology or engineering). Only 5 social scientists (8%) and 5 economic and business management scientists (8%) were involved in these peer-reviewed publications, with only 4 of

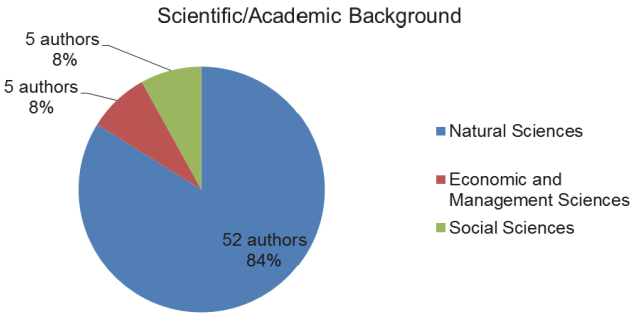

Figure 2
Scientific/academic background of authors of selected peer-reviewed sources

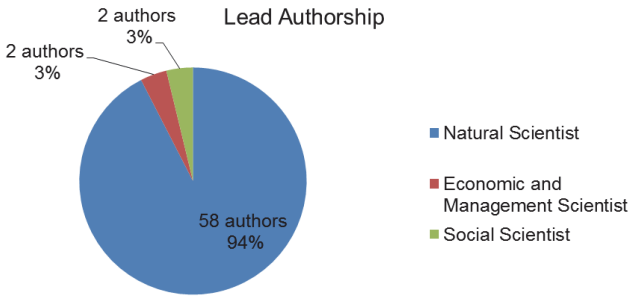

Figure 3
Lead authorship of selected peer-reviewed sources

these 10 authors as lead authors (see Fig. 3). These key authors' backgrounds were verified by investigating their profiles on their respective institutions' websites.

The fact that so many authors from the literature subset that was consulted come from the natural sciences is a significant observation since it can be argued that the complexity of social-environmental problems should be understood in a holistic manner rather than from only one disciplinary perspective. This is because 'nature and society interact to make a whole that is different from the sum of its parts' (Kinzig, 2001 p. 709). Understanding the complex relationship between nature and society requires the integration of knowledge from various traditional disciplines (Kinzig, 2001). In this regard, researchers cannot expect that an integration of various disciplines should be the responsibility of policy-makers, managers or a broad array of other knowledge users (Kinzig, 2001). Kinzig (2001 p. 709) goes so far as to say that '[s]cholarship that can bridge the traditional divides among the social, natural, behavioural, and engineering sciences represents one of the great intellectual challenges of the 21st century.'

Interdisciplinarity is seen as a promising way to overcome silo-based disciplinary research. It goes beyond multidisciplinary approaches, where different disciplines work together in a parallel manner. Not only is interdisciplinarity a method (Reich and Reich, 2006), concept, philosophy or policy instrument, it is also an ideology (Moran, 2006) where scientists interactively combine their intellectual capital to solve problems (Cherwitz, 2005). As such, interdisciplinarity has the potential to transform, influence and challenge assumptions of mainstream disciplines.

A compelling reason for interdisciplinary research is the testing of existing theories from different disciplines. Theories developed in the different disciplines have 'blind spots' that have an impact on the policy process. Ecological theories were

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at times developed with the absence of humans, or in systems where humans are seen as external, simple or a detrimental factor. Their interaction with ecological systems is almost never considered (Kinzig, 2001). Neoclassical economic theory, on the other hand, is based on the assumption of a 'reliable and uniform biosphere, one with flows of ecosystem services and natural resources that are expected to persist or expand so as to conform to stated political or economic goals, and to vary little from biome to biome' (Kinzig, 2001: 710). This theory is also limited in that it assumes that natural resources and accompanying ecosystem services will automatically adapt to fit in with society's predetermined political or economic objectives. Interdisciplinary research is therefore necessary for two reasons: (i) the solution of environmental problems demands it, and (ii) 'pushing the frontiers of intellectual inquiry compels it' (Kinzig, 2001: 710). However, while intellectual enquiry can develop approaches to address environmental problems, such approaches will not necessarily always resolve these problems, but may in fact, at times, aggravate them.

A further argument in favour of interdisciplinary research is that there is almost no problem that does not require an interdisciplinary approach, because society has escaped the confines of the ordinary and has become ever more complex. There is therefore also a close link between interdisciplinarity and complexity thinking (Hoffmann-Riem et al., 2008). Employing interdisciplinarity, infused with complexity thinking, in governance systems would give more substance to otherwise abstract scientific processes and would assist actors to break the mould of the command and control philosophy inherent in bureaucratic thinking in government and/or the private sector. In addition to bringing researchers or academics from different disciplines together, the results of interdisciplinary research can also be used to inform decision-making to address complex issues in the policy and business environments.

In this regard, Jäger's (2008 p. viii) advice is instructive: 'There are barriers within the scientific community where many scientists prefer to continue their basic research and not confront issues and questions raised by non-scientists.' 'While such research will remain important…', she continues '…tackling complex issues of concern to the public and the policy-makers will need input from scientists and non-scientists, resulting in a different type of research.' This can only happen through the notion of collaborative learning (Jäger, 2008 p. viii). Doing research that is not truly transdisciplinary has implications not only for the nature of the research agenda, but in the long-run also for the policy process. The broader theme of water resource management institutions includes aspects that have a distinctive social scientific flavour, for example, stakeholder engagement. Such aspects are therefore a good reason why water resource management institutions should be studied from not only an interdisciplinary, but also from a transdisciplinary perspective.

Having discussed the authors' scientific and academic background of the literature subset that was identified for the purposes of this exercise, and some implications around this, we now turn our attention to an analysis of the prominent cross-cutting themes that we identified from our literature review.

Cross-cutting theme coverage

As is evident from Fig. 4, the cross-cutting themes that are covered substantially in the literature include: adaptive management, challenges/constraints, co-learning/learning organisations, complexity, cooperative governance, finances/financial resources and IWRM and stakeholder participation. These

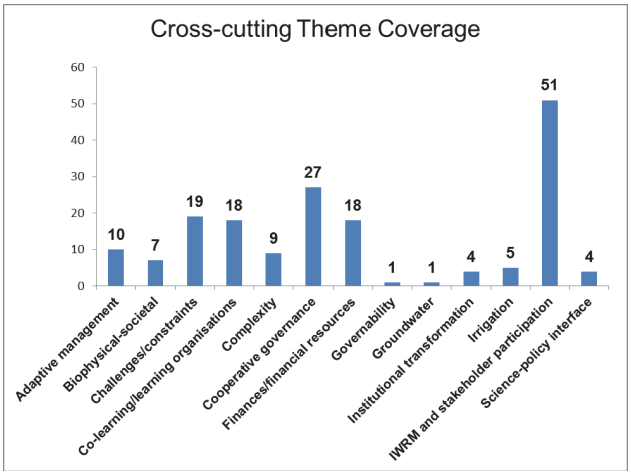

Figure 4
Cross-cutting theme coverage

cross-cutting themes, which relate to South African water resource management institutions, are considered in more detail below to give an overview of the nature of the debate and ideas that are prevalent in discussions about each of them. The themes are discussed in alphabetical order.

Adaptive management

The literature that was reviewed had quite a bit to say about adaptive management, and its derivative strategic adaptive management (SAM). According to Pollard and Du Toit (2008), past water resource management approaches have failed to deal with complexities and rapidly changing systems. In order to grapple with such changes and complexities a 'learning by doing' or adaptive management approach is needed. This requires an understanding of water resources as complex systems. Adaptive management is viewed as the 'management strategy that builds rather than erodes resilience' (Pollard and Cousins, 2008 p. 13). Adaptive management requires having an initial adaptive planning process that is iteratively followed by an adaptive decision-making process. The adaptive planning process starts with all stakeholders agreeing on a 'desired state' that they should work towards. The reason behind the need for such an agreement is to ensure that decision-making identifies and influences factors that can contribute to achieving a desired future condition, rather than choosing between immediate alternatives. The 'desired state' is made operational by a set of objectives with well-defined measures and targets. These measures and targets are subsequently monitored, and depending on the results of the monitoring, adaptation (changing the ways things are done) may be required (Roux et al., 2009).

SAM is a South African developed variant of adaptive management. SAM has 3 key components. It can be considered strategic because it involves decisive action with foresight and purpose. It is adaptive because of the strong 'learning by doing' element that underpins it, and it is participatory (Roux et al., 2009). Rogers et al. (2000) state that SAM is a departure from a 'command and control' management style, and is inclusive, strategic, adaptive and creative. It also rests on knowledge management as a central pillar in order to create a partnership between science, management and society to move towards a common vision. SAM is particularly suitable for application to CMAs (Roux et al., 2009).

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SAM was also hailed as a success by participants in the WRC 2nd Governance Think Tank on 4 November 2011. Change, and its facilitation and implementation, was the main theme of the workshop. For change to happen, SAM needs to be incorporated into planning initiatives, especially in the co-creation of knowledge within the ambit of transdisciplinarity and complexity (Palmer, 2011). Dent's CMA Leadership Newsletters cover a wide range of 'learning-by-doing' or SAM advice to water resource management institution leaders.

Challenges/constraints

A number of challenges with regard to the nature, transformation, establishment and operation of water resource management institutions in the South African context have been documented in the literature that was reviewed. As mentioned above, South Africa adopted a decentralised approach to water resource management in 1998, which necessitated the establishment of multi-stakeholder institutions such as CMAs and WUAs (Faysse, 2004; Faysse and Gumbo, 2004; Seshoka et al., 2004). Faysse (2006) identifies 5 broad challenges associated with multi-stakeholder platforms or institutions. These challenges include issues related to power relationships, the composition of the institutions, stakeholder representation and capacity to participate meaningfully, decision-making powers and mechanisms, and the costs of multi-stakeholder institutions. Mirumachi and Van Wyk (2010) investigate the extent to which the cooperative principle has facilitated stakeholder interaction within the context of multi-stakeholder institutions in South Africa and elsewhere. They argue that the challenges faced within the context of multi-stakeholder institutions relate to power disparity, the interdependence of actors and the perceptions about risks associated with inclusive decision-making.

Challenges have also been documented regarding the involvement of historically disadvantaged individuals (HDIs) in the process of transforming IBs into WUAs as required by current legislation. Seshoka et al. (2004), for example, found that HDIs still did not sufficiently participate in the decision-making processes in the Lower Olifants Water User Association, which had been transformed from the Vredendal Irrigation Board. This lack of participation has been attributed to insufficient communication and trust among stakeholders. Similar findings were documented by Faysse and Gumbo (2004) in their study of the Hereford Irrigation Board.

Mosai (2004) documents the challenges associated with the establishment and operation of CMAs. These include socio-political, financial, water quality and technical capacity and capability challenges.

Co-learning/learning organisations

The idea of co-learning has become prominent because of the growing recognition that the sustainability of social-ecological systems (SESs) depends on the capacity of actors to learn and respond to changing circumstances together. When considering co-learning in relation to water resource management institutions, it is important to recognise that the term is part of a suite of interlinked concepts that aim to explain how people learn together within a given socio-environmental context. Some terms that overlap and often co-exist with the idea of co-learning are social learning, learning organisation, trans- and interdisciplinarity, cooperative governance, synergism, adaptability and SAM (Colvin et al., 2008; Roux et al., 2009; Roux et al., 2010).

Dent (2004a) indicates that co-learning will be a vital process in the success of CMAs. With specific reference to the Inkomati CMA, Roux et al. (2010) go so far as to say that in order for the CMA to deal with the challenges it faces, staff need to go on a path of continuous learning, with SAM as their main tool. This means that CMAs need to acquire, create and transfer knowledge and adapt where necessary. It is not only at the organisational level that learning will take place but also at the individual level. Learning can take place through observation, learning from role models and learning through active participation (Roux et al., 2009).

In terms of linking co-learning with stakeholder participation, Van Wilgen et al. (2003) are of the opinion that stakeholder participation will bring about a learning experience and enhance the effective management of river systems. Dent (2004b) shares a similar sentiment, especially regarding systems models and their operation. Dent also believes that knowledgeable persons should guide the various approaches to water systems modelling (Dent 2004b). He does not, however, specifically clarify who these knowledgeable people are and who decides on what counts as being knowledgeable. Such judgements would need to be negotiated in specific local contexts as a knowledgeable person in one area may not be similarly knowledgeable in another area. Dent (2006a; 2007a; 2007b; 2010) also notes that a learning environment needs to be created for CMA board members to do IWRM 'test runs' and learn from mistakes (Roux et al., 2009).

In addition to the above-mentioned benefits of co-learning, it is also suggested that co-learning and the resultant co-production of knowledge are particularly important when no single actor has the solution to a particular problem. By working on solving the problem together the chances of creating a sustainable solution are better (Roux et al., 2009). Also, co-learning creates the space for stakeholders to create a shared vision or body of knowledge rather than being consulted on someone else's views. This has the benefit of creating space for capacity building within stakeholder groups and for people to explore practices in relation to water in a creative rather than restrictive or management-driven manner (Colvin et al., 2008).

In order for co-learning to take place, it is important that there is a high degree of trust between actors, and that the various parties all commit resources to the process. It is also important to be sensitive to power relations in this interaction. Ideally one actor should not be more influential than another (Colvin et al., 2008; Roux et al., 2009). It should be recognised that co-learning occurs most easily if communities of practice exist and there is a culture of knowledge sharing to facilitate this interaction between and within organisations and networks (Roux et al., 2009; Roux et al., 2010). Organisations or networks with a co-learning culture also need to show an appreciation and respect for a variety of knowledge forms as not all actors necessarily bring so-called scientific knowledge to the debate. Knowledge will often be experiential or rooted in cultural understandings. Presently, there is an expectation that CMAs, and other forms of water resource management institutions such as WUAs, will help to foster these communities of practice and collaborative organisational spaces (Roux et al., 2009).

Complexity

Complexity is a term that commonly creeps into water resource management institutions literature and is closely tied to ideas around adaptive management and inter- and transdisciplinarity. The issue of complexity has grown in predominance

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in water resource management institutions literature given the growing recognition that SESs, as well as the institutions created to manage these systems, are inherently complex. In addition, SESs and the institutions that govern them are able to self-organise and as a result are unpredictable (Roux et al., 2009). This unpredictability is the result of multiple local actors and processes interacting, which leads to unintended outcomes. It is important to note, however, that complexity understandings and approaches are not always favoured in the water sector. Historically there has been a preference for more control and predictability based approaches to both knowledge production and management in this sector (Simpungwe, 2006).

Dent (2006b) suggests that operating in a manner that recognises and actively deals with complexity demands that we firstly commit to working in big teams and with a variety of stakeholders in a cooperative manner (Dent 2006b). Secondly, we have to grapple with communication, and barriers to communication, and commit to ongoing dialogue with each other (Dent 2006b, Dent 2006c). Thirdly, it is necessary to build meaningful long-term relationships with people, and commit to working out how to effectively achieve integration within the water sector (Dent 2006b). Fourthly, we must make significant resources available to deal with social issues relating to environmental management as investing in technical and scientific innovation alone is not enough (Dent 2006b). Finally, we need to understand inter-linkages, such as how knowledge travels in a multi-sectoral setting (e.g. from catchment level up to national settings, from the water sector into other related sectors, from catchment level down to specific individuals and groups) (Dent, 2008a).

Grappling with complexity is a challenging task and thus demands innovative leadership that can balance the need for creativity and control (Dent, 2004c) within water resource management processes.

Cooperative governance

In the literature that was reviewed, the idea of cooperative governance is closely related to the idea of participatory governance as well as community-based governance. It is also linked to the notion of co-learning. Two closely related, and often confused terms are cooperative governance and cooperative government. These will be unpacked in more detail in this section.

In broad terms cooperative governance is a process where multiple actors both from within government and different parts of civil society work together to manage, respond to, and coordinate in relation to a specific issue of mutual interest. Cloete et al. (2003) suggest that cooperative governance is based on 4 main assumptions. Firstly, no single actor can effect change. Secondly, complementary and competing interests must be recognised. Thirdly, new structures should be established to promote cooperative behaviour amongst various stakeholders. Finally, the responsibilities of different stakeholders involved in an issue need to be clarified.

Brown (2011) argues that there are a number of key influences that have shaped the cooperative governance paradigm and its assumptions. Firstly, there is the idea that local, decentralised management limits the potentially negative influence of centralised government control, which runs the risk of being inefficient and corrupt (Brown, 2011). Secondly, there is a precedent (and arguably even some pressure) from the international community to adopt participatory, decentralised forms of governance (Brown 2011). Finally, there is the idea that participation has socially transformative power. In other words, by including a variety of government and civil society actors in governance processes, the actors become more educated, aware and active in governance processes (Brown, 2011).

Cooperative government is a specific facet of cooperative governance. Chapter 3 of the South African Constitution enshrines the principle of cooperative government. This principle implies that the different spheres of government (national, provincial, and local) are separate and independent but cannot function without cooperating with each other given that they impact on each other. Therefore, the functioning of government needs to be driven by notions of unity, decentralisation and cooperation. Government is expected to establish structures and institutions to promote and facilitate cooperative governance as well as mechanisms and procedures to promote and facilitate intergovernmental relations (RSA, 1996; Colvin et al., 2008; Mazibuko and Pegram, 2008). Governance is therefore a process whereas government is one of many social institutions that provide a specific structure within which governance can take place.

The National Water Act has been important for establishing what cooperative governance implies in a water resource management context and is seen as a pioneer in promulgating the participatory and devolutionary approaches which lie at the heart of the cooperative governance paradigm (Brown and Woodhouse, 2004). As a result, cooperative governance can be found as a cross-cutting theme in all water resource management institutions.

The establishment of CMAs to facilitate cooperative governance in catchments is seen as crucial for decentralising water resource governance. CMAs are believed to be important for fostering cooperative governance between themselves, local government and other actors in a catchment, such as WUAs, IBs and non-governmental organisations (Colvin et al., 2008; Mazibuko and Pegram, 2008). It is, however, important to note that although there is general acceptance and support for the idea of cooperative governance, the water sector has not been particularly effective at pragmatically implementing these sentiments or making them operational (Mazibuko and Pegram, 2008; Pollard and Cousins, 2008).

Finances/financial resources

Water resource management institutions, especially CMAs, will need an appropriate financial policy and pricing strategy, according to Pegram and Palmer (2001). In order for CMAs to be viable, decision-makers must consider the appropriate formulation of user charges and cost recovery for infrastructure capital expenditure. A vital step in this process would be the registration of water users (Pegram and Palmer, 2001). Pegram and Palmer (2001) write about the pricing strategy which is planned to underpin CMAs. In particular, they focus on the need to ensure that the pricing strategy which at the moment works well for water resource management cost recovery by DWA is adapted to the financing requirements of future CMAs. Without such a pricing strategy, water resource management institutions will find it difficult to operate effectively.

Cost effectiveness also came under the spotlight in the literature consulted. Dent (2004d), for example, states that the information systems of CMAs need to be cost effective and transparent. This speaks directly to their financial management, which will be crucial in their success or failure. It is here where those who work in water resource management institutions will be able to gain considerable knowledge from

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the business community, by tapping into their experience of financial management (Dent, 2006d).

Integrated water resource management (IWRM) and stakeholder participation

Analyses of various aspects of IWRM featured strongly in the literature that was reviewed. IWRM focuses particularly on the integration of natural and human systems in order to facilitate a balance between resource use and resource protection, which is very relevant to South Africa's water legislation (Funke et al., 2007b). In their analysis of how the principles contained in the National Water Policy and the National Water Act can be attained, Karodia and Weston (2001) conclude that it is important to realise that both government and stakeholders need to work together to realise the objectives of sustainable water resource management within the context of IWRM. For this reason we combined IWRM and stakeholder participation under one theme and related our discussion of this theme to the themes of cooperative governance and co-learning.

An argument has been made for acknowledging the importance of striving to attain the ideals embodied in IWRM. One of these ideals is coordinated land and water resource management to maximise economic and social welfare without compromising the sustainability of vital ecosystems (Funke et al., 2007b). The National Water Act implies that CMAs are the only legally constituted organisations with a specific mandate to implement IWRM in South Africa (Dent, 2008b). However, despite the importance accorded to CMAs and IWRM in the national water legislation, questions exist about the applicability of IWRM to the South African context. These questions centre on the administration and implementation of IWRM (Braid and Görgens, 2010), and whether it is possible to manage water resources in a decentralised manner in South Africa, which is marked by considerable socio-economic and other disparities (Denison and Karar, 2010). Instead of attempting to roll out IWRM in its entirety, some researchers suggest that it might be preferable to use CMAs to focus on a few easily implementable aspects of IWRM (Denison and Karar, 2010). In particular, it has been argued that it is important to focus on management and institutional capacity as well as good governance practices (Kurian, 2004; Funke et al., 2007b).

Another issue regarding IWRM is that there is not enough sectoral cooperation (Denison and Karar, 2010) or enough coordination between the different spheres of government (Braid and Görgens, 2010). Rather than working together, different sectors seem to be following their own interests without necessarily considering each other, and seem to be functioning under the assumption that water will always be available at a certain price. There is therefore a need for various role players to be brought together to enable different sector demands to be consolidated (Denison and Karar, 2010).

Problems around stakeholder participation in IWRM in South Africa include a lack of holistic planning and feedback to stakeholders, insufficient attention being paid to when it is necessary to draw in stakeholders, and procedures that are too elaborate and complicated for the initial stages of public engagement (Du Toit and Pollard, 2008). Stakeholder connectedness is another issue that is widely discussed, and authors argue that it is important to promote stakeholder connectedness through capacity building, especially of disadvantaged communities, amongst women (Gueze, 2007), multi-sectoral fora (Van Wilgen et al., 2003; Sherwill et al., 2007) and multi-stakeholder platforms, although expectations should be realistic around what stakeholder coordination mechanisms can achieve (Faysse, 2006; Warner, 2006). According to Du Toit and Pollard (2008), a task- and outcomes-specific approach to IWRM should be followed and stakeholders should only be drawn in when necessary to prevent stakeholder fatigue.

CONCLUSIONS

In sum, the literature on water resource management institutions seems to be characterised by a disproportionately large focus on CMAs (Rogers et al., 2000; Schreiner and Van Koppen, 2001; DWAF, 2002; Smit, 2003; Brown and Woodhouse, 2004; Mosai, 2004; McConkey et al., 2005; Mazibuko and Pegram, 2006; Fowkes, 2007; Gueze, 2007; Colvin et al., 2008; Dent, 2008b,c; Pollard and Du Toit, 2008; Dent, 2009a-e; Roux, et al., 2009; Du Toit and Pollard, 2010; Roux et al., 2010; Dent, 2011; DWA, 2011). With the ideal number of CMAs having been revised by DWA, and so few CMAs having gotten off the ground, it may be good to focus on how integrated catchment management is functioning in the absence of CMAs. What functions are WUAs, catchment forums (which can be established to support the establishment of a CMA) and other actors performing in the absence of CMAs, and what lessons can be learned from how these functions are being carried out?

Another feature of the literature on water resource management institutions is how it seems to perpetuate, to a large extent, a silo-based way of thinking about water resources and the way in which they are managed. Water resource management institutions are seen as something separate to institutions dealing with the environment, mining, agriculture, and tourism (Jacobs and Nienaber, 2011), as well as institutions dealing with water supply services, such as water boards and water services authorities. The risk of such a silo-based mentality is that problems that should be seen as integrated and institutions that should be intrinsically linked, come to be seen as separate. Given the inherently interlinked nature of most problems, such silo-based research and practice must be approached with caution. This is also true for the development of theory. A silo mentality carries the potential of inducing theoretical myopia, so to speak, through too narrow a focus on what is happening in the real world. It is here where developments in social science theory can shed light. Widening the focus on reality will ultimately assist in better theoretical developments. This holds much potential for the policy process since scientists will be better able to present decision-makers with answers and guidance. More nuanced theories can lead to more in-depth understandings of the water sector, and these, in turn, can potentially lead to the development of better policy and better implementation.

Linked to the need for giving decision-makers better assistance, another research focus that could be explored in more depth is the interface between science and policy, or science and other end-users of scientific knowledge. This is significant because it is essential to ensure that end-users are aware of and take into consideration research findings coming out of research on water resource management institutions. In the reviewed literature many of the sources consulted had an implicit focus on being policy-relevant in that their findings could be useful to policy-makers and other end-users (Gleick, 2000; Rogers et al., 2000; Thompson et al., 2001; Walmsley et al., 2001; James, 2003; Mackay et al., 2003; Wester et al., 2003; Raven, 2004; McConkey et al., 2005; Mazibuko and Pegram, 2006; Gueze, 2007; Schreiner, 2007; Sherwill et al., 2007; Burt et al., 2008; Colvin et al., 2008; Dent, 2008c; Braid and Görgens,

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2010; Du Toit and Pollard, 2010; Roux et al., 2010). The challenge lies in taking policy-relevant knowledge one step further and finding ways in which research can be taken up into policy-making and by other end-users more effectively.

These and other significant research gaps need to be filled in a truly inter- and transdisciplinary fashion, taking complexity and structural conditions into consideration. Achieving this challenge is not easy; the design of a research framework to take these and other issues and phenomena into account should move beyond the propagation of a panacea or set of panaceas (e.g., Ostrom, 2007). Panaceas could be taken to include approaches such as IWRM or adaptive management that are often mentioned as 'silver bullet' solutions to water resource management challenges. A move away from panaceas through the combination of different perceptions, models, frameworks and theories, could mean different empirical results, conclusions, recommendations as well as a more nuanced understanding of water resource management.

It is here where the social sciences can play a significant role. The vocabulary of social scientists is such that core concepts and theories can be employed to bring the finer nuances of actors and structures to the fore. Examples of concepts and theories include governability (Kooiman et al., 2005; Kooiman, et al., 2008), agential power (Hobson, 2000), politics (Easton, 1985), water politics (Meissner, 1998; 2004), governance without government (Rhodes, 1996; Rosenau, 2006), interest groups (Wilson, 1990), hydro-normative commensalism (Meissner, 2004), the hydro-social contract (Meissner and Turton, 2003), meta-governance (Kooiman and Jentoft, 2009), social constructivism (Wendt, 2000) and securitisation (Wæver, 2011). The concepts on this list are of course not exhaustive and may need to be explored further. A new research agenda should consider the development of frameworks that include and combine some of these concepts.

In conclusion, this paper presents the status quo of recent literature on water resource management institutions. The identified gaps need not be seen as limitations but rather as opportunities for further knowledge generation and understanding of water resource management institutions. The literature review indicates that more effort is needed to move away from empirical and theoretical silos and towards alternative knowledge generation tools. This is necessary because scientists' empirical research and findings will influence their theoretical stance and outlook, which will ultimately impact on their answers and guidance to policy-makers and other end-users of their research.

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